Validating the UNICEF/Washington Group Child Functioning Module as a method for disaggregating Fiji's Education Management Information System

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Abstract

Disability disaggregation of education management information systems (EMIS) is vital to inform policies and resourcing for disability-inclusive education and evaluate progress towards targets. The approach to disaggregation must use a valid and reliable method for identifying children with disabilities. The UNICEF/Washington Group Child Functioning Module (CFM) is recommended by the United Nations for identifying children with disabilities and has been recommended for disaggregating education program data by disability.

In the context of an education sector support program in Fiji, this research aimed to validate a method for disaggregating Fiji's EMIS by disability. A cross-sectional diagnostic accuracy study was undertaken in which teacher and parent CFM responses for 472 primary-aged students were compared to reference standard clinical assessments in five domains: vision, hearing, musculoskeletal, speech and cognition. Receiver operating characteristic curves (depicting the trade-off between sensitivity and specificity) were constructed and optimal cut-off points and inter-rater reliability were assessed. Nested survey data on learning and support needs were analysed to explore whether combining CFM data on activity and participation data with data on environmental factors related to LSN (educational adjustments, assistive technology and personal assistance requirements) more accurately identifies children with disabilities.

The study produced a range of novel findings. Diagnostic accuracy of parent observations related to seeing, walking and speaking was stronger than that of teachers, however teacher accuracy was very acceptable. Conversely, for cognitive domains teacher accuracy was far stronger than parents. The CFM domains seeing, hearing, walking and speaking showed "good" to "excellent" accuracy, however remembering and focusing attention showed only "fair" to "poor" accuracy. The domain learning was "good" with teachers as respondents, but only "fair" with parent respondents. As a whole, the CFM had "fair" accuracy (area under the Receiver Operating Characteristic curve: 0.763 parent responses, 0.786 teacher responses). Severe impairments were reported relatively evenly across CFM response categories "some difficulty", "a lot of difficulty" and "cannot do at all".

If the cut-off level for identifying children with disabilities were "a lot of difficulty", nearly 40% of children with moderate clinical impairments and 28% of children with severe impairments would miss out on services as they were reported as having "some difficulty". On the other hand, the rates of false positives would be very high if the cut-off "some difficulty" were used. Combining data from the CFM with LSN data shows potential to increase the accuracy of domain-specific disability identification and, crucially, identification of children with disabilities amongst those reported as having "some difficulty" on the CFM.

The CFM alone is not accurate enough for the purpose of disaggregating Fiji's EMIS by disability. The choice of cut-off level and the mixture of severity of impairments reported across response categories are particular challenges for the CFM. Combining CFM data with data on educational adjustments, assistive technology and personal assistance requirements could improve disability identification accuracy. Follow-up verification visits are required to confirm funding eligibility due to inherent risks of tools based on self-report.

Declaration

This is to certify that:

(i) the thesis comprises only my original work towards the PhD except where indicated in the Preface,

(ii) due acknowledgement has been made in the text to all other material used; and

(iii) the thesis is fewer than 100,000 words in length, exclusive of tables, maps, bibliographies and appendices.

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Preface

In consultation with the supervisors, the candidate took responsibility for:

1) The study design.
2) Developing related funding applications.
3) Developing the ethics applications.
4) Developing, managing and acquitting the budget.
5) Developing the learning and support needs questionnaire and selecting and sourcing validated measurement tools as the clinical reference standard assessments.
6) Developing the terms of reference and contracts for, and recruiting and training, data collectors (contracted through the Pacific Disability Forum).
7) Implementing the study design.
8) Managing data collection; logistics of the team's travel and accommodation, communications with all schools, daily team meetings and ongoing quality assurance of data collection.
9) Managing the database, including contracting and providing quality assurance for a short-term data entry research assistant for survey data; the candidate did the data entry for all clinical data.
10) Co-designing the approach to statistical analysis and undertaking all data analysis, except the development of the normative data set for section 6.4.
11) Writing a complete first draft of each paper and chapter prior to providing these to co-authors and supervisors for review.
12) Submitting articles to journals; responding to peer review comments and editing the articles in response to the reviews, then providing the peer review responses and revised articles to co-authors for review before re-submission.

The candidate's contribution to the journal articles exceeded 80%, except the paper on the cognitive questions (section 6.4), for which the contribution was 70%. The table below outlines the co-author contributions for the chapters presented in article format. Dr Manjula Marella and Professor Barbara McPake, both from the Nossal Institute for Global Health, The University of Melbourne, supervised the candidate throughout the development and implementation of the study and the preparation of the journal articles and thesis chapters. Associate Professor Martha Morrow and Dr Hasheem Mannan co-supervised the candidate in the early months of the candidature prior to their resignations, supporting the candidate to establish an early draft of the research objectives. Associate Professor Umesh Sharma of Monash University was the Principal Investigator for an overarching grant (Pacific INDIE, described in section 1.2, funded by the Department of Foreign Affairs and Trade (DFAT), grant #66440) within which parts of the PhD research were funded as a sub-study. The salaries of the data collectors were covered through the Pacific INDIE budget. The conceptualisation and written submission for the sub-study within the overarching Pacific INDIE funding proposal was entirely the candidate's work. Additional funding was provided through another DFAT-funded investment, the Access to Quality Education Program (AQEP, described in section 1.1); this covered accommodation and travel costs during field work.

None of the work towards the thesis was submitted for other qualifications or carried out prior to enrolment in the degree. No third-party editorial assistance was provided in preparation of the thesis.

Publication status of all chapters presented in article format

Chapter	Title	Publication status	Co-author contribution
3.1	Sprunt B, Marella M, Sharma U. Disability disaggregation of Education Management Information Systems (EMISs) in the Pacific: a review of system capacity. Knowledge Management for Development Journal. 2016;11(1):41-68. Available from: http://km4djournal.org/index.php/km4dj/article/view/309	Published by *Knowledge Management for Development Journal* on 2 October 2016	MM: supervision, review and editing. US: wrote narrative for a table in the results section; review and editing.
6.2	Sprunt B, Hoq M, Sharma U, Marella M. Validating the UNICEF/Washington Group Child Functioning Module for Fijian schools to identify seeing, hearing and walking difficulties. Disability and rehabilitation. 2017; Published online:[1-11 pp.]. Available from: http://dx.doi.org/10.1080/09638288.2017.1378929.	Published by *Disability and rehabilitation* on 20 Sept 2017	MH: statistical advice. US: review and editing. MM: supervision, review and editing
6.3	Sprunt B, Marella M. Measurement accuracy: Enabling human rights for Fijian students with speech difficulties. International Journal of Speech-Language Pathology. 2018;20(1):89-97. Available from: https://doi.org/10.1080/17549507.2018.1428685	Published by *International Journal of Speech-Language Pathology* on 21 Feb 2018	MM: supervision, review and editing
6.4	Sprunt B, Cormack F, Marella M. Measurement accuracy of Fijian teacher and parent responses to cognition questions from the UNICEF/ Washington Group Child Functioning Module compared to computerised neuropsychological tests.	In revision following peer review by *Disability and rehabilitation*	FC: advised on sub-tests to be included in the computer-based cognitive assessment; developed a normative dataset using data collected by the candidate. MM: supervision, review and editing
6.5	Sprunt B, McPake, B, Marella M. UNICEF/Washington Group Child Functioning Module - accuracy, inter-rater reliability and cut-off level for disability disaggregation of	Published by *International Journal of Environmental*	BM: review and editing. MM: supervision and review and editing.

	Fiji's education management information system.	*Research and Public Health*	
6.7	Sprunt B & Marella M. Combining child functioning data with learning and support needs data to create disability identification algorithms in Fiji's Education Management Information System.	Unpublished material not yet submitted for publication	MM: supervision, review and editing.
7.2	*Case Study: Disability Disaggregation of Fiji's Education Management Information System*. From within the book chapter: Mont D, Sprunt B. Adapting education management information systems to support inclusive education. In: Schuelka M, Johnstone C, Thomas G, Artiles A, editors. SAGE Handbook on Inclusion and Diversity in Education: SAGE Publications.	Accepted for publication by *SAGE Handbook on Inclusion and Diversity in Education* on 12 Oct 2018	DM: lead-authored the chapter in which the case study featured. Reviewed and edited the case study.

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This thesis is dedicated to the hard-working disability activists who have kept the momentum expanding into ever-increasing spheres of influence to achieve the rights outlined in the Convention on the Rights of Persons with Disabilities. To those with lived experience, leaders and motivators, service providers, families and carers, volunteers, policy makers and implementers, civil society organisations, and to researchers and others dedicated to ensuring data is useful. I think it's going pretty well!

I would like to acknowledge the love, welcome and collegiality I have enjoyed in Fiji. I feel truly blessed to have Fiji in my life, and to have been able to contribute to the progress that Fijians in the disability sector are making. The guidance and strategic counsel from Setareki Macanawai and the late Frederick Miller were strong motivating forces in the lead up to this thesis.

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Acronyms

AQEP	Access to Quality Education Program
AUC	Area Under the ROC curve
CANTAB	Cambridge Neuropsychological Test Automated Battery
CFM	Child Functioning Module
CRPD	Convention on the Rights of Persons with Disabilities
EMIS	Education Management Information System
FEMIS	Fiji's education management information system
ICC	Intra-class correlation
ICF	International Classification of Functioning, Disability and Health
ICF-CY	International Classification of Functioning, Disability and Health for Children and Youth
ICS	Intelligibility in Context Scale
IEP	Individualised Education Plan
IIEP	International Institute for Educational Planning
IRR	Inter-rater reliability
LMIC	Low- and middle-income countries
LSN	Learning and support needs
MoE	Ministry of Education
MSI	Musculoskeletal impairment
Pacific INDIE	Pacific Indicators for Disability-Inclusive Education
PFRPD	Pacific Framework for the Rights of Persons with Disabilities
RAMI	Rapid Assessment of Musculoskeletal Impairment
ROC	Receiver operating characteristic
SDAC	Survey of Disability, Ageing and Carers
SDG	Sustainable Development Goal
STARD	Standards for Reporting of Diagnostic Accuracy Studies
TQSI	Ten Questions Screening Index
UN	United Nations
UNESCO	United Nation's Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WG	Washington Group
WGSS	Washington Group Short Set

1. Introduction

Transforming Our World: The 2030 Agenda for Sustainable Development

As we embark on this great collective journey, we pledge that no one will be left behind. Recognizing that the dignity of the human person is fundamental, we wish to see the Goals and targets met for all nations and peoples and for all segments of society. And we will endeavour to reach the furthest behind first. (1)

1.1 Background and context to the study

This research was undertaken in the Republic of Fiji, in the Pacific Islands region. It stemmed from a practical, yet complex problem faced by the Ministry of Education – how to identify which children had disabilities so that the education management information system (EMIS) could be disaggregated by disability. Estimating numbers of children with disabilities had proven challenging in Fiji, as in many countries.

The World report on disability (2) estimated that there are one billion people with disabilities worldwide, including between 93-150 million children under 15 years of age. Whilst the measurement approaches underlying these estimates are the subject of extensive and ongoing discussion in the literature (2-4), it is clear that adults and children with disabilities represent an enormous sub-population which has rightly gained increased focus within global development efforts. Disability has been correlated with low levels of income, employment, health and social participation (5-8) and increasing education for people with disabilities can mitigate these effects (9-11). Despite the beneficial potential of education, children with disabilities, particularly those in low- and middle-income countries (LMICs), are less likely to ever attend or complete primary or secondary education than children without disabilities (12). They have lower literacy rates and represent a disproportionately high percentage of out-of-school children (13).

The fundamental human right for children with disabilities to access a quality and inclusive education is clearly articulated in many treaties, most recently and explicitly in the United Nations Convention on the Rights of Persons with Disabilities (CRPD) (14). Disability-inclusive education enables children with disabilities to access education within mainstream schools, or within environments that best correspond to their requirements and preferences (15). This modality is accepted as the most suitable one for States to ensure universality and non-discrimination in the right to education (16). Article 24 of the CRPD recognises disability-inclusive education as the means to fulfil the right to education for people with disabilities.

In addition to human rights treaties, disability-inclusive education is clearly embraced within major development frameworks including the Sustainable Development Goals (1) and the Incheon Strategy to “Make the Right Real” for Persons with Disabilities in Asia and the Pacific (17). All Pacific Island countries have signed up to both frameworks as well as the more recent Pacific Regional Education Framework 2018-2030 (18) and the Pacific Framework for the Rights of Persons with Disabilities (2016-2025) (PFRPD) (19). Pacific regional commitments to ensure access to primary schools for children with disabilities are not new however, and date back to 2002 when education ministers jointly agreed to achieve the Biwako Millennium Framework targets (20).

Fiji strongly supports disability-inclusive education and the Fiji Ministry of Education's Policy on Special and Inclusive Education emphasises that no child will be left behind (21). Fiji ratified the CRPD in March 2017 shortly after legislating related commitments in the Rights of Persons with Disabilities Bill (22). Whilst momentum towards disability-inclusive education has increased recently, legislative support for the right of children with disabilities to access education within mainstream schools actually dates back nearly 20 years to the Fiji Human Rights Commission Act (23).

Despite widespread and longstanding policy commitments, achieving disability-inclusive education remains a challenge both globally, in the Pacific and within Fiji. There is ambiguity about how to successfully implement disability-inclusive education and measure its effectiveness (11, 24-26). Sound evidence regarding the situation and needs of students with disabilities is an essential element in quality education for all. Meltzer highlighted the importance of administrative or survey data to examine trends to monitor the implementation of the CRPD (27). The principal administrative data mechanism within ministries of education that enables this evidence for policy development, planning and budgetary allocation is the EMIS. For EMISs to support disability-inclusive education, student data must be disaggregated by disability and the process for determining disability in students must be valid and reliable. This thesis validates a methodology for disability data disaggregation in Fiji's EMIS (FEMIS).

Fiji has approximately 885,000 people (28) and has historically provided education for children with disabilities predominantly within 17 special schools located in major towns around the country. However, 2011 marked a transition towards more strategic and resolute implementation of disability-inclusive education, framed by two notable opportunities. The Minister for Education signed the first inclusive education policy and in the same year commenced a partnership with the Australian government to implement a large sector program called Access to Quality Education Program (AQEP) 2011-2017, which had a strong emphasis on disability-inclusive education. The PhD candidate was the Disability Inclusion Specialist on AQEP from its inception in August 2011 until early 2015, responsible for developing and leading a team implementing AQEP's Disability Inclusion Strategy.

AQEP focused its initial disability inclusion efforts on five "inclusive education demonstration schools" located in four rural areas and a squatter settlement in the capital Suva. Subsequently, the Ministry of Education began trialling "cluster inclusion schools" which are mainstream primary schools located near special schools. AQEP and the Ministry of Education worked closely together, rolling out capacity development programs across Fiji to build capacity of head teachers, teachers and teacher aides. A range of other resources were provided through AQEP, including building works for accessibility, salaries for teacher aides, activities with disabled people's organisations to raise awareness and enable networking, and provision or referral for disability-specific needs including health services and assistive technology.

AQEP's Disability Inclusion Strategy emphasised the use of disability disaggregated data to monitor and evaluate progress and to inform programmatic decisions. Data analysis efforts by the candidate within her work on AQEP identified fundamental problems with the Ministry's existing disability data, related mainly to questionable validity and reliability (elaborated further in section 3.2). These challenges were recognised by the Ministry which acknowledged that funding to support children with disabilities was simply calculated based on enrolment numbers in special schools. The prevailing disability data in mainstream schools had no links to funding and there was no available option for determining and providing disability inclusion funding for mainstream schools. Given the policy, political and social imperatives to expand disability-inclusive education in Fiji, the inadequacy of disability data within the school system was patently a major sticking point to achieving the desired outcomes. The identification of this problem triggered the researcher to resign in her role as Disability Inclusion Specialist on AQEP and commence the PhD.

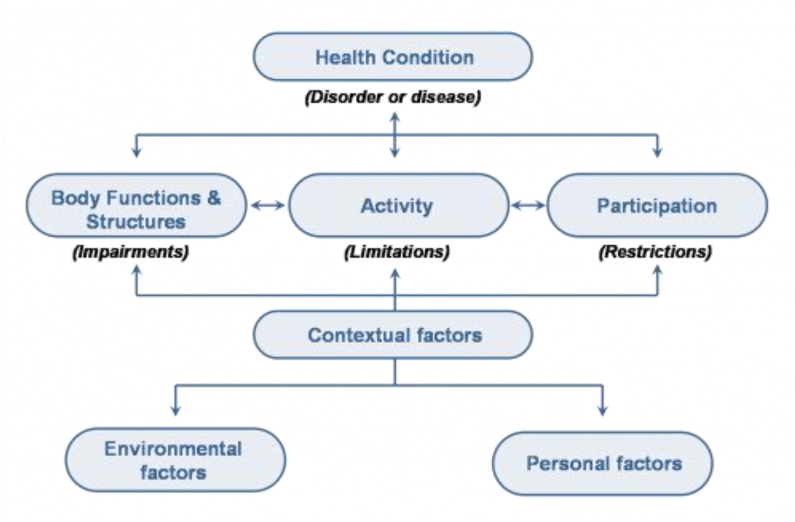
With the irregular and limited access to disability and rehabilitation skills in the Fijian health system (29), particularly in areas outside of the capital, the Ministry of Education needed a system for screening and identification of disability which was practical in the absence of clinical diagnoses. The method also needed to be feasible, considering school staff workload and inherent disability knowledge levels of teachers.

Definition of disability

Disability is a complex and nuanced concept and variations in definition and measurement approaches have hindered efforts globally to gauge the effectiveness of policies and programmatic approaches for people with disabilities. Disability was historically understood through a "medical model", in which disability was perceived to stem from an individual's health condition. In contrast, the "social model" argues that social and physical barriers disable the individual (30). Measurement using either of these models alone presents challenges. Health conditions and impairments can result in various levels of functional difficulty, making it hard to plan services, and measurement using these categories tends to capture a minority of people with disabilities (see section 2.2). Conversely, measuring the impact of barriers without taking into account the health condition or impairment also prevents planning relevant services that may reduce disability, such as health and rehabilitation services.

The International Classification of Functioning, Disability and Health (ICF) (30) is the most accepted framework for measuring disability (see Figure 1). It is a multifaceted conceptual framework which describes disability as problems with human functioning in any or all of three interconnected areas of functioning - impairments in body functions and structures, activity limitations, and/or participation restrictions. These functioning difficulties arise from the interaction between a person with a health condition and that individual's contextual factors (environmental and personal) (31).

Figure 1 - International Classification of Functioning, Disability and Health (30)



The aim of the ICF is to provide a "unified and standard language and framework for the description of health and health-related states" (30)(p3). However, researchers differ in their views on its application and debates are ongoing in the literature regarding which ICF elements or combination of elements are feasible and effective to apply for different measurement purposes in resource-poor settings (32, 33). Debate about its application is hardly surprising given that core ICF documents themselves state that: (i) the ICF "does not model the 'process' of functioning and disability (but provides) the means to map the different constructs and domains", (ii) disability is "an interactive and evolutionary process" and (iii) "the ICF can be seen as a language: the texts that can be created with it depend on the users, their creativity and their scientific orientation" (34)(p17). In developing a method for disability disaggregation of FEMIS, it was important to explore the different ICF components and their interactions.

The UNICEF/Washington Group Child Functioning Module (CFM) is the tool recommended by the United Nations for identifying children with disabilities (35, 36). The CFM constitutes questions that ask about functional difficulties mostly at the ICF level of "activity limitations" but also "participation restrictions". The dominant focus within this thesis is an investigation of the properties of the CFM in relation to its potential use for the purpose of disability disaggregating FEMIS. Specifically, the research:

- compares parent and teacher responses with clinical assessments to investigate the CFM's sensitivity and specificity (diagnostic accuracy) at different response category levels;
- examines inter-rater reliability;
- explores the interplay and associations between CFM items; and
- investigates the effects of combining activity and participation data from the CFM with data on environmental factors (educational adjustments, assistive technology and personal assistance requirements) on the accuracy of identifying children with disabilities.

1.2 The candidate

I graduated from La Trobe University as an occupational therapist in 1995 and worked in a range of settings, including in Bangladesh where I headed up Occupational Therapy at the Centre for the Rehabilitation of the Paralysed. This work was seminal for me; it included clinical work, community-based rehabilitation, teaching at the Bangladesh Health Professions Institute and developing the degree curriculum. Within a subsequent Master of Public Health, I undertook a major research project with a team of six local youth researchers in the Federated States of Micronesia, which began my journey of working in and learning about the Pacific. I worked on Pacific programs for the Burnet Institute, UNICEF Pacific and Oxfam.

I then worked at the Nossal Institute for Global Health, University of Melbourne for 16 years involving a mix of development program work, policy advocacy, teaching and research. Over that time I started Nossal's disability program, co-founded the Australian Disability and Development Consortium and the CBM-Nossal Partnership for Disability Inclusive Development and co-led the technical advisory services contract (held by CBM Australia) for the Department of Foreign Affairs and Trade.

One piece of work particularly relevant to this research is *Pacific Indicators for Disability-Inclusive Education* (Pacific INDIE). In October 2011, Pacific Directors of Education agreed to work towards a regional EMIS that would include substantial data for children with disabilities (37). The Pacific Islands

Forum Education Ministers Meeting in May 2012 sanctioned EMIS improvement and the addition of indicators on children with disabilities (38). In 2012, through discussions I held with two disability leaders in the region, Setareki Macanawai from the Pacific Disability Forum and Frederick Miller from the Pacific Islands Forum Secretariat, we identified key challenges related to the Pacific's aspirations for reforms towards disability-inclusive education. We formed partnerships for a significant body of work funded through the Australian Development Research Awards Scheme from 2013; a $1.1 million study across 14 Pacific countries to develop Pacific INDIE, led by Associate Professor Umesh Sharma at Monash University. Of the four countries involved most deeply over the three years, I was the co-investigator for the research in Fiji. Pacific INDIE played an important role in the history of Fiji's evolution towards disability-inclusive education and in supporting field work for this thesis.

My roles on Pacific INDIE and AQEP (see section 1.1) provided the opportunity to build buy-in for the PhD research. Knowledge of global efforts to improve disability measurement in LMICs, both disability measurement for censuses and surveys and for the purpose of education systems, contributed to my idea to test the CFM specifically for the purpose of disaggregating Fiji's EMIS.

1.3 Significance of the study

Identification of disability can mitigate its severity by triggering solutions to participation barriers. In addition to enabling teachers to identify children who may benefit from educational adjustments, identification facilitates opportunities for benefitting from schemes and services including access to what medical, rehabilitation and assistive technology programs may be available.

The programmatic context within AQEP provided an invaluable opportunity to apply the research findings, which are now the basis of FEMIS, in the context of an ongoing program. This included working with Information Technology programmers to develop and test algorithms, developing online data entry and automated analysis processes and leading capacity development across the ministry to operationalise the findings. The FEMIS Disability Disaggregation Package, developed as an operational guideline for the new system, has been the basis of training rolled out to over half of the schools across Fiji and rollout is ongoing within the current bilateral aid partnership between Fiji and Australia - the Fiji Program Support Facility. A video resource developed by the candidate is hosted on the website of the Ministry of Education, along with the Package and downloadable forms (39). Immediately following the online data entry process, teachers are directed to relevant information in the Disability Inclusion Toolkit for Fijian Teachers, also developed by the candidate within her work on AQEP, which guides teachers in considering relevant educational adjustments based on disabilities.

Fiji has shown compelling leadership in the Pacific, both in relation to disability-inclusive education and in the advanced architecture and function of its EMIS. Locating this research in Fiji was a unique opportunity to test and establish an effective approach to disability disaggregation of EMISs within the region. The work has subsequently been established in Vanuatu's EMIS, in the context of a bilateral agreement between the two Melanesian heads of government. Additionally, the Fiji Facility provides EMIS support to the government of Tuvalu and has received a request for the disability disaggregation component to be built into Tuvalu's system. In July 2018 Fiji was one of eight countries invited to participate in the United Nation's Educational, Scientific and Cultural Organization (UNESCO) International Institute for Educational Planning (IIEP) technical Round Table in Paris. The countries were selected for their specific contributions to disability-inclusive planning, and Fiji's specific contribution was its approach to disability disaggregation of its EMIS. As a result of the Round Table, IIEP and UNICEF are developing distance education courses on disability-inclusive education sector planning. Through this, the application of the research will be shared directly with disability-inclusive education planners globally.

One of the primary contributions of the research is the examination of a key tool being rolled out globally – the UNICEF/Washington Group CFM. Whilst the tool has been cognitively tested and field-tested using Washington Group processes (detailed in section 4.6), the sensitivity and specificity (or 'diagnostic accuracy') of the tool in identifying children with disabilities has had limited research. This study reports on the diagnostic accuracy of this tool in the Fijian context and goes further to examine the increased accuracy achieved when combining the activity limitations and participation restrictions data from the CFM with another component from the ICF – environmental factors. This is an important contribution to the literature on disability measurement generally, and regarding the application of the ICF in education settings.

Finally, regarding an international imperative framing this thesis, was the need to disaggregate data to report against Sustainable Development Goal (SDG) indicators. Given Fiji's uptake of the system, it is now well-placed to report on disability disaggregated data for all relevant SDG education indicators.

1.4 Thesis outline

This thesis is organised around seven chapters. Chapter two draws on relevant literature to provide an overview of the sectoral and geographic context in which the research is located. The chapter explores the global mandate for disability-inclusive education, introduces the complexity of measuring disability in children, provides an overview to disability-inclusive education in the Pacific and then examines its application in Fiji. Chapter three critically examines disability within education management information systems (EMIS); most of this chapter is in the form of a peer reviewed journal article (paper one), which reviews EMISs from 14 countries in the Pacific. Chapter four identifies the gap in disability data for education in LMICs and provides a critical review of literature within the field of childhood disability measurement generally and specifically within education systems, with a particular focus on studies validating the UNICEF/Washington Group Child Functioning Module.

Chapter five outlines the study's aims and objectives, methodology and analytical approaches.

Results are presented in chapter six, including five major results sections, each with a related discussion. Sections 6.2 and 6.3 are in the form of published peer-reviewed journal articles; section 6.4 and 6.5 have been submitted to journals although are pending publication; section 6.7 is structured as a journal article but has not yet been submitted. Section 6.2 examines results related to the domains of seeing, hearing and walking (paper two); section 6.3 looks at the domain of speaking (paper three); and section 6.4 investigates the cognitive domains of learning, remembering and focusing attention. Section 6.5 analyses the results of all disability domains together, including the functioning domains that did not have reference standard (clinical) assessments (self-care, anxiety/worry, sadness/depression, controlling behaviour, accepting changes to routine and making friends). This section draws important distinctions between the results from the individual domain analyses and results from analysis combining all CFM domains. Section 6.6 explores the interplay and associations between items on the CFM. Section 6.7 illustrates how combining child functioning data (activity limitations and participation restrictions) with learning and support needs data (environmental factors) provides a valuable means of overcoming accuracy limitations of the CFM, outlined in the earlier results sections.

Chapter seven consolidates the major research findings and discusses the implications for childhood disability measurement and its application within EMISs. The chapter outlines study limitations and makes recommendations for future research. Within this final chapter an excerpt is included from a book chapter soon to be published which used the system developed in Fiji through this research as a case study to illustrate good practice in disability disaggregation of EMISs.

2. Disability-inclusive education – globally, in the Pacific, and in Fiji

Education of children with disabilities is embraced within Sustainable Development Goal 4 (40) and the Education 2030 Incheon Declaration and Framework for Action: Towards inclusive and equitable quality education and lifelong learning for all (41). Sustainable Development Goal (SDG) 4 explicitly undertakes to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all". Its emphasis on achieving this goal for people with disabilities is evident through the requirement for disability disaggregation of many of the Goal 4 indicators (42). World Education Forum leaders proclaimed:

> Inclusion and equity in and through education is the cornerstone of a transformative education agenda, and we therefore commit to addressing all forms of exclusion and marginalization, disparities and inequalities in access, participation and learning outcomes. No education target should be considered met unless met by all. We therefore commit to making the necessary changes in education policies and focusing our efforts on the most disadvantaged, especially those with disabilities, to ensure that no one is left behind. (41)

This pledge further added to global momentum to overcome barriers to education for children with disabilities (43, 44), building on earlier developments including the World Conference on Education for All in Jomtien in 1990 (45), Standard Rules on the Equalization of Opportunities for Persons with Disabilities (46), World Conference on Special Needs Education (47), World Education Forum in Dakar (48), and the adoption of the CRPD (14). The commitment within the SDGs to education for children with disabilities characterised an important shift in focus since the Millennium Development Goals era, in which the needs of persons with disabilities were overlooked (49).

Despite decades of international promises and pledges, children with disabilities are the sub-population most excluded from the education system. In 2016 there were 263 million children and youth who were out of school (13), and evidence from various analyses indicates that a large proportion of these are likely to have disability of some type. Plan International analysed its dataset of 1.4 million sponsored children across 30 countries and found that children with disabilities were ten times more likely not to attend school (50).

The UNESCO's Global Monitoring Report (51), with analysis of Multiple Indicator Cluster Surveys from four countries, added further evidence of the greater likelihood of children with disabilities being out of school. Of the children with disabilities who are enrolled in school, attendance and promotion is lower (5, 52-54). UNESCO's recent analysis of multiple national datasets supports these findings, showing that people with disabilities are less likely to ever attend school, complete primary or secondary education; have lower rates of basic literacy skills; are more likely to be out of school; and that females with disabilities experience greater disadvantage in accessing education than males with disabilities (8).

Disability has been shown to have correlations with economic disadvantage and poorer levels of education, employment, health and wellbeing and social participation (5-7). Graham et al. (9) argue that access to education may mitigate some of these associations for people with disabilities. This view is captured in a report by the European Agency for Development in Special Needs Education (55):

> … children identified as having special needs are more likely to be excluded from school. Being part of an educational underclass places individuals and groups at risk of becoming part of a social underclass, which has long-term economic as well as social consequences, not only for those individuals and groups, but also for the rest of society. Therefore, dealing with exclusion and underachievement is not only the right thing to do, it also makes sound economic and social sense (p15).

To delve into the realities behind these figures and assertions it is important to understand who the children with disabilities are, which requires unpacking how disability is conceptualised and defined.

2.1 Disability in children

The CRPD states that "persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others" (14). This conceptualisation of disability is consistent with the ICF (30), which presents a standard language and operational framework that is utilised to guide disability measurement. As outlined briefly in the Introduction (section 1.1), the ICF describes disability as problems with human functioning in any or all of three interconnected areas of functioning - impairments in body structure/ function, activity limitations and/or participation restrictions. These functioning difficulties arise from the interaction between a person (with a health condition) and that individual's contextual factors (environmental and personal) (31). Acknowledging that people are disabled by both health conditions and by contextual factors, the medical and social models of disability are integrated in the ICF (6).

Children with disabilities can include those with health conditions such as muscular dystrophy, cerebral palsy or Down syndrome, children with impairments related to vision, hearing, motor function, communication and intellectual function, as well as difficulties related to areas such as behaviour, attention, mood and socialisation. For some children disability may be present from birth and for others it may occur later from factors such as poor nutrition, illness, injuries or abuse and neglect. Children with disabilities are more likely to experience discrimination and poorer access to health and social services, be underweight and stunted, and be physically punished by parents (56). Young children with disabilities often miss out on accessing mainstream services which can be critical in optimising child development and preventing the loss of developmental potential (57). This lost opportunity can result in difficulties becoming more severe, exacerbating the disability and its interactions with social participation, education, employment and poverty.

Environmental factors which limit functioning and participation are commonly referred to as "barriers" and include elements in the education context such as physically inaccessible environments, negative attitudes to disability, curriculum inflexibility, homogenous education practices and lack of resources and support services (58). Ainscow and Booth note that while the role of schools in surmounting impairments is narrow, they can have a meaningful bearing on reducing disabilities by providing support and eradicating physical, personal, and institutional barriers that limit participation and learning for children with disabilities (59).

The complex interaction between the underlying health condition and environmental factors plays an enormous role in the extent to which disability is experienced, and to which it impacts on quality of life. For example, a child with cerebral palsy who has access to mobility aids, a supportive and inclusive educational environment, affordable and accessible transport, and health and rehabilitation services when needed, may successfully complete schooling, obtain employment and live independently. A child with the same health condition for whom these factors are unavailable or inaccessible may have a vastly reduced quality of life related to the interaction of the health condition and the barriers in the environment. Meltzer highlighted how this complex interaction results in challenges in identifying and measuring disability in children (60).

2.2 Measuring disability

Estimates of childhood disability vary widely, with prevalence rates ranging from below one percent to 48% (12). The World Disability Report estimated that there are between 93 and 150 million disabled children under 14 years globally, with 5.2% prevalence for moderate and severe disabilities combined and 0.7% for severe disabilities only (2). However, in a comprehensive review of child disability data and data collection instruments, Cappa et al., (4) demonstrated large variations in prevalence both across countries as well as within countries due to different measurement tools and study designs. This affected both high- and low-income countries. The enormous scope of definitions, methodologies and measurement tools used to identify disability has given rise to a lack of reliable estimates of people, including children, with disabilities (2, 61-65), gross underestimations of the number of children with disabilities (66) and a lack of trust in disability statistics (36). This disparity in disability definition and measurement approaches has also been found across the Pacific (67, 68).

At the World Bank's 2004 Disability and Development Research Agenda meeting, Metts articulated the challenge:

> Disability is a normal phenomenon in the sense that it exists in all societies, affecting predictable and identifiable proportions of each population. Therefore, it should be possible to estimate the sizes of the various disability populations, determine their needs and develop appropriate and cost-effective strategies to meet those needs. This is yet to be accomplished however, largely because disability is a complex interconnected bio-medical, social and environmental phenomenon that is yet to be fully analyzed and understood. (69)(p2)

Seven years later, in light of the challenge remaining a major concern, a key recommendation of the World Report on Disability (2) was development of comparable definitions of disability, based on the ICF, with consistent data collection methods. It also recommended testing these across cultures and applying them consistently in censuses, surveys and administrative data (which includes EMISs). In contrast to medical or impairment categories, which tend to capture a minority of the children experiencing difficulties (70), identifying disability by classifying activity limitations and participation restrictions provides useful understanding of the range of difficulties that people face (43). This aligns with the World Report's recommendation to use a "difficulties in functioning approach" instead of an "impairment approach" for disability prevalence and better capture the magnitude of disability (2).

The World Report specifically highlighted the need to develop appropriate tools for measuring disability in children and to support LMICs to collect "robust, comparable, and complete" disability data (p45). This thesis aims to respond directly to these recommendations in order to facilitate implementation of legislation, policies and practices related to disability-inclusive education, which is a key response to the widespread exclusion of children with disabilities.

2.3 Disability-inclusive education

The CRPD, Article 24, requires States to provide an inclusive, quality, and free primary and secondary education to people with disabilities on an equal basis with others in the communities in which they live. 'Inclusive education' has been defined as a process of focusing on and responding to the diverse needs of all learners, removing barriers impeding quality education, and thereby boosting participation in learning and reducing exclusion within and from education (71).

The CRPD General Comment No.4 on the right to inclusive education (15), developed through lengthy global consultations including 87 formal submissions from peak bodies, agencies and national governments, was adopted by member States in August 2016. The document expands upon Article 24 of the CRPD, highlighting the centrality of inclusive education as a means of realising other human rights and arguing that is the "primary means" by which people with disabilities can overcome poverty, participate fully in society and mitigate exploitation. The document stresses that inclusive education requires "an in-depth transformation of education systems in legislation, policy and the mechanisms for financing, administering, designing, delivering and monitoring education" (p3).

The terms 'inclusive education' and 'special needs education' can relate to inclusion of a broader range of children than children with disabilities, including those disadvantaged by factors such as gender, poverty, conflict, homelessness and ethnicity (47, 72). Whilst much of the literature uses the term 'inclusive education' to refer to disability, the term has wider connotations. As this thesis focuses on children with disabilities, the term 'disability-inclusive education' is used to distinguish this emphasis.

Disability-inclusive education aspires to ensure that children with disabilities learn alongside their non-disabled peers, in the classrooms they would be attending if they did not have a disability (71, 73). The reality in many countries is that education of children with disabilities also occurs in settings including special schools and through integration classes in regular schools (2). The General Comment No.4 mainly emphasises accessing inclusive mainstream settings, but also acknowledges the importance of providing education in "the environment that best corresponds to their requirements and preferences" (p3). Depending on resources available, policies and attitudes in schools, and the nature of the learning needs, at certain times a child with a disability may benefit more from a segregated or integrated setting rather than a mainstream setting. This is particularly the case for children who need to learn Braille before enrolling in a mainstream school or children who need to be immersed in a sign language environment to learn the language comprehensively (74). Large, noisy classrooms can be overwhelming for some children with social difficulties. Periods of learning in a separate space within the mainstream school, particularly whilst a child is adjusting to school or a new classroom, can support some children to manage high levels of sensory overload. Whilst the importance of choice is acknowledged within a disability-inclusive system, global commitments generally seek resourcing, reform and progressive realisation focused on students accessing a relevant curriculum and achieving meaningful outcomes in regular schools (2).

2.4 Disability-inclusive education in the Pacific

The Pacific region is culturally diverse and covers thousands of islands over 30 million square kilometres of ocean (75). Most Pacific island countries have achieved primary school enrolment rates of over 90%, however quality of learning is a challenge, with many students finishing school without basic literacy and numeracy (76). There is a long history of efforts to move towards disability-inclusive education in the Pacific. In 2002, Pacific education ministers jointly agreed to achieve the Biwako Millennium Framework targets for access to primary school for children with disabilities, improve teacher training opportunities and to develop a regional program to build capacity for disability-inclusive education (20). In 2007, a meeting of Pacific experts hosted by the United Nations Economic and Social Commission for Asia and the Pacific established Pacific principles in education, including: increased access to schools for children with disabilities; transformation towards inclusive education with strengthened teacher capacity for student diversity; and early identification and intervention (20). In 2009 the regional education agenda, the Pacific Education Development Framework, explicitly incorporated a focus on 'students with special educational needs and inclusive education' (77) and Pacific Ministers responsible for disability (24) and education (77) endorsed provision of an inclusive, quality, and free primary and secondary education to people with disabilities. In ratifying or signing the CRPD and/or the *Incheon Strategy to "Make the Right Real" for Persons with Disabilities in Asia and the Pacific* (17), most Pacific Island governments have committed to disability-inclusive education. This is demonstrated by the existence of special or inclusive education policies or at least reference to inclusion of all students within general education policies across the Pacific (25).

However, despite political commitments and observations that inclusive education fits naturally with Pacific cultures (78, 79), widespread implementation in the Pacific has been slow (26). There is also uncertainty about how to successfully implement and measure its effectiveness (25, 77). In 2009 the Pacific Islands Forum Secretariat estimated that less than 10% of children with disabilities in the region had access to education (80). The Secretariat of the Pacific Board for Educational Assessment (81) added that ''access to basic education is uneven across the region particularly for girls, the very poor, those with disabilities and for those in remote regions and outer regions'' (p10), cited in (25).

Poor access by children with disabilities is attributed to a range of reasons, including: parental efforts to be 'protective', school management decisions not to allow enrolment of children with disabilities; inaccessible curriculum, pedagogy and school environments, lack of appropriately trained teachers, and lack of access to specialist equipment (26, 79, 82). Macanawai, a leading disability advocate in the region, described how the widespread perception that disabling conditions are associated with ancestral curse, witchcraft and parental transgression, lead to ongoing isolation of many people with disabilities (83). Sharma et al. reported that in the small number of schools which were attempting to include children with disabilities in Fiji, Samoa and Solomon Islands, teachers appeared to have limited understanding about the children's need and lacked expertise in meeting these needs. They also reported confusion about how teachers would be able to identify if a child had a disability (84).

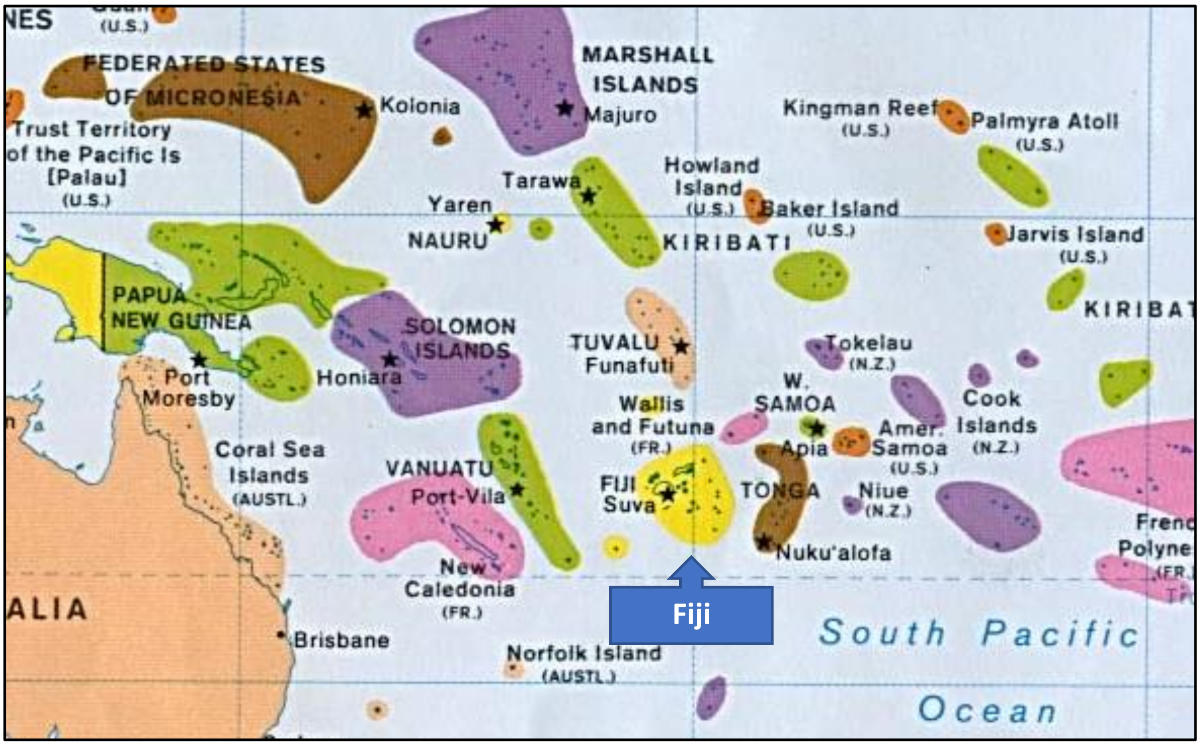
Efforts to overcome these barriers continue across the Pacific (85). The conference Outcomes Statement from the 2015 Pacific Regional Conference on Disability re-affirmed regional commitment to improve education for children with disabilities in regular schools with appropriate supports (86). The Pacific Framework for the Rights of Persons with Disabilities 2016-2025 (19) stressed the need to ensure the development and implementation of inclusive education policies aligned to the CRPD. Acknowledging the centrality of good data for implementing disability-inclusive education, Pacific Directors and Ministers of Education agreed to work towards a regional EMIS that would include significant data on children with disabilities (37, 87).

Fiji, where this research is based, is one of the Pacific Island countries working hard to fulfil its commitments to quality education for children with disabilities.

2.5 Fiji - disability and education

The Republic of Fiji, located in Melanesia in the South Pacific Ocean (Figure 2), consists of more than 330 islands, of which 110 are inhabited. The population is approximately 885,000 with 87% located in the two main islands Viti Levu and Vanua Levu and 55.9% in urban areas (28). The median age is 27.5 years, up from 17.8 years in 1976. Despite this steady increase, the population remains relatively young, with 10.4% being under 5 years (compared to about 3% in Australia (88)). Whilst Fiji no longer reports population by ethnicity, figures from the 2007 Census indicate approximately 57% iTaukei (Fijian), 37% Indo Fijian and 6% other (89). There are 731 primary and 168 secondary schools (90).

Figure 2 - Map of the Pacific Islands region [4]



The 2017 national census, which used the Washington Group Short Set of questions, showed a total population prevalence of 13.7% of people with disabilities (28). Census data by age are not available yet and it is expected that childhood figures are under-estimated as the Short Set is known to miss children with difficulties in behaviour, learning, coping with change and psychological functioning (91). Prior to this census, the disability prevalence figure most commonly used was 0.93% of children aged 0-19 years and 1.4% for the total population, based on a survey conducted in 2007 (92). The author, Fiji National Council on Disabled Persons, “believes that this figure could increase to 10 percent or more if all areas in the central, eastern, northern, and western divisions in Fiji were surveyed” (p17). The survey teams sought to identify all people with disabilities, but due to limited funding and time was incomplete. The number of people with disabilities identified was wrongly used as the numerator over the total population to arrive at this widely-cited, and extremely low, prevalence of 1.4%.

The right of children with disabilities in Fiji to access quality education is enshrined in several policies and acts:

- the Fiji Constitution (93),

- the Fiji Policy on Special and Inclusive Education (21),
- the Fiji National Policy on Persons with Disabilities 2008 – 2018 (94),
- the Fiji National Council for Persons with Disabilities Act (1994),
- the Fiji Human Rights Commission Act (1999),
- the Convention on the Rights of the Child (95),
- the Social Justice Act (2011),
- the Rights of Persons With Disabilities Bill (22), and
- in the CRPD, which Fiji ratified in March 2017.

Despite political, legislative and policy efforts to uphold the rights of children with disabilities in Fiji, a large proportion do not access education or complete a primary education cycle (92). The Fiji Islands Education Commission Report noted the lower school attendance and progression to secondary school among people with disabilities than their non-disabled peers (96). The 2010 national disability survey reported that 41% of people with disabilities surveyed had not undertaken or completed education due to disability-related issues, including inaccessibility of the built environment, approaches to teaching and/or financial barriers. The report also indicated that only approximately 21% of people with disabilities completed primary school, and underscored the links between poor access to education and unemployment and poverty in Fiji (92). The raft of policies and commitments appear to benefit only a minority of children with disabilities.

Efforts by the various stakeholders in Fiji to increase access to quality education for children with disabilities have slowly built momentum. The earliest known formal education for children with disabilities was in the 1960s, led by Christian mainstream schools. The first special school opened in 1967, catering for children with severe physical impairments and hearing loss. Following that, other special schools opened and there are now 15 primary and 2 post-primary special schools located mainly in major urban centres around Fiji. In the capital city Suva, two special schools focus on children with vision impairment and hearing impairment, and the other special schools enrol children with a range of impairment types. Whilst Fiji's approach to education of children with disabilities had been based predominantly on education in special schools, some efforts towards disability-inclusive education have been made over many years (97). In 1992, the Lautoka Teachers College (Fiji National University), included a subject entitled 'The Education of Children with Special Needs in the Regular Classroom' (98). In 2007, the Permanent Secretary for Education declared that Fiji was:

> ready to advance the concept of inclusive education and to … do three things straight away: revisit our current education policies to see what changes are needed, step up awareness and dissemination of information to support capacity-building in our schools and school communities, and strengthen advocacy to bring about a transformation of attitudes towards special needs students" (99)(p6).

In November 2011, the Ministry of Education's Policy in Effective Implementation of Inclusive Education in Fiji was signed (100) and by January 2013 under the AQEP program, children with disabilities commenced enrolling in five "inclusive education demonstration schools" around Fiji. At the beginning of 2014 the Ministry of Education began trialling "cluster inclusion schools". The cluster schools receive support from the special schools and some children are transitioned from special schools to the cluster schools, with teacher aides relocating where required and possible. In 2016, the government released its revised *Policy on Special and Inclusive Education* and the accompanying *Special and Inclusive Education Policy Implementation Plan 2017-2020 (101)*. This document further affirmed strong and ongoing government commitment to making Fiji's education system inclusive, notably including objectives around school-based screening to identify children with disabilities and developing intervention and management plans to maximise learning outcomes.

Fijian policy definitions of disability

The *Fiji Islands National Policy on Persons with Disabilities 2008 – 2018* states that "People with disabilities are persons with long term physical, mental, learning, intellectual and sensory impairments and whose participation in everyday life as well as enjoyment of human rights are limited, due to socio-economic, environmental and attitudinal barriers". The Special & Inclusive Education Policy states that "Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others". Both definitions are fundamentally consistent with the definition in the CRPD, which highlights the interaction between the long-term impairment and the various barriers in causing disability.

In the previous version of the policy (100), which was current at the time of this research, the definition varied substantively:

> A child with a disability/special need (is) any child who is diagnosed and medically proven to have, hearing impairment, speech impairment, visual impairment, serious emotional disturbance, physical impairment, specific learning disabilities and other health impairments that adversely affects the child's educational performance to the degree that he/she cannot be educated in the regular school environment without additional support and special services.

The earlier policy's definition presented fundamental challenges partly because it located the source of the problem in the child with an impairment (the medical model approach) rather than in the environment (the social model approach), and partly because it relied on diagnosis to prove the disability. A critical contextual factor in Fiji is the limited capacity for disability diagnosis in most parts of the country (29, 68, 102). A 2015 qualitative study undertaken by the candidate with co-authors, to explore Fijian peoples priorities regarding measuring success of disability-inclusive education (103), echoed this difficulty, raising concerns about several issues related to identification of children with disabilities. These included the lack of skills and tools within schools which would be required to identify students with disabilities and the lack of specialist diagnostic services required to formally assess children. In addition, study participants were concerned about the tension between identifying children with disabilities to improve access to services and education, and the risks of the child being 'labelled' and therefore potentially experiencing (increased) stigma, discrimination and/or lower expectations of achievement. Equally important were the concerns raised about the vital importance of identifying out-of-school children with disabilities in the context of a system which is focused entirely on identifying disability amongst enrolled students.

The current policy and its implementation plan outline a clear process for identifying disability amongst students, which is integrally related to the structure and design of Fiji's EMIS (FEMIS). The next chapter examines disability in EMISs across the Pacific, providing a detailed description of FEMIS in section 3.2, which is required to contextualise the research methods, results and outcomes of this thesis.

3. Education management information systems and disability

School and student information is captured in EMISs which are used to manage education systems in a range of ways. For example: to count numbers of students in schools, to determine student teacher ratios, and to describe achievement and transition rates of girls versus boys (104). To determine how students with disabilities are doing in comparison to students without disability, EMISs must be disaggregated by disability. Disability disaggregated EMISs are useful for providing data to measure education indicators within the SDGs and national and regional education commitments (105, 106), however there are many other benefits. Examples include tracking whether students with certain types of disabilities are missing out on quality education, determining eligibility for funding, and informing targeted professional development for teachers (107).

The need for improved disability-disaggregation of EMISs has been promoted for over a decade (108, 109), however the impetus for this has grown only over recent years (87, 110-112). The UNESCO Institute for Statistics maintains that to effectively implement disability-inclusive education: EMISs must include information on students that can be disaggregated by disability and data on school accessibility; disability definitions and instruments need to be aligned with international standards such as the ICF framework; and data collection by ministries and national statistical offices needs to be synchronised (113). These and other issues on disability data disaggregation in EMISs are explored below in the form of a peer reviewed journal article.

3.1 Paper One: Disability disaggregation of EMISs in the Pacific

Paper One, published in 2016 in *Knowledge Management For Development Journal* (105), used published literature as well as documents directly from ministries of education across fourteen Pacific Island countries to review and critique approaches to disability data collection within Pacific EMISs. The aims of the paper were to: (i) compare the types of disability data collected in Pacific Island EMISs at the primary and secondary school levels, including data on environmental factors; and (ii) review the status of and system capacity for disability-disaggregation within Pacific Island EMISs in relation to global and regional reporting requirements for indicators of education of children with disability.

Sprunt B, Marella M, Sharma U. Disability disaggregation of Education Management Information Systems (EMISs) in the Pacific: a review of system capacity. Knowledge Management for Development Journal. 2016;11(1):41-68.

Sprunt, B., M. Marella and U. Sharma. 2016.
Disability disaggregation of Education Management Information Systems (EMIS) in the Pacific:
a review of system capacity.
Knowledge Management for Development Journal 11(1): 41-68
http://journal.km4dev.org/

Disability disaggregation of Education Management Information Systems (EMISs) in the Pacific: a review of system capacity

Beth Sprunt, Manjula Marella and Umesh Sharma

Pacific Island governments have to report against an increasing number and range of global and regional education indicators that require disability-disaggregated data for monitoring disability-inclusive education. Given the effort required to adapt data systems and build capacity for disability disaggregation, it is imperative that indicators provide optimal information to inform policy and planning. This paper reviews current approaches to disability data collection and disaggregation within Education Management Information Systems (EMISs) across 14 Pacific Island countries. It compares disability-related education indicators from the Sustainable Development Goals, the Convention on the Rights of Persons with Disabilities, the Incheon Strategy, and the Pacific Education Development Framework in relation to current capacity of Pacific EMISs to report against these. Amongst the countries studied, the most common approach to EMIS disability disaggregation is to categorise children based on impairments, which is less reliable and comparable as a measure than categories based on difficulties in functioning. Data on school accessibility, human resources related to inclusion and learning support needs is rarely included in EMISs and then only sparsely. Measurement of regional and global disability indicators requires minor to substantial adaptations to the EMISs, outlined in the paper at a country-specific level. 'Granular' EMISs, which are based on individual student electronic files, are increasingly common in the Pacific and offer greater capacity for disability disaggregation and analysis of data. A range of recommendations are discussed for enhancing the data systems to enable reporting against the indicators and a more useful evidence base for disability-inclusive education.

Keywords: disability disaggregation; education management information system (EMIS); disability-inclusive education; indicators; Pacific islands

In line with global efforts to scale-up access to quality education for children with disabilities, better data is required for planning, resourcing and measuring processes and outcomes. This requires governments to have valid and reliable data within Education Management Information Systems (EMISs) to enable disaggregation by disability. The main purpose of an EMIS is to collect and integrate information about educational activities, and to make it available in comprehensive yet succinct ways to a variety of users (Villanueva et al. 2003). Governments use EMISs to manage education systems in a number of ways, for example, to record and monitor school staffing, infrastructure and school grants, or to calculate enrolment rates, student teacher ratios, and completion rates (Abdul-Hamid 2014). EMISs enable learning outcomes to be compared between sub-populations to assess, for example, effects of policies or capacity development approaches, or to identify students at risk of dropping out.

Disability-disaggregation of EMISs – which is contingent on being able to determine disability in students - enables governments to undertake activities such as: calculating disability loading for school grants; determining staffing needs; planning for provision of student learning supports and staff capacity development; budgeting for implementation of disability-inclusive education policies; measuring outcomes of those policies; and determining whether there are differential outcomes for students with different types or degrees of disability (Sprunt 2014). Disability disaggregation can simply involve processes to distinguish people with disabilities from those without disabilities, using disability as a single variable. Alternatively, it can provide more specific disaggregation, enabling detailed analysis based on categories of disability.

The call for disability-disaggregation of EMISs has grown over many years (PIFS 2012, Robson 2005, GPE 2013, UNDESA 2014, Savolainen et al. 2000, Mitra 2013). Disability disaggregation of datasets is acknowledged as central to the process of establishing baselines and measuring progress against the Sustainable Development Goals (SDGs) (CRPD Secretariat 2015). Furthermore, Article 31 of the UN Convention on the Rights of Persons with Disabilities (CRPD) outlines the obligations of States Parties to collect appropriate disaggregated data to enable them to formulate and implement policies and to help assess the implementation of obligations under the CRPD (UN 2006). *Education 2030 Incheon Declaration Framework for Action*, the new global education agenda which addresses Goal 4 of the SDGs (UNESCO & WEF 2015), includes the requirement for unequivocal and targeted support to Member States to enable reporting of disaggregated EMIS data by a range of characteristics, including disability. Indeed SDG target 17.18 is to, by 2020, support States to significantly increase the availability of 'high-quality, timely and reliable data disaggregated by gender, age, ethnicity, disability (and) geographic location' (UNESC 2015):46.

Like other large data collection efforts, the human resource cost of regularly collecting and entering data in every school is substantial. Data requirements must be carefully selected to maximise usefulness whilst minimising time required. Disaggregation using a simple 'Yes/No' classification for disability would take the least amount of time however this is inadequate for meaningful disability measurement (Mont 2007, Loeb et al. 2008). The International Classification of Functioning, Disability and Health (ICF) conceptualises disability as difficulties in human functioning in the areas of impairment, activity limitation and participation restriction; these difficulties result from interactions between a person (with a health condition) and contextual (personal and environmental) factors (WHO 2001, Leonardi et al. 2006). The universal applicability of the ICF enables activity limitations and participation restrictions experienced in an education context to be located within the schema used to classify disability. To understand factors related to access to education for children with disabilities, it is inadequate to simply measure the number of children with functional limitations that are in or out of a school system. It is vital to measure variables that relate to the environment and which act as barriers or facilitators, such as accessibility of the physical school environment and transport, inclusive teaching practices, access to assistive technology and accessible learning materials. Inclusion of this broader set of information in EMISs is important to build government knowledge systems that can inform disability-inclusive education policies and their implementation. One of the aims of this study is to explore the extent to which these environmental factors are included in EMISs in the region.

Disability-inclusive education in the Pacific

The Pacific region is vast and complex with diverse peoples spread across many thousands of islands spanning millions of square kilometres of ocean (Vince 2015). The countries in this study are from the three ethnogeographic groupings: Melanesia (Fiji, Papua New Guinea, Solomon Islands and Vanuatu), Polynesia (Niue, the Cook Islands, Samoa, Tonga, Tuvalu), and Micronesia (Federated States of Micronesia, Kiribati, Nauru, Palau, and Republic of the Marshall Islands).

Since 2009, the Pacific Education Development Framework (PEDF) has had an explicit cross-cutting theme: ‘Students with special educational needs and inclusive education’ (PIFS 2009b). The vast majority of Pacific Island countries have either distinct special or inclusive education policies or reference to the inclusion of all students within general education policies (Forlin et al. 2015). Pacific Island governments, through ratifying or signing the CRPD and/or the Incheon Strategy (UNESCAP 2012), have committed to disability-inclusive education, which is also reflected in the 2015 Pacific Regional Conference on Disability Outcomes Statement (PDF 2015). The Incheon Strategy, adopted in Incheon, Korea in November 2012 at a high-level intergovernmental meeting of 60 countries from the Asia and the Pacific regions, contains a set of cross-sectoral disability-inclusive development goals for the decade 2013-2022, focused on improving the quality of life and fulfilment of the rights of people with disabilities in the region. However, despite the range of political commitments and existence of legislation and policies, widespread implementation of disability-inclusive education in the Pacific has been slow (Miles et al. 2014) and there is ambiguity about how to successfully implement and measure its effectiveness (PIFS 2009a, Forlin et al. 2015).

Disability-disaggregated EMISs have the potential to play a principal role in Pacific Island governmental knowledge systems for disability-inclusive education, enabling national level planning and measurement. They could also provide the data to measure and report against regional frameworks such as the PEDF (PIFS 2009b) and the Incheon Strategy (UNESCAP 2012), and the global frameworks – the SDGs and the CRPD. Three initiatives underway in the Pacific contribute to progressing education statistics in the region: UNESCO's Institute of Statistics, the Secretariat of the Pacific Community's (SPC) program 'Strengthening Education Management Information Systems in the Pacific', and the Ten-Year Pacific Statistics Strategy (Kelly et al. 2014). However, alongside these broader approaches to strengthen EMISs and other statistical systems, knowledge and capacity is required to ensure appropriate and valid methods for disability disaggregation to fulfil the potential role of EMISs.

Given these regional efforts to improve Pacific EMISs and statistics, the increasing number and range of indicators that Pacific Island governments have to report against, and the global urgency for and momentum around disability-disaggregated data, it is timely to review and critique current approaches to disability data collection within Pacific EMISs. This paper aims to: (i) compare the types of disability data collected in Pacific Island EMISs at the primary and secondary school levels, including data on environmental factors; and (ii) review the status of and system capacity for disability-disaggregation within Pacific Island EMISs in relation to global and regional reporting requirements for indicators of education of children with disability. The paper will provide Pacific Island governments with information that supports effective decisions to improve methods for disability disaggregation in EMISs, to inform planning and resourcing of education for children with disabilities and better enable reporting against relevant indicators.

Methodology

EMIS documents including electronic versions of EMIS formats, policies, reports and statistical digests from 14 Pacific Island Ministries of Education listed in Table 1 were collected in September 2015 from EMIS officers of Ministries of Education and from the SPC. Some of these documents that were open access were also collected from government websites. Any clarification or further information required was achieved via follow up email correspondence with EMIS officers. The analysis and results were sent to all countries as well as the three most relevant regional agencies working on disability, education and data: SPC, Pacific Islands Forum Secretariat (PIFS) and the Pacific Disability Forum (PDF), to receive feedback and ensure appropriate representation of data.

The framework for analysing the documents was informed by a range of international and Pacific literature (UNICEF 2015a, UNESCO 2011, Sprunt 2014, DoE 2008a, Forlin et al.

2015, Sharma et al. 2016). Firstly, EMISs were categorised into overall data system types. Secondly, all data fields in the systems were reviewed to identify those that related to education of children with disabilities. This included the following fields: disability categories (e.g. vision, hearing, physical, etc); staff qualifications or training related to special and/or inclusive education; accessibility/infrastructure; and access to specialist services or reasonable accommodation, including teacher aides (Table 1). Thirdly, global and regional frameworks that require disability-disaggregated data were used to consider the countries' current EMIS capacity for reporting disability data (Table 2). The two **global** frameworks included in the analysis were the CRPD (CRPD 2009) and the SDGs, including core indicators as well as additional thematic indicators from *Education 2030*. These thematic indicators were developed to enable monitoring education targets more comprehensively than what would be possible with the limited number of core SDG indicators. Indicators from **regional** frameworks included in this analysis were from the Incheon Strategy (UNESCAP 2014) and the PEDF (PIFS 2015).

Only indicators related to primary and secondary education from the named frameworks are included. Countries were coded against each indicator (see Table 2) based on whether the EMISs are capable of reporting against the indicator using the current system, whether they need minor modifications to enable reporting against the indicator, or whether substantial modification was required. In addition, coding indicated whether household surveys or population census data are needed to measure the indicator. An example of a minor modification is the relatively simple inclusion of a new question in the EMIS such as whether schools have adapted infrastructure, or a new analysis of existing data that could be automated within existing computerised systems. An example of a substantial modification is the inclusion of a new matrix in an EMIS census form which requires additional relatively complex collection and manual disaggregation of new data at the school level or the development of new data systems or linkages.

Results

Types of data collection systems

Most countries in the Pacific disaggregate their EMIS by disability to some extent, using one or more of three main approaches.

1) Granular systems: Recording disability data on individual children's electronic files in EMISs, where each student file has a unique student identification (ID) number. Within granular EMISs, each child's record includes 'granules' of data, covering a large variety of variables, such as registered birth number, parent details, gender, ethnicity, date of birth, household income, school attendance, or financial assistance. The greater the extent of data sub-division into data fields, the more granular the system is. Compared to EMISs in which data is aggregated at the school level and individual data cannot be distinguished in the total

figures, EMISs that have *any* degree of individual data recorded electronically are considered 'granular' for the purpose of this paper.

2) Census-based systems: Annual school censuses are generally conducted within two months of the school year commencing. Census data collection comprises a frequently lengthy form for schools to complete with a variety of matrices that aggregate data such as total number of boys and girls with disabilities in each class. Within a census-based system, information such as enrolments by age, class and gender, or student transfers in or out of the school is collected.

3) Systems with separate disability databases: Data on children with disabilities are collected in a separate database, which are either integrated into the EMIS or used separately to report on indicators.

These systems are not mutually exclusive and several countries combine elements of the three approaches described above. For example, Vanuatu is transitioning from a census-based system to a granular system and collects information using both approaches currently. Table 1 is coded to identify which type of system is used in each country. Countries with granular systems include: Fiji, Federated States of Micronesia (FSM), Nauru, The Republic of the Marshall Islands (RMI), Palau, Tuvalu and Vanuatu. Countries with an annual school census-based EMIS include: Cook Islands, Kiribati, Nauru, Niue, Papua New Guinea (PNG), Samoa, the Solomon Islands, Tonga, Tuvalu and Vanuatu. Countries with a separate, detailed database of children with disabilities include: Cook Islands, FSM, Niue, Palau, PNG, RMI and Samoa. Samoa introduced a system of unique student numbers which are currently linked to assessment and will link to the census data soon; it also has a separate database of children with disabilities, which is currently the information source for reporting disability indicators.

Comparison of the disability-related information collected in Pacific EMISs

In addition to the overall approach of the EMIS, countries vary in the kind of disability information collected, for example the choice of categories to distinguish between 'types' of disability. Table 1 illustrates areas of comparability and variation in the way disability is captured in the EMISs across the 14 Pacific Islands. Thirteen countries include a means of separating data into 'types of disability', based on impairments, domains of activity limitation or a combination of both; one country collects overall number of children with disability. Most EMISs collect detailed infrastructure information on schools such as number and condition of classrooms and toilets, however only one EMIS (Vanuatu) includes questions related to accessibility of the built environment. Staffing information forms a large part of many EMISs, however only five countries (Fiji, RMI, Vanuatu, Cook Islands and Niue) collect any information on staffing related to disability inclusion.

Impairment categories of vision, hearing, speech, physical and intellectual (commonly termed 'mental disability') are used most commonly (see Table 1). Kiribati and the Solomon Islands are the only countries that specifically ask about fine motor skills. Tuvalu and Nauru would capture some children with difficulties with fine motor skills through the category 'difficulty washing themselves or putting on their clothes', although it would be impossible to know whether that category was picking up children with difficulties related to fine motor skills, cognition, or other factors. Several countries (5/14) attempt to distinguish between intellectual disabilities and learning disabilities, using terms such as 'reading' or 'slow learner'. The category emotional/behavioural is used least frequently (2/14). Several countries (6/14) have options for 'other' and 'multiple disabilities'. These two categories are difficult to interpret unless, as in Samoa, the disability is specified, or in Fiji the calculation of 'multiple disabilities' is by ticking multiple discrete categories on the child's individual electronic record. In addition to types of disability, Cook Islands, Nauru, Niue and Tuvalu also collect information on severity of the functional limitation (either low/moderate/high, or no difficulty/some difficulty/a lot of difficulty/cannot do at all).

Data are also collected on a selection of health conditions or diagnostic categories, such as Down Syndrome, cerebral palsy, autism and albinism. The collection of data on these conditions varies across the region. For example, the northern Pacific countries use a detailed system of forms, including relatively advanced diagnostic categories to comply with the United States Department of Education requirements for funding and technical support. This level of detail is stored in separate disability databases, as outlined in Table 1.

Assessment of children to support disability categorisation in Pacific EMISs

In most countries, the determination of disability category under which the child will be listed is made by the schools, with no definitions or guidance provided by Ministries of Education (MoE) in the EMIS data collection system. In some countries however, categorisation is supported by specialist staff who assess the children. The Cook Islands MoE's Inclusive Education Officer assesses all children identified by schools to determine or verify functional limitations and learning support needs. Niue does this also, although there is only one student with disability known in this small country of 1,190 people. Palau, FSM and RMI have specialists providing diagnostic services, although this may not be available across all islands within each country.

In PNG, the EMIS simply records whether a child is registered with the Special Education Resource Centre (SERC). Assessment of children on the SERC registers is made by staff. It was unclear based on the information made available to us how the assessment is undertaken and students are categorised. The PNG Department of Education Statistical Bulletin (PNG DoE 2013) does not include figures on children with disability. The PNG government superintendent of inclusive education noted that the Department of Education does not have an accurate record of students with disability in mainstream schools (Tamarua 2012).

Table 1. Disability/impairment categories, type of data collection system and other disability data recorded in the EMISs in Pacific Island Forum Secretariat member countries

	Type of data collection system			Vision / Sight	Hearing	Speech	Physical	Intellectual	Learning	Emotional / behavioural	'Other'	Multiple	Additional categories	Additional information recorded
	1	2	3											
Fiji[%]	✓			✓	✓	✓	✓	✓	Reading		✓	%		Links to teacher qualifications & professional development database
Kiribati[##]		✓		✓	✓	✓	✓- moving	Mental disability	✓		✓	✓	Physical disability – holding and gripping	Number of children in the community not attending school due to disability
Nauru[^ @]	✓	✓		Difficulty seeing	Difficulty hearing	Difficulty with the language (understanding what you say)	Difficulty walking or climbing steps	Difficulty remembering or concentrating					Difficulty washing themselves or putting on their clothes	
Republic of Marshall Islands[!!]	✓		✓	✓	✓	✓	Orthopaedic	Mental	Specific Learning Disability	✓		✓	Developmental delay, Deaf, Blind, Autism, Traumatic Brain, Other health problems	Special education recorded on staff form

Samoa[!!]		✓	✓	✓	✓	✓	✓	✓			✓ (specify)		Down Syndrome, Epilepsy, Cerebral Palsy, Autistic	
Solomon Islands[##]		✓		✓	✓	✓	✓- moving	Mental disability	✓		✓	✓	Physical disability – holding and gripping	Same as Kiribati
Vanuatu	✓	✓		✓	✓	✓	✓	Mental disability	✓(slow learner)	✓	✓ (albino, epilepsy)	✓	Down Syndrome	Same as Kiribati; presence of specialised disability teacher at the school.
Tuvalu[^@]	✓	✓		Difficulty seeing	Difficulty hearing	Difficulty with the language (understanding what you say)	Difficulty walking or climbing steps	Difficulty remembering or concentrating					Difficulty washing themselves or putting on their clothes	
Tonga		✓		Students are recorded as having a disability, not using impairment categories										Severity of effect of disability or ill-health on attendance
Papua New Guinea		✓	✓	Registered or not registered with the Special Education Resource Centre (SERC); method for categorisation by the SERC unavailable for this review										
Cook Islands[@] **& Niue**[@]		✓	✓	Impairments are recorded in a separate, detailed database with diagnostic categories unavailable for this review										Number of teacher aides and number of students receiving

					teacher aide support
Federated States of Micronesia, Palau	✓		✓		
Key	% Multiple categories can be ticked; ## A student with multiple disabilities can only be recorded under 'Multiple disability', not recorded under each individual impairment category; ^ Uses the adult set of Washington Group questions (for children from ECCE, primary and secondary); @ Severity of impairment is recorded; !! Children with impairments are recorded in a separate, detailed database.				
	Type of data collection system: 1) Granular 2) Census-based 3) Separate disability database				

Current capacity of Pacific EMISs to report on indicators from global and regional frameworks

Table 2 outlines the global and regional indicators that are expected to be disability-disaggregated. The coding illustrates which of these could be reported using current EMIS capacity within the 14 Pacific EMISs, or the degree of modification required to do so.

Global indicators

As illustrated in Table 2, two of the CRPD indicators (every child with disabilities has access to mandatory primary and secondary education) and one of the SDG indicators (gross intake ratio to the last grade - primary, lower secondary) require all countries to have disability data in household surveys or population censuses against which to compare the EMIS data.

Collection of data on one of the two core SDG indicators (percentage of children achieving at least a minimum proficiency level in reading/mathematics at the end of primary and lower secondary school) would be possible by implementing minor modifications to the current systems in Fiji, FSM, Nauru, Niue, Palau, RMI, Tuvalu, and Vanuatu. Substantial modifications to the systems are necessary in Cook Islands, Kiribati, PNG, Samoa, Solomon Islands and Tonga to collect data on this indicator. It should be noted that this paper focuses on the system capacity for disability-disaggregation of these indicators. Reviewing the accuracy of literacy and numeracy measurements in Pacific Islands is outside the scope of this paper.

The second core SDG indicator (percentage of schools with access to adapted infrastructure and materials for students with disabilities) is similar to the CRPD indicator 'schools are accessible'. To collect data on these indicators, minor modifications to the current systems in all countries are required, except Vanuatu which already collects relevant information. To report against the indicator 'completion rate - primary, lower secondary and upper secondary', the current system is adequate in 4 of the 14 countries (FSM, Niue, Palau, and RMI), while minor modifications are required in the remaining ten countries. Data collection on the indicator 'percentage of children over-age for grade - primary, lower secondary', also requires minor modifications to the current systems in eight countries (Fiji, FSM, Nauru, Niue, Palau, RMI, Tuvalu, and Vanuatu) and substantial modifications in the remaining six countries.

Table 2. Pacific Island countries' capacity for disability-disaggregated reporting against global and regional education indicators (primary/secondary)

Framework and Indicators	Code: ✓ = can report using current system **M** = minor modifications to current system required to report on indicator **S** = substantial additions to current system required to report on indicator **H** = household survey/population census data required	Cook Islands	Fiji	FSM	Kiribati	Nauru	Niue	Palau	PNG	RMI	Samoa	Sol. Islands	Tonga	Tuvalu	Vanuatu
GLOBAL INDICATORS															
UN CRPD[1]															
Every child with disabilities has access to mandatory primary education		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Every child with disabilities has access to mandatory secondary education		H	H	H	H	H	H	H	H	H	H	H	H	H	H
Schools are accessible		M	M	M	M	M	M	M	M	M	M	M	M	M	✓
Sustainable Development Goal 4 – including *Education 2030* indicators															
Core indicator: % of children/young people (i) in Grade 2/3, (ii) at the end of primary and (iii) at the end of lower secondary achieving at least a minimum proficiency level in (a) reading and (b)mathematics[2,3]		S	M	M	S	M	M	M	S	M	S	S	S	M	M
Core indicator: % of schools with access to adapted infrastructure and materials for students with disabilities[2,4]		M	M	M	M	M	M	M	M	M	M	M	M	M	✓
Gross intake ratio to the last grade (primary, lower secondary)[5]		H	H	H	H	H	H	H	H	H	H	H	H	H	H

Completion rate (primary, lower secondary, upper secondary)[5,6]	M	M	✓	M	M	✓	✓	M	✓	M	M	M	M	M
% of children over-age for grade (primary, lower secondary)[5]	S	M	M	S	M	M	M	S	M	S	S	S	M	M
REGIONAL INDICATORS														
Pacific Education Development Framework (Sept 2015)[7]														
Formal Education (primary and secondary):														
Net Enrolment Ratio	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Gross Enrolment Ratio	H	H	H	H	H	H	H	H	H	H	H	H	H	H
% new entrants to 1st year primary with ECCE experience	S	S	S	S	S	✓	S	S	S	S	S	S	S	S
Repetition rate	M	M	M	S	M	✓	M	S	M	S	S	S	M	M
Drop-out rate	M	M	M	S	M	✓	M	S	M	S	S	S	M	M
Promotion rate	M	M	M	S	M	✓	M	S	M	S	S	S	M	M
Transition rate (primary/secondary)	S	S	S	S	S	✓	S	S	S	S	S	S	S	S

1 United Nations Committee on the Rights of Persons with Disabilities (2009). Guidelines on treaty-specific document to be submitted by states parties under article 35, paragraph 1, of the Convention on the Rights of Persons with Disabilities Geneva, United Nations. CRPD/C/2/3

2 United Nations Economic and Social Council (2015). *Report of the Inter-agency and Expert Group on Sustainable Development Goal Indicators E/CN.3/2016/2.*

3 The indicator requires the development of a global metric for each subject as a reference point. (WEF 2015)

4 Major preparatory work is required to develop an approach on assessing school conditions for people with disabilities across countries. (WEF 2015)

5 World Education Forum (2015). Technical Advisory Group Proposal: Thematic Indicators to Monitor the Post-2015 Education Agenda. ED/WEF2015/REF/10, UNESCO

6 This indicator is currently available but work is required to finalise a common methodology and increase the number of surveys available to calculate it. (WEF 2015)

7 Pacific Islands Forum Secretariat (2015). List of Pacific Education Development Framework (PEDF) Indicators. Suva, Fiji, Pacific Islands Forum Secretariat.

Percentage out-of-school returning to formal schooling	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Literacy rate	S	M	M	S	M	M	M	S	M	S	S	S	M	M
Numeracy rate	S	M	M	S	M	M	M	S	M	S	S	S	M	M
% school leavers with at least a national or regional qualification	M	M	✓	M	M	✓	✓	M	✓	M	M	M	M	M
Teacher Development:														
Teacher training curriculum includes mandatory course on Disability-Inclusive Education	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Incheon Strategy[8]														
Primary education enrolment rate of children with disabilities	H	H	H	H	H	H	H	H	H	H	H	H	H	H
Secondary education enrolment rate of children with disabilities	H	H	H	H	H	H	H	H	H	H	H	H	H	H
% of children who are deaf that receive instruction in sign language[9]	S	S	S	S	S	S	S	S	S	S	S	S	S	S
% of students with visual impairments with educational materials in readily accessible formats[9]	S	S	S	S	S	S	S	S	S	S	S	S	S	S
% of students with intellectual disabilities, developmental disabilities, deafblindness, autism and other disabilities who have assistive devices, adapted curricula and appropriate learning materials[9]	S	S	S	S	S	S	S	S	S	S	S	S	S	S

[8] UNESCAP (2014). ESCAP Guide on Disability Indicators for the Incheon Strategy. Bangkok, United Nations Publication. ST/ESCAP/2708
[9] Non-mandatory indicator

Regional indicators

As seen in Table 2, all countries require household survey or population census data to report on regional (PEDF and Incheon Strategy) indicators including disability-disaggregated primary and secondary net and gross enrolment ratios and percentage of out-of-school children returning to formal schooling. Substantial modifications to current systems are required across all countries to gather information on percentage of children who are Deaf and who receive instruction in sign language; percentage of students with visual impairments with educational materials in readily accessible formats; and percentage of students with intellectual, physical, or any other disabilities who have assistive devices, adapted curricula, and appropriate learning materials.

Collection of data on teacher preparedness for the PEDF indicator 'Teacher training curriculum includes mandatory course on Disability-Inclusive Education', requires minor modifications in existing data collection systems in all countries. In countries that do not have teacher training programs, measurement would either have to relate to the teaching institutes in other countries where teacher trainees go for teacher training, or the indicator could be reported as 'not applicable'.

The existing systems in Niue, FSM, Palau, and RMI can provide data on the regional indicator 'percentage of school leavers with at least a national or regional qualification' (similar to the global indicator on completion rate), while the remaining ten countries require minor modifications to their systems. Substantial modifications are required for all countries (except Niue) to report against 'percentage of new entrants to first year primary with ECCE experience' and 'transition rate (primary and secondary)'. Due to the very small number of children identified as having disabilities, i.e. one child, the current system in Niue enables collection of data on repetition rate, drop-out rate, and promotion rate; whereas minor modifications are required to report on these indicators in the Cook Islands, Fiji, FSM, Nauru, Palau, RMI, Tuvalu and Vanuatu, and substantial modifications are required for Kiribati, PNG, Samoa, Solomon Islands and Tonga. To report disaggregated data on literacy and numeracy rates, minor modifications are required to the systems of Fiji, FSM, Nauru, Niue, Palau, RMI, Tuvalu and Vanuatu; and substantial modifications to Cook Islands, Kiribati, PNG, Samoa, Solomon Islands and Tonga.

Discussion

This paper compares the types of disability data collected in Pacific EMISs and reviews the capacity of those EMISs to provide data to enable reporting against a range of indicators of access to quality education by children with disabilities. The results indicate that mechanisms for some level of disability-disaggregation are in place in almost all Pacific Island EMISs included in this review, albeit to a limited extent in most systems. In considering the usefulness of the data and the strengths and limitations of the EMISs to report on global and regional indicators, there are a number of issues that arise.

Links between disability data from EMISs and population survey or census data
Disability-disaggregation at the simplest level, counting total numbers of children with disabilities per class, by 'disability type', and gender, is possible within most existing Pacific EMISs. However, to report on enrolment ratios (number of children with disabilities in school as a proportion of total number of children with disabilities in the population), which SDG, CRPD, PEDF and Incheon Strategy indicators require, the approach to measuring disability in the EMIS needs to be comparable with that used in national population-based data on children with disabilities (WHO & World Bank 2011). This is important as it is likely that many Pacific children with disabilities are out of school (Tavola and Whippy 2010) and outcomes of efforts to reduce this problem need to be measured.

In many Pacific countries, population data on children with disabilities is scant and suffers from variation in definitions, methodologies and measurement tools; a problem identified globally (WHO & World Bank 2011, Maulik and Darmstadt 2007, Cappa et al. 2015). The UN Washington Group on Disability Statistics (WG) in partnership with UNICEF has developed a comparable means of identifying disability amongst children in population censuses and surveys, called the WG/UNICEF Module on Child Functioning and Disability; this uses difficulty functioning (activity limitations, in ICF terms) across 13 domains as the disability indicator (Loeb 2016), with a continuum of difficulty established through the response categories. It would make sense for Pacific MoEs to consider aligning methods of identifying disability within EMISs to enable comparability with this approach being rolled out globally through the UN. In order to do this, MoEs need to work closely with National Statistics Offices (NSO). Samoa tested the WG/UNICEF Module in the recent Demographic Health Survey (DHS) (Government of Samoa 2015) and Fiji has tested the WG/UNICEF Module as a means of disaggregating the EMIS (Sprunt 2014, Sprunt and Marella 2016). Aside from EMISs, there are other means of collecting information to report on some disability-disaggregated indicators, for example population censuses or representative household surveys such as the DHS or the UNICEF Multiple Indicator Cluster Survey. Depending on the modules that NSOs decide to include in those surveys/censuses, a range of data could be calculated on education of children with disabilities, for example enrolment, learning outcomes and participation. The disadvantages of relying on these methods to report on disability indicators are that they are generally only undertaken every five years or more, survey samples can be too small to undertake much impairment-specific analysis, and adding a child disability module to a census is costly. UNESCO recommends the use of multiple sources of data to facilitate monitoring of social inclusion in education (World Education Forum 2015) and cautions about the risk of wrong interpretations and over-generalising the interpretations of household survey data (UNESCO (United Nations Organization for Education Science and Culture) 2011).

National level household surveys may provide estimates for a range of indicators; however, they do not help at the local level with understanding the number of out-of-school children with disabilities in the communities surrounding the school. Vanuatu, Kiribati and the Solomon Islands EMISs require teachers to collect information on out-of-school children with disabilities, which presumably increases the communication with families and others relevant to improving those children's chances of being enrolled. Within the Global Out-of-School Children Initiative, UNICEF highlights the importance of efforts to collect data on children with disabilities (UNICEF 2015b). Save the Children, an international non-government organisation, has done some work on Community EMISs (C-EMIS) (Heijnen 2004) which may offer some utility for Pacific Island governments, if data from the C-EMIS is available for national level reporting. C-EMISs use a community-based survey process which centres around the community identifying out-of-school children, analysing and interpreting the data, and discussing barriers and solutions for improving access to education for excluded children (Kafle and Dahal 2014). Governments would need to pay particular attention to the articulation between a C-EMIS and a national school-based EMIS in order to avoid duplication. Whatever method is used to collect information on out-of-school children with disabilities, it is clearly a very vulnerable sub-population which needs to be counted. Qualitative methods may be a useful means of gathering more in depth data on the barriers preventing inclusion of these children (UNICEF 2015c).

Supporting teachers in selecting categories and severity for disability data in EMISs

A basic problem of impairment-based disability categories in education is variability and inconsistency in use of terminology (Simeonsson et al. 2008). Most of the countries in the study separate data by impairment categories (Table 1), yet do not provide instructions or guidance to support teachers in doing so. Without appropriate guidelines, definitions and training of school personnel, it is difficult to be confident about the validity or reliability of the data. For example, 'mental disability' could be interpreted as related to psychosocial impairments or to intellectual/ cognitive impairments. In particular, the categories of intellectual, learning and emotional/ behavioural are open to variation in interpretation. It is more reliable and easier for teachers to observe functional difficulties and identify learning support needs, and resulting information is more relevant to inclusive education service provision. Using the UNICEF/Washington Group Module as the tool for categorisation of disability would shift the basis of categories from impairments to difficulties with certain activities. Learning support needs would not directly arise from this tool, however identifying areas of difficulty may assist teachers to more systematically consider these needs; this is explored further in a later section.

The lack of capacity within most EMISs to distinguish between severities of disability means that children with mild functioning difficulties are categorised the same as children with substantial ongoing support needs. The level of difficulty experienced by a child, when matched with learning support needs information, can be useful, for example, in informing human resource planning, estimating teacher aide requirements, or assessing whether only children with mild impairments are benefiting from inclusion policies.

Variation in geography, resources and capacity in education, health and social affairs sectors results in different approaches to determining disability categories for EMISs across the region. For example, the practice in the Cook Islands in which the MoE Inclusive Education officer personally assesses all children identified by schools would not be feasible in larger or more dispersed countries. Similarly, where specialist personnel are available (e.g. the northern Pacific) use of specialist testing may provide useful data to assist in selecting impairment categories on the EMIS. However, in many places, access to these personnel is unattainable and this would be too limiting a factor if EMISs required specialist testing before counting a child. This further adds to the rationale for strengthening the ability of schools to measure functional difficulties, which is consistent with the World Report on Disability recommendations to use a " 'difficulties in functioning approach' instead of an 'impairment approach' to determine prevalence of disability and to better capture the extent of disability" (WHO & World Bank 2011):45. Even with this approach however, some difficulties such as hearing can be hard to detect, and relying solely on teachers to detect hearing loss risks missing children who would benefit greatly from services. Each country needs to consider these issues in the context of their own education and health systems' capacity, and where needed, strengthen linkages between the sectors.

It is important to highlight that, whether categories are based on impairment or difficulty functioning, there are issues that still remain debateable. Identifying children who have difficulty with mobility may be easy, however it can be extremely challenging to accurately identify children with cognitive and learning difficulties. It is possible that teachers may inaccurately assume a child has a cognitive or learning impairment, whereas the student may simply struggle to adapt to the teaching style of the teacher. The labels of disability can be long lasting and can have negative effects on the child's development. Importantly, teachers, when appropriately trained, may identify children *at risk of* disability; they should not be asked to categorically diagnose disability.

Challenges in the category 'multiple disabilities'

In some countries, students with more than one impairment are recorded under a column 'multiple disabilities', which masks the types of impairment and is very difficult to interpret. A child with mild cognitive and speech difficulties may be categorised as 'multiple disabilities', which has very different resource implications from a child with spastic cerebral palsy and profound hearing loss who is a wheelchair user and requires support for eating and toileting. EMISs which allow schools to record children only under one category, the 'primary disability', avoid challenges with the category 'multiple disabilities' but the reality is that children frequently have difficulties in more than one domain. Systems which enable each child to be recorded with each of his or her domains of impairment (such as Fiji), and preferably with degree of difficulty, allow much more sophisticated data for planning responses.

The importance of measuring learning support needs, capabilities and access to reasonable accommodation

Many systems focus solely on measuring deficits rather than looking at capabilities and areas which need support to overcome environmental barriers. The significance of these environmental barriers, which co-create the experience of disability, is a central paradigm in the way disability is understood both in the CRPD and in the ICF, as outlined in the introduction. Pacific Disabled Persons Organisations are strongly supportive of this paradigm (PDF 2015). This is a serious consideration for Pacific Island governments in terms of their decisions about how to 'count' children with disabilities. As information on learning support needs is arguably the most critical element for planning service provision, and because identification of these needs is a basic skill of teachers, governments should consider ways of incorporating learning support needs into EMISs. However, whilst there are many examples of EMISs which incorporate capabilities, environmental factors and/or learning support needs (Griffin et al. 2010, EADSNE 2011, EADSNE 2012, State of Victoria (Department of Education and Early Childhood Development) 2011) (DET 2015), their implementation is relatively sophisticated and is more common in systems with individual electronic student records, that is, granular EMISs.

Of the global and regional indicators outlined in Table 2, three of the non-core indicators in the Incheon Strategy enable measurement of learning support needs, measured through percentages of children who receive instruction in sign language, materials in accessible formats, assistive devices, adapted curricula and appropriate learning materials. Globally, the SDG indicator that assesses percentage of schools with access to materials for students with disabilities is the indicator which will provide data most relevant to understanding the role of responding to learning support needs. However, the UN acknowledges that this is a difficult indicator, and that 'major preparatory work will be required to develop an approach on the assessment of school conditions for people with disabilities. This is expected to take 3-5 years (i.e. by 2020).' (UNSTATS 2016).

A further area for consideration is the inability of many EMISs to distinguish between children with disabilities whose learning support needs have been met and those for whom support is still required, which hampers resource planning or evaluation. The Cook Islands EMIS addresses this in part by recording number of children who have Teacher Aide support; and the special needs databases in FSM, RMI and Palau may include this level of information as they are linked to the children's Individual Education Programs (IEP). However, the majority of countries need to consider how they interpret data that may indicate, for example, 15 children with hearing impairments and 8 with musculoskeletal impairments. Does that mean that all 23 children require referrals to services and potentially require hearing aids, mobility devices or other services; or have those services already been provided? Countries with granular EMISs may be able to readily incorporate this type of information as it can be updated on the children's electronic files in real time and used at the MoE level for resource planning. Countries with census-based EMISs could incorporate a new question into the EMIS census form, or may use non-EMIS based mechanisms for gathering this information from schools. Countries with granular systems and IEPs may consider the advantages of using IEP data in the EMIS.

Narrative information may assist interpretation of EMIS data
Interpreting data from evolving systems brings challenges. For example, a report showing higher enrolments of children with disabilities at a school does not provide sufficient information on whether it implies: improvements in access for children with disabilities from the community; an increasing capacity of staff to identify disability amongst existing students; better access to screening services so previously undetected hearing and vision impairments are known; or even a perception by the school that recording more children with disabilities brings more resources to the school. These are challenging areas to provide simple recommendations for. However, it may be useful to include a section in EMISs for schools to provide comments on possible reasons for changes in relation to disability data over time. Reporting on data trends along with narrative explanations from the schools, provides information for government officers to discuss with schools during regular monitoring visits. These monitoring reports could then form sources for periodic evaluation processes to understand the effects of policies and resourcing decisions.

Screening, identification, assessment and support – a model from South Africa
South Africa's Department of Education has a model worth considering, which includes a staged sequence of screening, identification, assessment and support (DoE 2008b). The 'Support Needs Assessment' process assesses children for functional limitations. An 'Extended Learner Profile' includes barriers to: learning and development; communication; behavioural and social competence; health, wellness and personal care; and physical accessibility and transport. Contextual factors assessed include community, family and individual; classroom; and school. An 'Assessment for Support Requirements' form is completed through a combination of a District Based Support Team, the Institution Level Support Team, the educator and parents/caregivers and the student. Eligibility for support is determined based on parents providing reports from medical services, or an assessment by the District Based Support Team.

Interestingly, the South African EMIS does not record information on the severity of disability and only the primary disability is noted. Assessment by the District Support team as an alternative to medical assessment offers a useful flexibility depending on needs and context. This example may offer a solution for simplifying the data required in an EMIS whilst retaining options for resource planning and evaluation through an alternative database for information on children with disabilities. Several Pacific countries, such as Samoa or the Cook Islands have this capacity. In countries such as Fiji or Vanuatu, the EMIS itself is capable of incorporating learning support needs and data on other environmental factors, such as physical accessibility and a separate database is not needed.

Granular EMISs enable more sophisticated analysis

The shift within some Pacific countries from census-based to granular EMISs bodes well for disability disaggregation. To report on literacy rate by disability type, gender, class, age, ethnicity and location, it is straightforward to compute in a granular system. However in a census-based system, to report against the same indicator with the same variables for disaggregation, it is more difficult and would require complex matrices in the reporting formats.

Granular EMISs that incorporate or are linked to national teacher data systems and student results, e.g. literacy and numeracy assessment outcomes, provide unique opportunities to analyse information in relation to a large variety of relatively complex questions. The types of questions include: which children with which impairments, in which schools, with which learning supports, are achieving what educational outcomes? Are teacher aides with Braille skills located in schools where they are needed? How well do Deaf children with particular learning supports perform on assessments in comparison to Deaf children without those supports? Which teachers with what type of training or qualifications are creating environments that result in good learning outcomes for children with disabilities? There is no doubt that granular EMISs, when based on valid and reliable means of determining disability, provide more and better data for resource planning and policy evaluation.

However, shifting from an annual census-based EMIS to a granular EMIS is not possible for many countries and there is clearly a need to improve the way disability inclusion is understood through the former. UNICEF has published a guide on disability disaggregation of census-based EMISs (UNICEF 2015a), which would be an important tool for several Pacific Island governments to consider. Where available, separate databases with detailed information on children with disabilities, especially when linked to student identification numbers such as in Samoa, offer another alternative for answering some of the more complex questions, while keeping the EMIS itself relatively simple in terms of disability questions.

The challenge of prioritising improvements in complex systems

There are widespread challenges in the Pacific in collecting and using quality data even for fundamental and seemingly basic data such as attendance or literacy and numeracy of the general student population (SPC & SPBEA 2014). Given this, together with the relative infancy of disability-inclusive education policy implementation in the region (PDF and PIFS 2012), and in the context of increasing and competing demands for data within EMISs, it is understandable that governments have taken a pragmatic approach of collecting minimum data on disability in EMISs, which is impairment based.

Kelly and Cordeiro highlighted the value of administrative data, i.e. EMISs, as part of Pacific national statistics systems, but noted that given the increasing variation, capacity and resourcing in the Pacific Island countries, statistics development strategies need to be differentiated and appropriate to each country (Kelly et al. 2014). Given the variety of types of EMIS in the Pacific – granular, census-based, separate disability database, or commonly a combination of these – the solutions to disability-disaggregated data will be different across the region. An important principle in progressing disability data has to be recognition of countries' starting points. The fact that nearly all countries in this study collect data disaggregated into disability types needs to be acknowledged as a positive foundation. Despite the limitations of impairment-based categorisation discussed in this paper, this approach is widely used in low and middle income country EMISs (UNICEF 2015a) and is likely to be used by some countries globally as a means of disability disaggregation to report against education indicators.

Whilst it is outside the scope of this paper to provide an in depth critique of the indicators of global and regional frameworks, the review highlights the problem of slight variations in indicators seeking to measure very similar concerns and objectives across different frameworks. These variations can lead to substantial additional measurement burden on States parties, entailing financial and opportunity costs. Global collaboration in setting and aligning indicators is critical, with perhaps a degree of compromise required to ensure the 'disability data revolution' helps countries rather than exhausting them and distracting from the task of implementing measures to fulfil the rights of persons with disabilities.

This paper has largely focused on whether and how disability disaggregation of EMISs can be undertaken. However, there are important ethical issues that Pacific Island countries should consider in relation to whether or how data is published in small populations where identification of children may be entirely possible, for example in Niue. Pacific EMISs are in a state of rapid change and the findings of this review should be considered as merely an observation at a point in time. Whilst the issues raised in the paper may remain relevant in the medium to long term, the country-specific results are likely to change over the coming months and years as the EMIS strengthening programs in the Pacific are swiftly achieving improvement in the capacity of the systems. Since the EMISs were compared for this study for example, Fiji has made substantive progress in converting to categorisation based on functioning difficulties, incorporating learning support needs and detailed infrastructure accessibility data (Sprunt 2016).

Conclusion

Eleven years ago, Robson and Evans (Robson 2005) observed that large education data sets in developing countries were 'fragmentary and inconsistent in their definitions of disability', providing a poor basis for international comparisons. They also critiqued the reliability and validity of most of the datasets they reviewed. To some extent, this review of disability within Pacific EMISs draws similar conclusions. Many Pacific countries' disability-related policies align their definitions of disability with the CRPD, providing important regional consistency, however this definition is yet to be translated into valid, reliable and comparable student disability data in Pacific EMISs.

This study has highlighted a number of challenges and provided recommendations throughout the discussion section which may help overcome these. The primary challenge relates to disability definition, particularly the limitations of using 'impairment' as the key measure of disability to disaggregate EMISs. Instead, using 'difficulties in functioning' as the measure of disability would increase validity and comparability over time and across students, data sources and countries. Importantly, this would enable comparability with population data to answer disability-disaggregated enrolment ratio indicators required for the SDGs, CRPD, Incheon Strategy and the Pacific Education Development Framework.

Other than comparability, there are many other requirements of disability data in EMISs. To enable evidence-based planning, resourcing and evaluation for disability-inclusive education, a number of other recommendations to improve disability disaggregation of EMISs have been discussed in the paper. In summary, these are: including questions on environmental barriers, human resources for inclusion and learning support needs (including a means to differentiate those which have already been, and those yet to be, addressed); collecting information on out-of-school children with disabilities; providing disability disaggregation guidelines, definitions and training to schools; strengthening linkages between education and health sectors, particularly to ensure children identified as having functioning difficulties receive formal assessments and services (eg. vision and hearing services); ensuring families are clear that teachers are not diagnosing disability, rather, identifying children 'at risk of disability'; ensuring EMISs can capture multiple separate domains of difficulty functioning, or impairment, to avoid the ambiguous category 'multiple disabilities'; whilst EMISs require 'deficit' information on children with disabilities (focusing on difficulties/ impairments/ needs), at the individual assessment and teaching level teachers should ensure children's capabilities are identified and embraced; where Individual Education Programs (IEP) are in effect, consider including IEP data in the EMIS; collect narrative information in EMISs to support interpretation of quantitative data; and finally, consider the various elements of the screening, identification, assessment and support model used in South Africa, many of which would be applicable in Pacific Island education systems.

Whilst the list of recommendations may appear daunting, there is reason for optimism. The people behind the Pacific EMISs balance the reality of complex and varied geographic, economic and cultural settings, and delicate system change in large government mechanisms, whilst maximising the opportunities of technology and a global appetite for better data to improve education for long-neglected populations. Many Pacific Island countries are in a dynamic period of improving the underlying data systems, allowing opportunities to improve the measurement of disability within their EMIS. Increased availability of technology has enabled many countries to develop granular EMISs, and other countries to move towards doing so. This period of change provides a remarkable window to shape approaches to disability disaggregation so that indicators can provide meaningful information to improve access to quality education for children with disabilities.

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3.2 Fiji's Education Management Information System (FEMIS)

The Ministry of Education introduced FEMIS in 2013, with technical support from AQEP. The previous system used was the Fiji School Information Management System (SIMS), which officially closed in 2012. Like many other EMISs in the Pacific, SIMS was based on an annual school census survey for which schools manually aggregated data. FEMIS is an online system into which the school enters individual student data. Each child's file includes numerous data points, such as: student ID number, registered birth number, demographics, parent details, home living standards data, enrolment and attendance data, school fees, and financial assistance accessed. School information includes data such as utilities, buildings, equipment, locality description (eg. urban/rural/remote), governance and management, staffing and finances.

An important feature of FEMIS is its links to student literacy and numeracy assessment results and to the national teacher data system. This enables analysis which can answer a multitude of questions that were impossible with an annual school census survey, such as: which children with disabilities, in which settings, under what circumstances, are achieving anticipated learning outcomes? Or, are students with specialist requirements such as sign language supported by relevant staff? Or, what type of training appears to contribute to environments that result in sound learning outcomes for children with and without disabilities?

Before this research, disability disaggregation was possible within FEMIS, however there were problems with the approach. The instruction merely specified: "Please indicate disabilities for this student", with tick-boxes next to the following categories: No disability; Hearing; Sight; Speech; Intellectual; Physical; Reading; Others. Multiple categories could be selected, unless 'no disability' was chosen. No teacher training was provided to select categories. The Ministry of Education acknowledged that these categories were provided to the FEMIS database programmers with limited time for consultation and that the data being entered by schools was very difficult to interpret and was not being used (personal communication, May 2014). The questionable validity and reliability of the approach, lack of detail about degree of difficulty experienced or whether the students learning needs were met or unmet resulted in unusable figures that did not inform planning or monitoring and evaluation of funding and efforts.

To further illustrate the context and purpose for the study, it is helpful to understand the various questions education stakeholders were facing as they endeavoured to create inclusive education reform. Some of the questions, outlined in the lead up to the study (68), were:

- How do we calculate loading for the school grants as the schools enrol children with disabilities?
- How do we determine staffing needs?

- How should the individual needs of the child be assessed?
- How do we verify whether school figures on disability are correct?
- Which level of difficulty should be interpreted and counted as a 'child with a disability'?
- What specific supports and resources are needed by students with disabilities to experience equal conditions in accessing their right to education?
- How do we know which schools should be prioritised for Braille or sign language specialists?
- How do we plan for additional supports outside of the system (eg. rehabilitation needs)?
- How do we measure change against the national policy?
- How much will implementation of the national policy cost?
- How do we measure change related to the out-of-school children with disabilities?

There are several additional contextual issues and challenges which framed this research, which were identified during the course of the candidate's work as Disability Inclusion Specialist on AQEP.

Firstly, in Fiji teachers and head teachers are relocated somewhat frequently and so a teacher may not know the child well enough (in terms of functional difficulties, participation or health condition). Therefore, whilst teachers are indisputably important in recognising children at risk of disability, a system centred exclusively on teacher-based screening may be flawed.

Secondly, in Fiji it has been common practice to label children as "non-readers" and categorise this as disability, despite other factors that affect children's reading, for example teaching in languages which are not mother tongue for the child, poor access to books, or under nutrition. In the context of countless children being labelled 'non-readers', some of whom were suggested to drop out of mainstream schools and enrol in special schools, the MoE requested technical support to develop a feasible and suitable method of identifying specific learning disabilities such as dyslexia. Correct identification would enable appropriate responses for children with specific learning disabilities, as well as distinct responses for children who may benefit from mother tongue teaching, social protection and community and family engagement.

Thirdly, data from FEMIS is intrinsically restricted by its application within schools. Many children with disabilities are out of school and are therefore uncounted. To track progress towards enabling access to education for these children, disability data from FEMIS must be contrasted with national data to gauge the percentage enrolled and attending school out of the total children with disabilities in the population.

A final challenge is to develop a system to disaggregate FEMIS which accomplishes a balance between being feasible and valid for the primary purpose of data, and one which enables comprehensive and verifiable information to inform eligibility for services or financial support, and information needed to provide suitable individualised supports.

4. Disability data and education

This chapter starts by summarising the growing body of literature that demonstrates the gap in disability data available for education systems, particularly in LMICs. It then moves into a deeper, more critical exploration of the challenges and controversies related to approaches and methods of disability measurement within education systems.

Measuring exclusion of children with disabilities from and within education has proven difficult globally. Whilst many countries can count numbers of children in special schools, very few collect accurate and reliable data on those in mainstream schools (114). Population data, commonly used to measure educational access in LMICs, has not been detailed enough to disaggregate by marginalised groups such as people with disabilities. Variable government estimates reflect challenges in collecting and monitoring disability data as well as the invisibility of people with disabilities (54). In a report analysing 49 national datasets (115), UNESCO Institute for Statistics highlighted challenges comparing data due to variation in understandings of disability and priorities for data collection. These variations relate to what is counted as a disability (for example some definitions include chronic diseases identified by a health condition irrespective of functional difficulties), how severe the impact must be for it to be labelled as disability, and how questions are phrased.

A dearth of rigorous research led to the deduction from a 2013 systematic review that it was “not possible to draw any firm conclusions about the most effective approaches (in terms of impact or indeed cost) to increase the accessibility of education for children with disabilities’’ (116)(p34). A 2018 systematic review of disability-inclusive education further underlined the need for more and better quality studies that explore system- and school-level interventions (11).

The difficulty of collecting effective data on numbers of children with impairments that affect their access to school, and whether that education is useful, has been recognised for a long time (10, 117). Florian and Rouse (118) suggest that there are substantial challenges to tackle in progressing education data systems, which they categorise into four areas: (i) *technical issues* pertaining to data collection, entry, analysis and information technology system capacity and compatibility; (ii) *ethical/legal issues* pertaining to privacy, access and ways by which collecting data may interfere with educational judgements; (iii) *economic issues* relating to cost-benefit of data systems; and (iv) *conceptual issues* pertaining to classification of disability or special educational needs, means of assessment, reliability and validity, and the comparability of data. These challenges were all relevant in the context of the study in Fiji and are explored in the Discussion (section 7.3).

Disability data is vital to ensure appropriate policy development to overcome barriers to education. The 2007 Report of the Special Rapporteur on the Right to Education drew attention to the acute absence of statistical information on people with disabilities in school systems, including enrolment, achievement, dropout and trajectories through the school system and between institutions (119). One of the reasons statistics on educational access and outcomes for children with disabilities have been rare in LMICs is that household surveys, which have been the dominant source of this type of information, have not included enough information on degree or type of disability. Additionally, sample sizes are often too small to draw conclusions about the situation for children with disabilities. (51)

A lack of data on out-of-school children with disabilities makes it difficult to know the extent of and factors causing the problem, and how their right to education should be fulfilled most appropriately (113). Most countries involved in the Global Initiative on Out-of-School Children reported a lack of appropriate disability identification assessment tools and methodologies. Data collection was impeded by the "serious and persistent differences in definitions of disability, alongside the mass of methodologies and measurement instruments that are used to identify the children concerned" (p80) (113). The problems caused by differences in classification and categorisation of children with disabilities have been highlighted by academics and donor agencies alike (64, 120). This results in variations in prevalence estimates to the extent that comparisons both internationally, within countries and over time become meaningless (121).

Also problematic for ascertaining information on disability is the widespread under-reporting of children with disabilities by parents. This hesitancy to report a child's disability may be related to stigma and discrimination towards children with disabilities and their families, a lack of awareness of the disability due to non-availability of screening services, or a perceived lack of benefit to identifying the child as having disability (113).

The European Agency for Development in Special Needs Education argued that learners do not count if they are not counted (55). Singal et al. (43) agree, highlighting the right to be counted as outlined Article 31 of the CRPD, through which States Parties are bound to collect statistical and research data to enable the formulation and implementation of policies to give effect to the Convention (14). The Secretariat of the Conference of States Parties to the Convention on the Rights of Persons with Disabilities further underscored the centrality of reliable data and statistics to advance disability-inclusive development (122) and the General Assembly identified the urgent need to prioritise efforts to strengthen disability data and statistics, analysis, monitoring and evaluation (123).

The High-Level Panel of Eminent Persons on the Post-2015 Development Agenda outlined the central principle of the SDGs – to "leave no one behind", emphasising the importance of designing the goals to focus on reaching excluded groups, including people with disabilities, and the importance of data to enable the tracking of progress and access to essential services (124). The roadmap to achieve the 10 targets of SDG 4 is the *Education 2030 Incheon Declaration and Framework for Action for the Implementation of Sustainable development Goal 4*, adopted by 184 countries in November 2015. Leaders at the World Education Forum 2015 resolved to develop comprehensive national monitoring and evaluation systems to produce accurate evidence for policy formulation, education system management and accountability. They specifically requested partners to support governments with capacity development in data collection, analysis and reporting, including in capacity to disaggregate data by disability (41). The UN Economic and Social Council encouraged Member States, UN agencies and all related stakeholders to enhance disability data collection, monitoring and analysis and to promote the requirement for internationally comparable data and statistics disaggregated by disability, amongst other variables (125). Additionally, leaders at the Oslo Summit on Education for Development considered options for investment in dependable data systems that collect information on children with disabilities disaggregated for age, gender and type of impairment (126).

4.1 Measuring disability in education systems

Measuring disability in educational settings has particular nuances and connotations. Previously, disability has been defined using a medical model approach which categorises children based on health conditions or impairments and focuses on managing the impairment (127). This approach is mirrored by the "integration" approach within education, in which the emphasis is on "fixing" the child (through rehabilitation, remedial education and other services) so he or she can fit in with a regular school, instead of addressing environmental factors which cause barriers to education, such as improving curricula and teaching to enable differentiated instruction (58). Various authors have outlined problems with categorising children with disabilities based on health condition or impairment, as was required by Fiji's policy on special and inclusive education that was current at the time of this research (128). Daley et al., (129) caution that categorical disability labels and diagnoses compress the child's difficulties into a sole category, masking the character and severity of the problems. Whilst diagnosis- or impairment-based categories can be useful to inform aetiology or behavioural phenotypes, they are not adequate to understand everyday functioning of children (70, 130) or to advise supports for individual children (131). Anaby et al. showed how medical diagnoses of categories such as autism spectrum disorder, attention deficit hyperactivity disorder and learning disorders were poor predictors of participation compared with environmental and personal factors (132) and Lee (133) demonstrated the diversity of functional abilities within and across these categories. Florian (134) felt that a key problem in medically based disability categories in education settings was the inconsistency in how the terms were used and interpreted, particularly for children with learning difficulties, intellectual disabilities, emotional or behavioural problems. Research into the ICF in education settings supports use of a functioning profile instead of a medical diagnosis to inform educational design (135-137) (explored in section 4.3).

Ghana provides a useful example of a low-income country in which the challenge of disability definition in the education system has been examined over time. In 2005, the Ghanaian government acknowledged the insufficiency of its system for classifying and categorising disability within schools (138) however finding solutions for defining disability has been challenging. Ten years later, Singal's analysis of Ghana's education data showed enormous fluctuations in enrolment figures of children with disabilities attributed to variations in measurement parameters (139). In the same year, Lamptey (140) analysed Ghanaian inclusive education policy documents and reported an absence of definitions of disability in most of the documents, leading to problems concluding which children with what types of disability were eligible for assistance from the policy conditions. Disability definitions are clearly vital both for determining eligibility for assistance and for monitoring and evaluating policy impact.

4.2 The identification debate

Our discussion so far has focused on approaches to disability identification, however it is important to acknowledge a contested issue regarding whether identification of children with disabilities (or special educational needs) is even appropriate. Rieser contends that this debate arose from reactions to medical model or deficit-focused approaches in the 2000s and resulted in a focus on generalised inclusion principles, de-emphasising the specific needs of children with disabilities, including the need to even identify a child as having disability (141, 142). Within the debate are concerns about whether identification of disability may lead to educational exclusion, reduced learning expectations by parents and teachers or other discriminations met by children with disabilities (115, 143) (144, 145). These concerns mirror local concerns in Fiji raised in the qualitative study by the candidate, described in section 2.5 (103).

On the contrary, compelling arguments have been made by many authors about the benefits of identifying disability in education systems (51, 146). Bi and Roberts demonstrated the importance of teachers being able to observe children with disabilities and assess developmental and learning needs (147). The World Report on Disability highlights the importance of early identification and intervention in reducing the extent of educational supports needed by children with disabilities during schooling (2). Urwick and Elliot (148) agree, maintaining that individual differences among students with disabilities must be considered, especially in LMICs (for which they use the term "south"):

> Advocates with an evangelical desire to reject any suggestion of individual impairment tend to lose sight of the need for the highly specialised skills and knowledge that are essential if inclusive practices are to be sustained over time. While differences of context must be understood, it is irresponsible to disregard the systems of identification, assessment and referral that have been carefully developed in the countries of the north, on the grounds that these belong to a 'medical model' or to assume

> that these procedures have no place in the south. Such procedures are actually all the more vital in the south because of the more limited resources available for interventions, whether through inclusive or through special schooling. (pp139-140)

Madden (149) acknowledges that whilst classification is political and contains ethical decisions, the compromise must be made to avoid a structureless system. Watkins and Ebersold agree, arguing that unless there is some way of counting children with disabilities, there can be no accountability and that the issue is not about whether to count, but how to count children at risk of exclusion from education (114). In order to fulfil the mandate presented globally to disaggregate SDG and other framework indicators by disability (41, 124-126), outlined at the beginning of this chapter, classification is necessary. The candidate's opinion about this issue is echoed in Kauffman's (150) clear contention that "controversy about how best to sort, categorize, and label individuals is legitimate; controversy about whether to perform these functions is spurious" (p142).

Whilst risks related to disability identification are genuine, these can be mitigated through awareness-raising, teacher education programs and policy enforcement (130) and are outweighed by the practical necessity for identification. Identification enables knowledge about who has access to and who is excluded from education (151) as well as determination of eligibility for supports and accommodations, provision of appropriate learning methods and referrals and early intervention where necessary (150).

4.3 Application of the ICF in education

In high-income countries researchers have applied the ICF in school settings as a means to identify disability and determine special educational needs and eligibility for educational support (120, 136, 152-155). Indeed Portuguese law, in replacing clinical diagnosis as the normative criteria for eligibility, requires a functioning approach through the use of the ICF for Children and Youth (ICF-CY) (34) to determine eligibility and to guide assessment and intervention measures for students with additional support needs (135). As disability-inclusive education has advanced to concentrate on adjustment of environmental factors alongside activities to enhance function and capacity of children with disabilities, the multi-component structure of the ICF (and ICF-CY) offers an important framework for defining and measuring services and supports to enable access to quality education (156). In their review of the utility of the ICF for educational psychologists, Aljunied and Fredrickson (157) identified a number of generally encouraging reviews of the potential usefulness of the ICF for this purpose, including for multi-disciplinary team management of youth with cystic fibrosis (158), work with parents of children with cerebral palsy (159) and in multi-disciplinary service delivery for children with specific language impairments (160).

However, despite its potential as a comprehensive tool within education settings, the uptake of the ICF in the education sector appears to have been slow, with no evidence of its use at scale except in Portugal (127, 157, 161, 162). The lack of evidence for its implementation may be because the conceptualisation of disability and function within the ICF has been broadly applied in education systems but the full ICF taxonomy and tools may not have been taken up. As noted by Benson (163), "the ICF's complexity can be bothersome" (p10) even in well-resourced settings where the person completing the ICF form may be an educational psychologist. Indeed even in health settings, where the ICF has been used most extensively, researchers have acknowledged low efficacy of the ICF (164) in part because it: is too extensive in some types of data collection settings (165); contains ambiguous concepts especially regarding the qualifiers "capacity" and "performance"; and lacks clear differentiation between the concepts "activity" and "participation" (166, 167).

Whilst the comprehensiveness of the ICF as a tool may appear too complex for widespread application in school settings, the contrasting approach commonly found in LMICs – whereby children are frequently identified as simply having a disability or not (105, 106) – is manifestly inadequate. For the purposes of planning services, the type and severity of disability makes an important difference (10).

4.4 Disability as a continuum - the importance of understanding cut-off levels and measurement properties

Disability can be seen as a continuum ranging from nominal difficulties to fundamental impacts on a person's life. As outlined earlier, disability is the product of the interaction between individual characteristics (including health condition, impairments, functional status or personal factors) and characteristics of the environment (natural, built, cultural, social, policy) (30). Both individual and environmental characteristics and their relative degree vary depending on the setting, time and conditions. Hence, disability is contextual and dynamic over time and circumstance. It is critical that the rationale and implications of the cut-off which defines someone as having a disability are clearly understood. If for example the cut-off is relatively low on the continuum and includes mild disabilities (such as difficulty seeing which can be fully overcome with glasses or by sitting closer to the board), the number of children counted as having disability will be high. Whereas if severe disability is the cut-off (having a great deal of difficulty with basic functions), the number of children counted as having disability will be comparatively low. The cut-off level must be appropriate to the reason for identifying disability and will change depending on the purpose. For example, an education system may consider it important to identify children with mild and moderate disability to enable early interventions and educational adjustments, whereas a program determining eligibility for permanent cash benefits may target a higher level of disability (168). Madans et al. point out that "as disability is not a singular static state, there is no simple, singular way to collect disability data" (36)(p1165) and therefore the purpose for the data must be identified to ensure appropriate data collection.

Croft provides a clear example illustrating the importance of knowing the level of impairment for planning educational interventions. Children with profound pre-lingual deafness will likely need sign language to access quality education, whereas children with moderate hearing impairment may require hearing aids but not sign language (10); the difference in resourcing and choice of educational intervention is very different in these cases. However, differences in cut-offs are required not only to plan the type of intervention, but also the scale. This is evidenced by the wide variance in disability prevalence estimates between moderate compared to severe impairment outlined in the World Report on Disability (2).

Recognising the importance of the continuum of disability, measurement tools must be able to identify levels of difficulty to enable their use for different purposes. This has been a central principle in the work of the United Nations' leading agency focused on population level disability data, the Washington Group on Disability Statistics.

4.5 The Washington Group on Disability Statistics

In June 2001, based on general agreement about the requirement for population-based measures of disability for both international comparisons and country-based use, the United Nations International Seminar on the Measurement of Disability endorsed the development of principles and standard forms for indicators of disability. The Washington Group on Disability Statistics (WG) (169) was formed to meet this requirement. The WG is a United Nations Statistics Commission City Group made up by national statistical office representatives. To date, 130 countries have been involved with the WG's work.

The primary purpose of the WG is to promote and coordinate international cooperation on disability statistics suitable for censuses and national surveys, with an emphasis on data that is culturally neutral, internationally comparable and feasible (170). The WG approach was guided by the principle of equalisation of opportunities between people with and without disability (171), with the aim that data would be available to inform and monitor policy efforts to improve equalisation of opportunities for social participation of people with disabilities.

The WG focuses fundamentally on the part of the ICF which is *activity level functioning* (explained earlier in section 2.1), as these basic actions form the fundamental elements for more complex activities and which, in the context of environmental barriers, can result in inequalities in participation (172). The rationale for focusing on activity level functioning is to capture a consistent number of people identified as having disability, irrespective of changes in the environment. Take for example a disability identification tool that sought to count all children with cerebral palsy who use wheelchairs to mobilise at school. A *participation level* question such as "Is the child limited in the amount he can participate in the classroom due to a physical, mental or emotional problem?", may result in children with cerebral palsy without access to wheelchairs reporting limitations and therefore being 'counted'. Whereas children who have wheelchairs and where schools have ensured accessible facilities, may respond 'no' to the same question, thus not being 'counted'. Therefore, schools which provided means of overcoming barriers would appear not to have any children with disabilities.

The primary tool produced by the WG has been the WG Short Set of six questions which identifies most people in a population who are at greater "risk" of experiencing restricted social participation due to activity limitations (169). Six domains are covered including seeing, hearing, walking, cognition, self-care and communication. When the Short Set disability identifier is embedded in censuses or surveys, data from those statistical instruments can be disaggregated by disability to identify discrepancies in access to and outcomes from education, employment, housing, health and every other topic explored in the instrument (170). The Short Set has been validated through a range of studies (169, 173, 174). Whilst the Short Set identifies many children with disabilities, it misses several functional domains particularly relevant to child development including behaviour, psychological functioning, learning, and coping with change (91), which results in under-identification of children with disabilities (175). To address this, and the gap in tools which met the purpose, the WG and UNICEF developed a tool focused on identifying disability amongst children.

4.6 UNICEF/Washington Group Child Functioning Module – rationale and background to its development

Before the ICF was adopted in 2001, the most widely used tool for measuring disability in children in LMICs was the Ten Questions Screening Index (TQSI) (176). A range of countries conducted the Multiple Indicator Cluster Survey using the TQSI, enabling a large body of data globally (56, 177). However, the tool had significant limitations. Whilst designed as a first stage screening tool, to be followed up by clinical assessment, the second phase was rarely undertaken, resulting in widely varying prevalence estimates across and within countries (4). The TQSI resulted in high levels of false positives, identified in a number of two-stage studies (178-181). In addition, it used yes/no response categories instead of levels of severity and was limited to children aged 2 – 9 years.

To address the limitations of the TQSI, and improve the international comparability of child disability statistics, UNICEF and the WG developed the Child Functioning Module (CFM), which was finalised in 2016 (available from www.washingtongroup-disability.com). The CFM was designed as an interviewer-administered tool for parent/caregiver respondents, for incorporating into population censuses and surveys (Crialesi, De Palma, & Battisti, 2016). With the ICF-CY (World Health Organization, 2007) as its conceptual framework, "the CFM aims at capturing activity limitations that, in an unaccommodating environment, would place a child at higher risk of participation restrictions than children without similar limitations" (175). This sought to overcome an important limitation of the TQSI, whereby two-stages of data collection are required using resources that are largely unavailable in LMICs to obtain data on the ICF elements of impairments and health conditions. The CFM has two age group versions (2–4 and 5–17 years) which cover a range of areas for measuring functioning difficulties. The 2-4 years version includes: seeing, hearing, walking, fine motor, communication/comprehension, learning, playing and controlling behaviour. The 5-17 years version includes: seeing, hearing, walking, self-care, speaking, learning, remembering, attention/concentrating, accepting change, controlling behaviour, making friends and affect (anxiety and depression) (182). Response categories for most questions are: "no difficulty", "some difficulty", "a lot of difficulty" and "cannot do it at all". UNICEF/Washington Group emphasised the usefulness of the different severity levels for different data purposes, and recommended use of the cut-off "a lot of difficulty" for disaggregating outcome indicators by disability (183, 184).

There is consensus by United Nations agencies and disability peak bodies that the CFM should be the key tool globally for disaggregating the Sustainable Development Goal indicators relevant to children (35, 36), including education indicators (115). To illustrate the uptake of the CFM, it is being rolled out in the current round of Multiple Indicator Cluster Surveys (185) globally, and the Girls Education Challenge, a flagship programme of the United Kingdom's aid program, has used the CFM to disaggregate all projects across 18 countries by disability (186). The Australian government's Department of Foreign Affairs and Trade provides substantial funding to support the rollout of capacity amongst national statistical offices for implementation of the WG tools including the CFM (187). In addition, the United States Agency for International Development (USAID) has advised that the WG Short Set and/or the CFM should be used in USAID-funded education programs wherever possible to disaggregate data sets by disability (188). The Stakeholder Group of Persons with Disabilities for Sustainable Development, representing persons with disabilities for high-level UN processes including the SDGS, was the most recent peak body to recommend the CFM. In a submission responding to a request from the UN Statistical Division in December 2018 for a disability data disaggregation policy priority, the Group clearly supports the use of the CFM, with the front page stating:

> The Stakeholder Group of Persons with Disabilities highlights that the short set of questions developed by the Washington Group on Disability Statistics and the UNICEF/Washington Group Child Functioning Module (that supports identification of children with disabilities) are sustainable and suitable for disaggregating by disability status and monitoring progress in attaining the SDGs on an ongoing basis. These modules are internationally comparable, well tested, efficient, low cost, and easy to incorporate into ongoing data collection of national statistical systems. (189)

Substantial cognitive testing of the CFM has been undertaken (190-192) along with field testing in various countries (183, 193-195). Visser et al. (196) assessed diagnostic accuracy of the CFM in a population of 2–4 year olds in rural South Africa, using access to a care dependency grant as the proxy for the reference standard test as it is based on a medical assessment of disability. Sensitivity of the full CFM was 0.60 (95% CI: 0.15, 0.95) and specificity was 0.84 (95% CI: 0.71, 0.94). However, generalisability of these findings is questionable as the study only had five children with disabilities, which is a major limitation in a diagnostic accuracy study.

In the context of a population survey (194, 195, 197), Mactaggart et al. tested the 2014 draft CFM in Cameroon and India against clinical tests for vision, hearing, musculoskeletal impairment and history of epilepsy. Results indicated that the cut-off level "a lot of difficulty" misses a large proportion of children with disabilities. It was recommended that children identified having "some difficulty" should receive subsequent clinical assessment in the same domain of functioning to identify a higher proportion of children with disabilities. Mactaggart subsequently used this approach in a national survey in Guatemala, which also showed that many children identified as having "some difficulty" within the CFM were then found to have moderate or above impairments in a second stage clinical assessment (198). Disability was defined in the study as being anyone reported as having "a lot of difficulty" or "cannot do" in any WG domain, or "some difficulty" in any domain plus screening positive for a moderate or higher clinical impairment in vision, hearing and physical impairment.

Mactaggart's research highlights the importance of a nuanced interpretation of the data resulting from the CFM. This is in contrast to advice provided by USAID (188), which specifies that "the answers can be used as a regular scale, with "cannot do it at all" denoting severe disability while "some difficulty" denoting minor disability in each functional domain. Answers across all domains can also be combined into a larger scale." (p4). There are risks in assuming that the response categories are a regular scale with responses used consistently to refer to particular levels of severity of disability. Research undertaken by the Australian Bureau of Statistics comparing the WG Short Set to the existing national survey, the Survey of Disability, Ageing and Carers (SDAC), showed large discrepancies between people identified as having disability across the two surveys (see Table 1). When the higher cut-off "a lot of difficulty" was used, 84.7% of people identified as having disability on the WGSS had disability on the SDAC; on the other hand, 73.1% of people identified on the SDAC as having disability were missed by the WG short set. In contrast, when the cut-off "some difficulty" was used 54.2% of people identified as having disability on the WGSS had disability on the SDAC and only 29.7% were missed; however 45.8% of those identified as having disability on the Short Set did not have a disability according to the SDAC (199). Some important differences existed across the data collection methods, outlined in Table 1.

Table 1 - Difference between the Australian Survey of Disability, Ageing and Carers and the Washington Group Short Set supplementary survey

Survey of Disability, Ageing and Carers (SDAC)	**Washington Group Short Set (WGSS)**
An extensive set of 150 questions to identify disability	6 questions to identify disability, with a comparatively limited number of functioning domains
Personal interviews	Questions were directed to a responsible adult to answer on behalf of the household
All ages	Five years and over
Included hospitals, nursing homes, hostels, etc	Only in a voluntary sub-set of households

<table>
<tr><td colspan="6">People identified as having disability by one or both survey tools – by WGSS cut-off level</td></tr>
<tr><td colspan="2">SDAC only – 2.7 million</td><td colspan="2">SDAC and WGSS – 994,700</td><td>WGSS only – 179,800</td><td>“a lot of difficulty”</td></tr>
<tr><td>SDAC only – 1.1 million</td><td colspan="2">SDAC and WGSS – 2.6 million</td><td colspan="2">WGSS only – 2.2 million</td><td>“some difficulty”</td></tr>
</table>

Whilst the methodological differences in data collection are considerable, the challenges in interpreting data in the response category “some difficulty” is noteworthy.

A recent series of articles by the authors of the CFM reported the official cognitive testing results (191) and field-testing results from studies in three countries (175). In Samoa the CFM was incorporated in the 2014 Demographic Health Survey; in Mexico it was a module in the 2015 National Survey of Boys, Girls & Women (ENIM); and in Serbia it was undertaken as a dedicated survey comparing the CFM to the TQSI for 2-4 year-olds and the CFM to the WG Short Set for 5-17 year-olds. The main objective of the field tests was to inform decisions on the cut-offs for determining a dichotomous categorisation of disabled and not disabled. The criteria used to assess cut-offs were: (i) prevalence levels consistency; (ii) conformity to expected patterns across domains and within sociodemographic groups based on earlier research; (iii) frequency of false positive cases established through respondents’ responses to probing questions on walking, self-care, remembering, controlling behaviours and accepting changes, and (iv) interviewer feedback on implementing the CFM in field settings. Cognitive testing indicated that interpretation of the “some difficulty” category might be varied within and across countries, and field-testing confirmed this, with this cut-off displaying highest variation across countries.

4.7 The relevance of the CFM for Fiji's Ministry of Education

There are several reasons why the CFM was considered a possible candidate for identification of disability within FEMIS. Firstly, previous methods to identify children with disabilities in Fijian schools have been relatively makeshift and standardised clinical assessments are unavailable in most parts of Fiji and not commonly used even in the capital Suva (200). Secondly, the majority of children with disabilities are out of school. In order to track progress against the principal aim of improving access to education for children with disabilities, it is vital to be able to compare FEMIS data to data on out-of-school children with disabilities. This national data is the remit of the Fiji Bureau of Statistics. Along with national statistical offices in the Pacific, Fiji is committed to incorporating Washington Group on Disability Statistics tools into censuses and surveys (201). The 2017 Fiji census used the Short Set and whilst household data collections have not yet included the CFM, over time it looks likely to be incorporated into data collections.

Robertson et al. (202) outlined a useful list of criteria for screening tools to identify children with intellectual disabilities in LMICs, which is pertinent in considering the relative merits of the CFM for Fiji. They maintain that tools should be:

- affordable, quick, acceptable in context,
- easy to use by community level workers (teachers, in the case of Fiji's education system), and
- have high specificity and sensitivity to balance the risks of cost-burden with false positives and adverse impacts on children's lives with false negatives.

The CFM is comparatively short, can be employed without medical expertise, enables classification by severity of functional difficulty and would support comparisons between EMIS data and national and international statistical data. However, it is designed to be interviewer administered with the child's parent or primary caregiver, whereas in education systems teachers are generally responsible for recording data in the EMIS and are often the ones who identify students with additional needs.

The government of Fiji is committed to inclusive and quality education for all, including children with disabilities. Ensuring this requires resources and processes for estimation and accountability, which require disability disaggregation of the EMIS. This disaggregation must be based on a feasible and valid means of identifying disability in the context of Fiji, with teacher respondents instead of parents, and must enable a clear understanding of the severity of disability reported within response categories.

Literature review summary

Despite abundant international commitment to disability-inclusive education, evidence about which policies and programmes are effective has been limited (203). This presents an enormous challenge and raises critical questions to governments and partner agencies about how and where to invest (115, 204). A key reason underlying the lack of evidence is the fact that many governments' EMISs have not had the capacity to disaggregate, or meaningfully disaggregate, data by disability (106, 205).

The literature demonstrates the challenges faced by the scientific community over decades in identifying methods to measure disability in children which are feasible in LMICs, internationally comparable, valid and reliable, and consistent with the biopsychosocial model of the ICF. The SDGs have contributed to the impetus to agree on a method for disability identification to embed in national data collections, which has resulted in broad consensus to use the CFM as the tool to disaggregate SDG indicators relevant to children. As the CFM was designed and tested with parents as the primary respondent, and as EMISs require teacher-based data, a critical gap in the literature has been identified – the absence of validation of the CFM with teachers as respondents. The properties and measurement accuracy of the CFM must be understood when used within education systems.

The literature indicates an important challenge related to the response categories of the CFM. The higher cut-off, whereby a child has "a lot of difficulty" (or "cannot do at all") doing an action, appears to have high specificity and therefore provides reasonable certainty that it is capturing children with disabilities. However, it has low sensitivity and misses many children with disabilities. The higher cut-off is a reasonable choice for censuses and surveys, for which the higher cut-off confidently distinguishes between people with and without disabilities in the population, which is invaluable for the purpose of comparing equalisation of opportunities. For an education system though, it is important to capture all children with disabilities in order to provide appropriate services and educational modifications. For this reason, the disability-status and learning and support needs of children captured in the lower cut-off "some difficulty" must be explored. Insufficient literature has been published on the disability domain specific measurement properties of the CFM, which need to be understood further to confidently distinguish between children with different types of disabilities to evaluate and plan for services.

Whilst there has been debate about the risks of identifying children with disabilities due to concerns about labelling and discrimination, the advantages of identification outweigh the risks. Identification of disability enables children greater access to services and resources and can mitigate the severity of disability by triggering solutions to participation barriers. People with disabilities, when identified, can avail benefits from government and non-government schemes and services including access to medical, rehabilitation and education services. At the system level, identification enables schools and ministries to make decisions on issues such as human resource and assistive technology requirements and to compare benefits of different inclusion approaches and models.

Prior to this study, there were no studies in the Pacific region that identified and validated a feasible method of disaggregating an EMIS by disability. This left a substantial and critical gap in the ability of Pacific Island governments to plan, monitor and evaluate their efforts to improve access to quality education for children with disabilities. As capacity is being developed for implementing the CFM in national statistical collections across the Pacific (and globally), and for strengthening EMISs across the Pacific, it was timely to validate the application of the CFM for potential use in EMISs.

5. Research aim, objectives and methodology

5.1 Aim and objectives of the study

The aim of the study was to identify a valid, reliable and feasible method for Fiji to identify children with disabilities in schools and disaggregate the Fiji EMIS by disability.

It was anticipated that the study findings would strengthen the capacity of Fiji's Ministry of Education to implement and monitor its policy on special and inclusive education and to report against national and international commitments on disability-inclusive education.

The objectives of the study were to:

1) Determine the diagnostic accuracy and optimal cut-off levels of the UNICEF/Washington Group Child Functioning Module (CFM) for predicting the presence of disabilities in primary school aged Fijian children compared to standard clinical assessments of impairment.
2) Determine the inter-rater reliability between teacher and parent CFM responses.
3) Explore interplay and associations between CFM items.
4) Determine whether combining CFM data with environmental data (learning and support needs) improves the accuracy of identifying different categories of functional difficulties among primary school aged Fijian children.

5.2 Study setting

Figure 3 shows the map of Fiji with the location of the 15 schools included in the study. Six of the schools were in Suva the capital city.

Figure 3 - Map of Fiji [5], showing location of 15 schools in the sample

5.3 Study design

5.3.1 Diagnostic accuracy study

A cross-sectional diagnostic accuracy study, two-gate design with representative sampling (206) was undertaken by the PhD candidate from March to July 2015 in Fiji. In diagnostic accuracy studies, the index test whose accuracy is being investigated (CFM) is compared to reference standard (clinical) tests that are considered the best available tests regarding the conditions of interest (207, 208). The purpose of a diagnostic accuracy study is to evaluate the ability of the index test to correctly classify study participants into two categories, those with and without the 'target condition'. This is usually done by comparing the distribution of the index test results with those of the reference standard (clinical) tests. Receiver operating characteristic (ROC) curve analysis is used for this purpose, which is a simple, two-dimensional measure of how well the index test classifies the participant, depicting the trade-off between sensitivity and specificity (209) (outlined in more detail in section 5.4).

Reference standard (clinical) tests were undertaken for vision, hearing, musculoskeletal impairment, speech and cognition (detailed in section 5.3.4). For the purpose of this study, the 'target conditions' are disabilities, defined as clinically assessed impairments of a moderate or more severe level. The decision to take this approach despite the risk of criticism for taking a medical perspective is discussed in section 5.3.6. For the purpose of this research these clinical assessments provided an objective assessment against which to compare parent and teacher responses to the index test.

An acknowledged limitation of diagnostic accuracy studies is the assumption that the reference standard tests perfectly distinguish between subjects with and without the target condition (210); in this case, assuming that the five reference standard tests (section 5.3.4) are "gold standards" against which the CFM can be measured. Recognising the likelihood that the reference standard tests themselves are imperfect, and in accordance with recommendations in the Standards for Reporting of Diagnostic Accuracy Studies (STARD) (211), this study undertook several steps to overcome this limitation. These included clear documentation of: eligibility criteria and flow of participants to be categorised as either cases or controls; distribution of disease severity in participants with the target conditions; alternative diagnoses; time interval between index test and reference standard tests; cross-tabulation of the index test results by the reference standard results; sufficient detail and rationale about the index test and reference standard tests to enable replication; definition and justification for test positivity cut-offs, differentiating pre-specified from exploratory; and blinding between data collectors of index test and reference standard tests. Representative sampling was used to further address limitations common to diagnostic accuracy studies, discussed below.

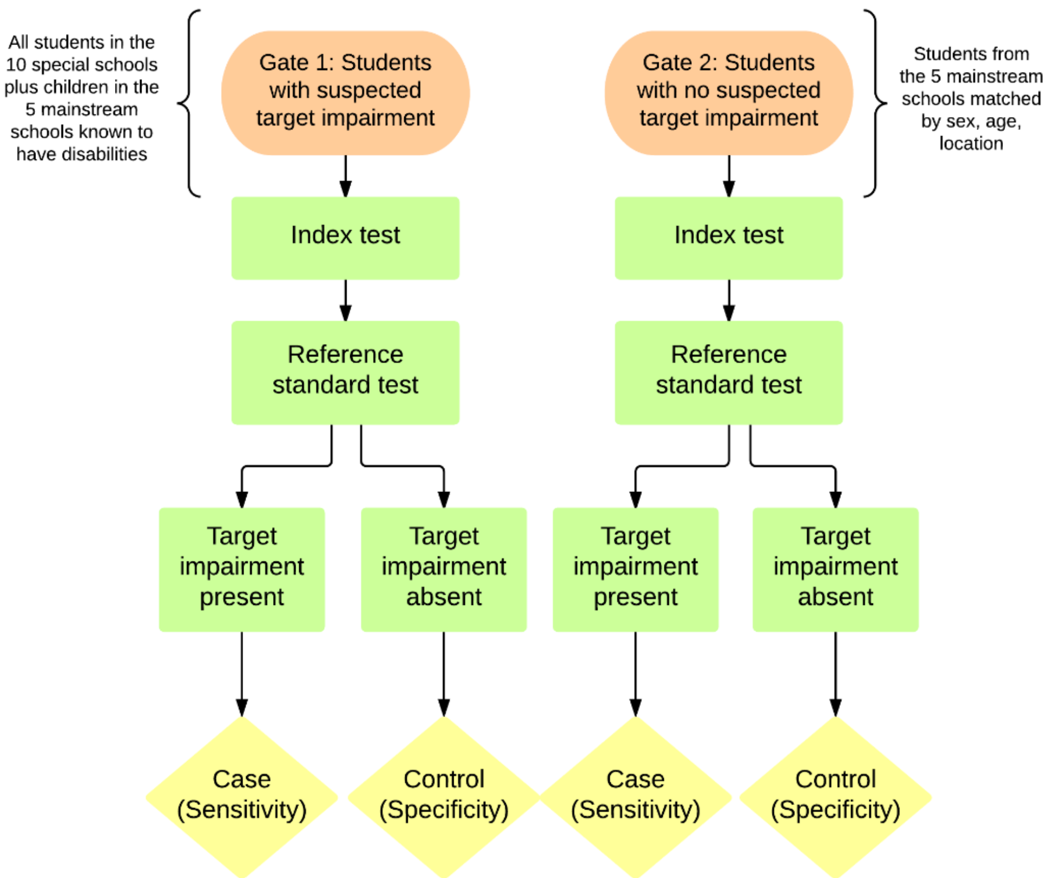
5.3.2 Sampling

Sampling was purposive regarding school selection and student participation to increase the chance of recruiting adequate student numbers within each impairment group (explained below) and to ensure a geographic spread across Fiji. Participants for the study were recruited from 10 special schools and five inclusive education (mainstream) schools from the four administrative divisions in Fiji. Children aged 5–15 years invited to participate included: all children in the special schools and all children in the mainstream schools previously identified by the school to have disabilities, as well as selected controls matched by age, sex, ethnicity and location (see Figure 4 – Flowchart of Participant Recruitment). Data for the CFM were through parents (or primary caregivers) and teachers as proxy respondents for the children; parent and teacher responses were compared. Teachers also responded to questions on the children's LSN (section 5.3.7).

Representative sampling focused on including cases with mild/moderate through to profound impairment to minimise "spectrum effect", whereby a sampling bias towards including only cases with more significant impairment can lead to higher estimates of sensitivity and specificity (206). This was operationalized in two ways: (i) by keeping tallies on impairment levels of children throughout recruitment and working closely with schools to achieve a mixture of impairment severity levels; and (ii) by assessing large numbers of children who were not initially identified by schools as having disability, which resulted in a sample with a full spectrum of function/impairment, including those around the lower or borderline end. The second potential bias is one of "limited challenge", whereby the exclusion of participants with alternative diagnoses can lead to reduced false-positive rates and higher specificity (206); this was mitigated by retaining participants in the sample who may have had alternative causes of difficulties, for example asthma or heart disease causing difficulty walking rather than musculoskeletal impairment.

Sample size was estimated based on minimum number to achieve a sensitivity or specificity of 0.85 (prevalence 0.10, alpha 5%, 1-beta 80%; CI 95%, lower confidence limit 0.65) (212). A target of 52 cases and 52 controls were sought under each of five impairment domains (vision, hearing, musculoskeletal, speech and cognition). Complete data sets (reference standard tests plus teacher and parent index test data) were available for a total sample of 472 children.

Figure 4 - Flowchart of participant recruitment



5.3.3 Index test – Child Functioning Module

This study used a draft of the CFM (5–17 years age group) current at February 2015, with permission from UNICEF and the Washington Group (see Appendices 1 and 2). Appendix B-1 in section 6.5 lists the differences between the version used in the study and the final version of the CFM, which is available from www.washingtongroup-disability.com. As described in section 4.6, the CFM covers a range of areas for measuring functioning difficulties, including: seeing, hearing, walking, self-care, speaking, learning, remembering, anxiety/worry, depression/sadness, controlling behaviour, attention/concentrating, accepting changes in routine and making friends. Response categories for most questions are: “no difficulty”, “some difficulty”, “a lot of difficulty” and “cannot do it at all”. It also includes questions to establish whether the child wears glasses, uses a hearing aid, or uses any equipment or receives assistance for walking. If the child does use the assistive device, the question for seeing is “when wearing his/her glasses, does (name) having difficulty seeing?”. Similar questions are asked for hearing and walking. The CFM has separate questions for difficulty walking with and without equipment for children who need equipment. Only data on difficulty walking without their equipment was used in this analysis to allow for comparison with the musculoskeletal assessment, which scores musculoskeletal function without equipment (described below).

The CFM was translated from English to Fijian and Fijian-Hindi by two separate bilingual speakers for each language, and back-translated. It was then pretested as per the guidelines of the Washington Group (213) using cognitive interviews with 10 teachers and 10 parents of children with disabilities. Teachers and many other people in Fiji speak English fluently and during cognitive testing it became clear that the English version of the Module would be the preferred version for teachers and in many cases for parents.

5.3.4 Reference standard (clinical) tests

The reference standard (clinical) tests for this study were selected based on international standards for vision and hearing and well-validated tools for speech, musculoskeletal impairment and cognitive impairment. Table 2 presents a summary and further details are available in papers or chapters referred to in the table. The assessment team consisted of three experienced screeners whose full-time job is school-based vision and hearing screening in Fiji, plus three qualified physiotherapists, an occupational therapist, and a local researcher who was trained by the lead researcher over two days in administration of the computer-based Cambridge Neuropsychological Test Automated Battery (CANTAB). For the vision, hearing and musculoskeletal assessments, in cases where there was doubt about the result, assessments were undertaken by other clinicians on the team, results were compared and clinicians arrived at consensus on the result.

Table 2 - Reference standard (clinical) tests summary

Impairment	Test used	Assessor	Case definitions
Vision (see Paper 2 in section 6.2)	Visual acuity using torchlight examination, Snellen chart, pinhole testing and refraction using a Topcon autorefractor	Experienced vision technicians	Presenting visual acuity in the better eye: <6/18 and ≥6/60 (moderate), <6/60 and ≥3/60 (severe) and <3/60 (blind) (214)
Hearing (see Paper 2 in section 6.2)	Otoscope and air conduction audiometer; pure-tone audiometry values for four frequencies in each ear (0.5, 1, 2 and 4 kHz) were averaged	Experienced hearing technicians	Threshold level of the better ear: 41–60 dBA (moderate), 61–80 dBA (severe) and ≥81dBA (profound)*
Musculoskeletal (see Paper 2 in section 6.2)	Rapid Assessment of Musculoskeletal Impairment (RAMI) (215)	Physiotherapists	RAMI categories of "severe", "moderate" and "mild" effect on the musculoskeletal system's ability to function as a whole
Speech (see Paper 3 in section 6.3)	Intelligibility in Context Scale (ICS) (216) administered to parents	Trained interviewer	ICS scores: 1.8 < 2.5 (moderate) and 1.0 < 1.8 (severe)
Cognitive (see section 6.4)	Cambridge Neuropsychological Test Automated Battery (CANTAB) (217), sub-tests: Motor screening (MOT), Paired Associates Learning (PAL), Spatial Working Memory (SWM), Stockings of Cambridge (SOC) and Reaction Time (RTI).	Trained administrator	CANTAB Overall Impairment Scores of 3 (moderate) and 4-5 (severe)
* Greater than 30 or 31dBA is commonly used as a criterion for hearing impairment in children (218, 219), however >40 dBA was used in this study to identify children with clinically relevant hearing impairment due to the ambient noise levels in the assessment rooms in the schools. This is consistent with the extensive prior experience of the hearing assessors in Fiji and with other studies in LMICs (220, 221).			

5.3.5 Implementation of the index test and reference standard tests

Data were collected through assessment camps over two to five days at each school in rooms set up with multiple assessment stations. Parents/caregivers were invited to attend the screening camp where a trained interviewer administered the CFM in a separate room from the reference standard assessments. The CFM was administered using either the Fijian, Fijian-Hindi or English version depending on parent preference. It was self-completed by teachers either during the camp or within the following week. The clinical team were blinded to the CFM results and teachers and parents were blinded to each other's CFM responses and to clinical results.

5.3.6 Using impairment-based tests as the reference standards

An important aspect of the study design is the decision to use impairment-based assessments as the reference standards to identify disability cases and controls. The CFM measures activity limitations and participation restrictions, therefore it is reasonable to question whether impairment-based reference standards should be used to assess sensitivity and specificity of the CFM in identifying children with disabilities. There are several reasons for this decision.

Fiji's latest Policy on Special and Inclusive Education (21) defines disability using the social model (see section 1.1), highlighting disability as resulting from the interaction between the impairment and environmental barriers. However the previous version of the policy (100) which was in place at the time of this study, identified children with disabilities as those who are diagnosed and medically proven to have impairments. Given the policy context, the existing approach to identifying students with disabilities through impairment-based categories in the EMIS (see section 2.5), and the prevailing understanding in Pacific Ministries of Education of disability as being synonymous with impairment (105), the study design used objective assessments of impairment as the reference standards. For the Ministry to consider the properties of a tool (the CFM) that may provide a valid and reliable approach to identifying disability that does not rely on clinical assessments, the known construct of impairments was an important standard against which to assess the CFM.

The ICF classifies functioning and disability associated with health conditions, and the conceptual model implies the link from impairments to activity limitations and participation restrictions by the arrows between components (30) (see Figure 1, section 1.1). Whilst Mitra interprets the ICF to theorise that disability has its genesis in a health condition that gives rise to impairments and then to activity limitations and then to participation restrictions within the context of environmental factors (222), the WHO maintains that the ICF does not imply a linear direction between elements; it "takes a neutral stand with regard to etiology (of disability) so that researchers can draw causal inferences using appropriate scientific methods" (34)(p4). In the case of this research, the differences between impairment and activity limitations and participation restrictions are acknowledged and it is noted that the index test and reference standard tests are inherently picking up different components of disability as outlined in the ICF. Furthermore, using impairment-based tests as the "gold standards" could imply that impairment-based measurement is the "true" measure of disability. This indisputable limitation of the study was borne because of the issues outlined in the previous paragraph, as well as the practical need for validated, objective and replicable approaches for the reference standards to ensure consistency throughout data collection.

5.3.7 Learning and support needs

The study also included a nested cross-sectional survey. This was self-administered by teachers at the same time as they completed the CFM on each student participant. The survey included questions on environmental factors related to learning and support needs, including personal assistance, adaptations to learning or assessment and assistive devices. A detailed description of the questions in this survey is in section 6.7 and can be seen in Appendix 2. Pictures of assistive devices that were available for reference during data collection are in Appendix 5.

5.4 Data analysis

The software program IBM SPSS Version 24 (Armonk, NY) was used for data entry and statistical analysis and MedCalc v.17.6 (Ostend, Belgium) was used for additional data analysis (as specified in the results chapters). Descriptive statistics were calculated for participant demographics and CFM results were cross-tabulated by reference standard results. Sensitivity, specificity and likelihood ratios (LR) were calculated for each respondent type for each cut-off level. Sensitivity (Sn) is the proportion of positives which are correctly identified as such; Sn was calculated as the proportion of true positives identified on the CFM over the total number of cases (as per case definitions in section 5.3.4). Specificity (Sp) is the proportion of negatives which are correctly identified as such; Sp was calculated as the proportion of true negatives identified on the CFM over total controls.

Positive (and negative) LRs indicate how many times more likely a positive (or negative) test result is obtained when the target condition is present than when it is absent. Likelihood ratios were calculated not predictive values because likelihood ratios are independent of target condition prevalence (223).

Receiver operating characteristic (ROC) curves were constructed separately for parent and teacher CFM-7 responses to determine the area under the ROC curve (AUC). ROC curves are constructed by plotting the false-positive rate (1 – specificity) against the true-positive rate (sensitivity) at each cut-off value defined by the test (the CFM) and then drawing a line from x=0, y=0 through the values at each cut-off point; the AUC is an overall figure of diagnostic accuracy with a perfect test having a value of 1.0 and a value of 0.5 suggesting that the test result is no better than chance (209, 224). AUC interpretations were classified as excellent (0.96–1.0), very good (0.9<0.96), good (0.8<0.9), fair (0.7<0.8), poor (0.6<0.7), and useless (0.5<0.6) (209). ROC curves used dichotomous clinical variables, differentiating cases and controls based on definitions outlined earlier.

The Youden Index was calculated for each ROC curve to determine the optimal cut-off level for each disability domain and respondent type. The Youden Index is the maximum vertical distance between the ROC curve and the line of random chance ([x=0,y=0] to [x=1,y=1]) and is calculated as maximum (Sn + Sp – 1). That is, the cut-off point at which (sensitivity + specificity -1) is maximal, is taken to be the optimal cut-off point (225). Throughout the thesis, results related to parents as proxy respondents are denoted by a subscript P and those by teachers by a subscript T.

Inter-rater reliability (IRR) between parents and teachers was tested using a two-way random, absolute, average-measures intra-class correlation (ICC) (226). IRR interpretations were classified as: poor (<0.40), fair (0.40-0.59), good (0.60-0.74), and excellent (0.75-1.00) (227). Spearman's rho correlation coefficient was used to test correlations between CFM items as well as between age, gender, school type and CFM items, with the criteria: very high (0.90–1.00), high (0.70<0.90), moderate (0.50<0.70), low (0.30<0.50) and negligible (0.00<0.30) (228). CFM results were cross-tabulated to measure co-occurrence of domains of difficulty at the levels "some difficulty" and ≥ "a lot of difficulty".

For the nested cross-sectional survey, frequencies were used to analyse relationships between assistive technology, adaptations and assistance required and: (i) five impairments (vision, hearing, musculoskeletal, speech and cognitive), including children with only single impairment as well as any/multiple impairments; and (ii) difficulties in the functional domains not covered by the five clinical assessments (behaviour, socialisation, anxiety and depression). Spearman's Rho correlation coefficient was used to test correlation between level of assistance needed and impairment severity and level of functional difficulty. Correlation coefficients were classified as very high (0.90–1.00), high (0.70<0.90), moderate (0.50<0.70), low (0.30<0.50) and negligible (0.00<0.30) (228). Level of assistance was cross-tabulated with impairment severity and level of functional difficulty.

Where further analyses were undertaken, these are detailed in the Methods section of respective chapters.

5.5 Ethics

Ethics approvals were obtained from the University of Melbourne's Human Research Ethics Committee [#1543942] and the Fiji MoE's ethics committee [RA09/15] (see Appendix 3 for letters of approval). The steps taken to ensure the research was undertaken ethically include:

1) A plain language statement and informed consent form (Appendix 4) was provided to all participants in Fijian, Fijian-Hindi or English as appropriate. In addition, the content was provided in accessible formats such as sign language, verbally or through large print text. All subjects provided written consent. A significant component of the training for the local research teams included information about informed consent requirements for the research activities. The PhD candidate was present at the schools for data collection and closely monitored the consent process in the field.
2) Children's assent was obtained prior to each clinical assessment and where this was not clearly given (as happened with eight children with significant cognitive impairments) the assessment was not undertaken.

3) Participation in the research was voluntary and participants were clearly informed that they were free to withdraw themselves (or their child) from the study during data collection, without negatively affecting their access to, or the quality of education and support received at, school. Participants were assured that names and other identifying details would not appear in any reports, papers or other forms of dissemination of the study.
4) At the request of the Schools Health Program, the study provided vision and hearing screening to all enrolled students at all 15 schools participating in the study. Children with conditions that needed treatment were treated on the spot where possible (for example removal of impacted wax or foreign bodies from ears) or referred for follow up treatment or services; many children identified with trachoma were treated by local medical services immediately.
5) The data were stored in the PhD candidate's locked hotel rooms each night during data collection and were stored in a locked cabinet at the AQEP offices at the earliest opportunities throughout the data collection period. In Australia data were stored in locked cabinets. The PhD candidate collated and de-identified all data, replacing identifiable details with a code. A research assistant contracted to undertake data entry had access to the paper files and the SPSS file over two weeks; this was undertaken in the PhD candidate's office and data were kept onsite. Access to computer files was by password only.

6. Results

6.1 Sample characteristics

The sample included 472 children with mean±SD age of 10.2±2.6 years (range: 5 to 15) in Classes 1 to 8, including approximately half from special and half from mainstream schools. Ninety-eight teachers participated. There were 231 cases in the study and 241 controls. Cases included 35 children with vision impairment ranging from moderate to total blindness, 60 children with hearing impairment from moderate to profound deafness, 42 children with mobility impairments from mild to severe, 71 children with moderate to severe speech impairment, and 125 children with moderate to severe cognitive impairment. 62.8% of the cases were male; 76.2% of cases were from special schools, contrasted with 76.8% of controls from mainstream schools. Controls were located reasonably evenly across urban, peri-urban, rural and remote; whereas 75.8% of cases were in urban or peri-urban areas. As seen in Table 3, total sample sizes varied across impairment domains. This relates to student absences during different clinical testing sessions over the several days of assessment camps at each school.

Table 2 - Demographic characteristics of the study sample

n=472, unless otherwise stated		Cases		Controls	
		n	%	n	%
		231	48.9	241	51.1
Gender	Male	145	62.8	118	49.0
	Female	86	37.2	123	51.0
Age	5-7	43	18.6	52	21.6
	8-9	52	22.5	53	22.0
	10-11	42	18.2	59	24.5
	12-13	51	22.1	57	23.7
	14-15	43	18.6	20	8.3
Ethnicity	i-Taukei (Fijian)	141	61.0	159	66.0
	Indo-Fijian	75	32.5	78	32.4
	Other	15	6.5	4	1.7
Type of school	Special	176	76.2	56	23.2
	Mainstream primary	55	23.8	185	76.8
Parent/guardian respondent	Mother	130	56.3	144	59.8
	Father	44	19.0	61	25.3
*Other: grandparent, aunty, uncle, guardian	Other*	57	24.7	36	14.9
Highest level of education of parent	Primary	57	25.4	52	22.3
	Secondary	125	55.8	146	62.7
	Higher education	42	18.8	35	15.0
Area of Residence	Urban	63	27.3	44	18.3
	Peri-urban	112	48.5	68	28.2
	Rural	45	19.5	79	32.8
	Remote	11	4.8	50	20.7

Table 3 - Clinical characteristics of the study sample

n=472, unless otherwise stated	Cases highlighted in grey	n	%
Vision impairment (n=416)	None (≥6/9 ¥)	376	90.4
	Mild (6/18≤6/12 ¥)	5	1.2
	Moderate (6/36≤6/24 ¥)	11	2.6
	Severe (4/60≤3/36 ¥)	2	0.5
	Blind (NPL≤CF2m ¥)	22	5.3
Hearing impairment (n=381)	None (<26dBA)	298	78.2
	Mild (26-40dBA)	23	6.0
	Moderate (41-60dBA)	24	6.3

	Severe (61-80dBA)	8	2.1
	Profound (≥81dBA)	28	7.3
Musculoskeletal impairment (n=435)^	None	393	90.3
	Mild (5–24%)	9	2.1
	Moderate (25–49%)	14	3.2
	Severe (50–90%)	19	4.4
Speech impairment (n=462)	None (4.0-5.0 ICS score)	257	55.6
	Inconclusive speech function (2.5<4.0 ICS score)	134	29.0
	Moderate (1.8<2.5 ICS score)	21	4.5
	Severe (1.0<1.8 ICS score)	50	10.8
Cognitive impairment (n=225)	Average/better cognitive function	25	11.1
	Low average cognitive function	75	33.3
	Moderate impairment (Overall Impairment Score 3)	47	20.9
	Severe impairment (Overall Impairment Score 4 or 5)	78	34.7

¥ Visual Acuity of better eye; NPL – no perception of light; CF2m – counting fingers at 2metres.

^Severity for the Rapid Assessment of Musculoskeletal Impairment was determined using the parameters for the percentage of function outlined in the ICF. Percentage loss of the musculoskeletal systems ability to function as a whole. Participants categorised as 'mild' were included as cases based on detailed consideration of each assessment; diagnoses in the mild category included: club foot, head injury, epilepsy, limb pain limiting function, developmental delay, knock knees, and 'other neurological'. 5 of the 9 mild cases had a 2nd diagnosis.

6.2 *Paper Two: Seeing, hearing and walking results*

This section presents the results from the domains of seeing, hearing and walking, in relation to objective one – the diagnostic accuracy and optimal cut-off levels of the CFM, using standardised assessments of vision, hearing and musculoskeletal impairment as the reference standards; and objective two – the inter-rater reliability between teacher and parent CFM responses in these domains.

The results are presented here in the form of a peer reviewed journal article published in Disability and Rehabilitation (200).

> Sprunt B, Hoq M, Sharma U, Marella M. Validating the UNICEF/Washington Group Child Functioning Module for Fijian schools to identify seeing, hearing and walking difficulties. Disability and rehabilitation [Internet]. 2017 26 December 2018; Published online: [1-11 pp.]. Available from: http://dx.doi.org/10.1080/09638288.2017.1378929.

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ORIGINAL ARTICLE

Validating the UNICEF/Washington Group Child Functioning Module for Fijian schools to identify seeing, hearing and walking difficulties

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ABSTRACT

Purpose: This study investigated the seeing, hearing and walking questions of the *UNICEF/Washington Group Child Functioning Module* and the inter-rater reliability between teachers and parents as proxy respondents.

Methods: Cross-sectional diagnostic accuracy study, two-gate design with representative sampling, comparing Module responses to reference standard assessments for 472 primary aged students in Fiji. Receiver operating characteristic curves were constructed to determine the area under the curve and optimal cut-off points.

Results: Areas under the curves ranged from 0.823 to 0.889 indicating "good" diagnostic accuracy. Inter-rater reliability between parent and teacher responses was "good" to "excellent". The optimal cut-off determined by the Youden Index was "some difficulty" however a wide spread of impairment levels were found in this category with most children either having none or substantial impairments.

Conclusions: The diagnostic accuracy of the Module seeing, hearing and walking questions appears acceptable with either parents or teachers as proxy respondents. For education systems, use of the cut-off "some difficulty" with accompanying clinical assessment may be important to capture children who require services and learning supports and avoid potentially misleading categorization. Given the high proportion of the sample from special schools research is required to further test the Module in mainstream schools.

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KEYWORDS
Child disability; disability disaggregation; inclusive education

➤ IMPLICATIONS FOR REHABILITATION

- Identification of children who are at risk of disability in Fiji is important to enable planning, monitoring and evaluating access to quality inclusive education.
- The UNICEF/Washington Group Child Functioning Module appears to be a practical and effective tool that can be used by teachers to identify children at risk of disability.
- Children identified on the UNICEF/Washington Group Child Functioning Module as having "some difficulty" or higher levels of difficulty in relation to vision, hearing or walking should be referred for further assessment and services.
- Rehabilitation services in Fiji need to prepare for greater numbers of referrals as the Ministry of Education increasingly rolls out the inclusive education policy, which includes identification by schools of children at risk of disability.

Introduction

Education indicators within the Sustainable Development Goals rely on disability-disaggregated education management information systems for data [1,2]. Education management information systems are important not only for the Sustainable Development Goals, but for measuring national and regional education progress [3,4]. Education management information systems collect and integrate school and student information and are used to manage the education system in a number of ways, for example: to count numbers of students in educational settings, to calculate student teacher ratios, and to report on completion and achievement rates of girls versus boys. In order to determine how students with disabilities are faring in comparison to students without disability, education management information systems must be disaggregated by disability.

Provision of an inclusive, quality, and free primary and secondary education to people with disabilities, as outlined in the UN *Convention on the Rights of Persons with Disabilities*, has been endorsed by Pacific Ministers responsible for disability [5] and education [6] and is wholly embraced within the Sustainable Development Goals [7]. In October 2011, Pacific Directors of Education agreed to work towards a regional education management information system that would include significant questions and data for children with disabilities [8]. This was endorsed by Pacific Islands Forum Education Ministers in May 2012 [9]. The indicator guidelines for the Pacific Education Development Framework includes multiple requirements for disability disaggregation [10]. However, collecting data that provides the basis for disability disaggregation requires a valid and reliable means of determining disability in children.

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There is consensus that the UNICEF/Washington Group *Child Functioning Module* should be the key tool globally for disaggregating the Sustainable Development Goal indicators relevant to children [11]. Given that the Module has been developed and validated with parents/primary caregivers as the proxy-respondents [12], and that education management information systems are largely completed by schools, it is critical that the Module is validated for use by teachers. Research into the validity of the Module with teachers as the proxy respondents has not yet been undertaken.

Development and intended use of the UNICEF/Washington Group Child Functioning Module

The wide range of definitions, methodologies and measurement tools used to identify disability has resulted in a lack of reliable estimates of children with disabilities [13–15]. To address this UNICEF and the Washington Group on Disability Statistics developed the Child Functioning Module [12,16–18]. This has the International Classification of Functioning, Disability and Health for Children and Youth [19] as its basis and includes 24 questions which cover seeing, hearing, mobilizing, self-care, speaking, learning, remembering and concentrating, behaviour, socialization and mood [18]. Scoring essentially uses a Likert scale of severity including "no difficulty", "some difficulty", "a lot of difficulty" and "cannot do at all". Children are considered at risk of disability if the response was "a lot of difficulty" or "cannot do at all" to any item. The Module has two age group versions (2–4 and 5–17 years); the 5–17 year old Module was used for this study to match the primary school age.

Substantial cognitive testing of the Module has been undertaken [17,20] along with field testing in various countries [12,16,21,22]. A South African pilot study with a population of 2–4 year-olds [23], the only published diagnostic accuracy study of the Module, showed its sensitivity as 0.60 (95% CI: 0.15, 0.95) and specificity as 0.84 (95% CI: 0.71, 0.94). Unfortunately, the sample of children with disabilities was very small ($n = 5$) which is a major limitation in a diagnostic accuracy study. Mactaggart et al. [16,22] using the 2014 draft of the Module compared its responses to clinical tests for vision, hearing, musculoskeletal impairment, depression and history of epilepsy in Cameroon and India. Results indicated that the cut-off level "a lot of difficulty" misses a large proportion of children with disabilities. It was recommended that children identified having "some difficulty" should receive subsequent clinical assessment in the same domain of functioning to identify a higher proportion of children with disabilities.

There are a number of reasons why the Module was considered a candidate for identification of disability within the Fiji education management information system. Current approaches to identifying children with disabilities in the school system in Fiji are relatively *ad hoc* and standardized clinical assessments are rarely used [3]. The Module is relatively short, can be administered without medical expertise, enables categorization by severity of functional difficulty and would enable comparison of education management information system data with national and international statistical data. However, it is designed to be interviewer administered with the child's parent or primary caregiver. In the context of an education system, in which teachers are frequently responsible for the data that is recorded in the education management information system, it makes sense for teachers to be able to identify children at risk of disability in their schools. The question for the Fiji Ministry of Education is whether the Module is effective when used by teachers to identify children at risk of disability in Fijian schools.

Study objectives

This paper reports findings from within a broader study that examined the entire Child Functioning Module. The study objectives addressed in this paper were:

1. To determine the diagnostic accuracy and optimal cut-off scores of the Module for predicting the presence of vision, hearing and mobility impairments in primary school aged Fijian children.
2. To determine the inter-rater reliability between teachers and parents in Fiji for identifying primary school children with vision, hearing and mobility impairments using the Module.

Methods

Study design and sampling

A cross-sectional diagnostic accuracy study, two-gate design with representative sampling [24] was undertaken from March to July 2015 in Fiji. Ethics approvals were obtained from the University of Melbourne's Human Research Ethics Committee and the Fiji Ministry of Education's Ethics Committee and all subjects had written consent. In addition, children's assent was obtained prior to each clinical assessment. Sampling was purposive regarding school selection and student participation. Participants for the study were recruited from 10 special schools and five inclusive education (mainstream) schools from the four administrative divisions in Fiji. Children aged 5–15 years invited to participate included: all children in the special schools and all children in the mainstream schools previously identified by the school to have disabilities, as well as selected controls matched by age, sex, ethnicity and location (Figure 1). Representative sampling focused on including cases with mild/moderate through to profound impairment to mitigate the risk of "spectrum effect", whereby a sampling bias towards including only cases with more significant impairment can lead to higher estimates of sensitivity and specificity [24]. Case definitions are described in the section "Reference standard tests".

Sample size was estimated based on minimum number to achieve a sensitivity or specificity of 0.85 (prevalence 0.10, alpha 5%, 1-beta 80%; CI 95%, lower confidence limit 0.65) [25]. At least 52 cases and 52 controls were required under each impairment domain. Complete data sets (reference standard tests plus teacher and parent index test data) were available for a total sample of 472 children, which is the sample used in this paper.

Test methods

Index test – Child Functioning Module

This study used a draft of the Module (5–17 years age group) current at February 2015, with permission from UNICEF and the Washington Group. The final version of the Module is available from www.washingtongroup-disability.com. The Module includes questions to establish whether the child wears glasses, uses a hearing aid, or uses any equipment or receives assistance for walking. If the child does use the assistive device, the question for seeing is "when wearing his/her glasses, does *(name)* having difficulty seeing?". Similar questions are asked for hearing and walking. The Module has separate questions for difficulty walking with and without equipment for children who need equipment. Only data on difficulty walking without their equipment was used in this analysis to allow for comparison with the musculoskeletal assessment, which scores musculoskeletal function without equipment (described below).

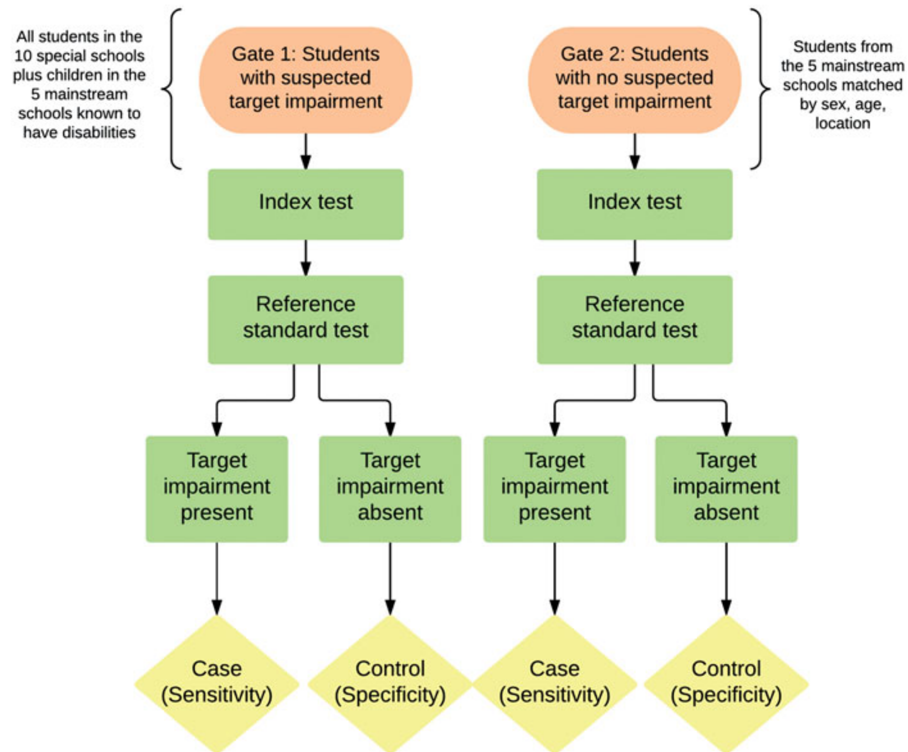

Figure 1. Flowchart of participation.

The Module was translated from English to Fijian and Fijian-Hindi by two separate bilingual speakers for each language, and back-translated. It was then pretested as per the guidelines of the Washington Group [26] using cognitive interviews with 10 teachers and 10 parents of children with disability. Teachers and many other people in Fiji speak English fluently and during cognitive testing it became clear that the English version of the Module would be the preferred version for teachers and in many cases for parents.

Reference standard tests

The clinical team consisted of trained vision and hearing technicians and physiotherapists. *Vision assessment* was performed with torchlight examination, visual acuity with Snellen chart, pinhole testing and refraction using a Topcon autorefractor. Children with presenting visual acuity <6/18 in the better eye were identified as cases with vision impairment [27].

Hearing assessment was performed by observation with otoscope and air conduction audiometer. The pure-tone audiometry values for four frequencies in each ear, including 0.5, 1, 2 and 4 kHz, were averaged and the threshold level of the better ear was used to determine cut-off for cases. The following levels of hearing loss were included as cases: 41–60 dBA (moderate), 61–80 dBA (severe) and ≥81dBA (profound). Greater than 30 or 31dBA is commonly used as a criterion for hearing impairment in children [28,29], however >40 dBA was used in this study to identify children with clinically relevant hearing impairment due to the ambient noise levels in the assessment rooms in the schools. This is consistent with the extensive prior experience of the hearing assessors in Fiji and with other studies in developing countries [30,31]. Children found to have impacted wax or foreign bodies in the ear had this removed and were tested for hearing after removal.

Musculoskeletal assessment was undertaken using the Rapid Assessment of Musculoskeletal Impairment [32]. Through consultations with the Ministry of Health senior physiotherapist, it was established that there is no standard assessment used or validated for children of this age group for Fiji. Based on a literature review of assessment tools, the Rapid Assessment of Musculoskeletal Impairment was deemed to be the best available method for establishing presence or absence of mobility impairments in this study setting [33]. The Rapid Assessment of Musculoskeletal Impairment includes an initial set of five questions, such as, "Do you have any difficulty using your legs?", with corresponding questions about duration indicating that it has lasted more than one month or is permanent. This is followed by observation of a series of gross and fine motor activities. In children where one or more of the five questions was answered positively, and one or more of the duration questions was "Yes", and one or more of the observations indicated difficulty with the activities, children were assessed further for the extent of the effect on the musculoskeletal system. The Rapid Assessment of Musculoskeletal Impairment does not consider functioning with equipment. Children identified on the Rapid Assessment of Musculoskeletal Impairment to have impairment only affecting the upper limb were excluded for this analysis on walking difficulty. Children with structure impairment including "severe", "moderate" and "mild" effect on the musculoskeletal system's ability to function as a whole were identified as cases with mobility impairment [32].

Implementation of the index test and reference standard tests

Data were collected through assessment camps over two to five days at each school in rooms set up with multiple assessment stations. Parents/caregivers were invited to attend the screening camp where a trained interviewer administered the Module in a location separate from the reference standard assessments. The Module was administered using either the Fijian, Fijian-Hindi or English version depending on parent preference. It was self-completed by teachers either during the camp or within the following week. The clinical team were blinded to the Module results and teachers and parents were blinded to each other's Module responses and to clinical results. At the request of the schools' health program, the study provided vision and hearing screening to all enrolled students. Children with conditions that needed treatment were referred and many children identified with trachoma were treated by local medical services immediately.

Data analysis

IBM SPSS Version 24 (Armonk, NY) and MedCalc v.17.6 (Ostend, Belgium) were used for statistical analysis. Descriptive statistics were calculated for participant demographics and Module results were cross-tabulated by reference standard results. Receiver operating characteristic curves were constructed separately for parent and teacher Module responses to determine the area under the receiver operating characteristic curve (AUC), which is an overall figure of diagnostic accuracy combining sensitivity and specificity. AUC interpretations were classified as excellent (0.96–1.0), very good (0.9 < 0.96), good (0.8 < 0.9), fair (0.7 < 0.8), poor (0.6 < 0.7) and useless (0.5 < 0.6) [34]. Receiver operating characteristic curves used dichotomous clinical variables, differentiating cases and controls based on definitions outlined earlier.

Sensitivity, specificity and likelihood ratios were calculated for each respondent type for each cut-off level. Sensitivity was calculated as the proportion of children identified on the Module as having difficulty over the total number of cases. Specificity was calculated as the proportion of children identified on the Module as not having difficulty over the total number of controls. Likelihood ratios indicate how many times more (or less) likely a test result of a given level is obtained when the target condition is present than when it is absent. Likelihood ratios were calculated not predictive values because likelihood ratios are independent of target condition prevalence [35]. The Youden index was calculated for each receiver operating characteristic curve and the highest value was used to determine optimal cut-off points for each disability domain and respondent type.

Inter-rater reliability between parents and teachers was tested using a two-way random, absolute, average-measures intra-class correlation [36]. The following criteria were used for the intra-class correlation interpretation: inter-rater reliability being "poor" for values less than 0.40, "fair" for values between 0.40 and 0.59, "good" for values between 0.60 and 0.74, and "excellent" for values between 0.75 and 1.00 [37].

Table 1. Demographic and clinical characteristics of the study sample.

n = 472, unless otherwise stated	n	%
Gender		
Male	263	55.7
Female	209	44.3
Age		
5–7	95	20.1
8–9	105	22.3
10–11	101	21.4
12–13	108	22.9
14–15	63	13.3
Ethnicity		
i-Taukei (Fijian)	300	63.6
Indo-Fijian	153	32.4
Other	19	4.0
Type of school		
Special	232	49.2
Mainstream primary	240	50.8
Parent/guardian respondent		
*Other: grandparent, aunty, uncle, guardian		
Mother	274	58.1
Father	105	22.2
Other*	93	19.7
Highest level of education of parent (n = 457)		
Primary	109	23.9
Secondary	271	59.3
Higher education	77	16.8
Area of residence		
Urban	107	22.7
Peri-urban	180	38.1
Rural	124	26.3
Remote	61	12.9
Vision impairment (n = 416)		
None (≥6/9a)	376	90.4
Mild (6/18 ≤ 6/12a)	5	1.2
Moderate (6/36 ≤ 6/24[a])	11	2.6
Severe (4/60 ≤ 3/36[a])	2	0.5
Blind (NPL ≤ CF2 m[a])	22	5.3
Hearing impairment (n = 381)		
None (<26 dBA)	298	78.2
Mild (26–40 dBA)	23	6.0
Moderate (41–60 dBA)	24	6.3
Severe (61–80 dBA)	8	2.1
Profound (≥81 dBA)	28	7.3
Musculoskeletal impairment (n = 435)[b]		
None	393	90.3
Mild (5–24%)	9	2.1
Moderate (25–49%)	14	3.2
Severe (50–90%)	19	4.4

Cases highlighted in grey.
[a]Visual acuity of better eye; NPL – no perception of light; CF2m – counting fingers at 2 m.
[b]Severity for the Rapid Assessment of Musculoskeletal Impairment was determined using the parameters for the percentage of function outlined in the International Classification of Functioning, Disability and Health (ICF). Percentage loss of the musculoskeletal systems ability to function as a whole. Participants categorized as "mild" were included as cases based on detailed consideration of each assessment; diagnoses in the mild category included: club foot, head injury, epilepsy, limb pain limiting function, developmental delay, knock knees and "other neurological". About 5 of the 9 mild cases had a second diagnosis.

Results

Participant demographics, distribution of impairments and comorbid conditions

Table 1 outlines participant demographics and clinical characteristics. The sample included 472 children with mean ± SD age of 10.2 ± 2.6 years (5–15) in classes 1–8, including approximately half from special and half from mainstream schools. Ninety-eight teachers participated. Cases included 35 children with vision impairment ranging from moderate to total blindness, 60 with hearing impairment from moderate to profound deafness and 42 with mobility impairments from mild to severe.

Comorbid conditions can challenge diagnostic accuracy studies as they may interfere with test performance, creating false-positives or false-negatives, however the inclusion of participants with comorbid conditions is important to increase generalisability to populations for whom the index test (Module) may be used [24]. The sample included the following comorbid conditions: one child with profound hearing impairment had moderate vision impairment; one child with severe hearing impairment was blind; two children with severe-profound hearing impairment had moderate mobility impairment. No children with vision impairment had mobility impairment nor vice versa. Three children with moderate vision impairment, 39 children with moderate-profound hearing impairment, and seven children with moderate-severe mobility impairment had speech impairments. Of the 85 children with difficulty learning rated "a lot of difficulty" or "cannot do at all", three had moderate vision impairment, three were blind, three had moderate hearing impairment, six had severe-profound hearing impairment, five had moderate mobility impairment and eight had severe mobility impairment. Of the 25 children with "a lot more difficulty" than other children controlling their behaviour, two were blind, one had moderate hearing impairment, two had profound hearing impairment and one had moderate mobility impairment. For a further eight children with significant intellectual impairments, we were either unable to undertake accurate assessments or we felt they did not indicate their assent for the assessment. This meant hearing tests for eight children and vision tests for four children had to be excluded. Assessment of conditions such as asthma and heart conditions which may act as confounders could not be undertaken.

Cross-tabulation of the index test results by the reference standard results

Table 2 presents the spread of Module responses across the reference standard results for vision, hearing and mobility impairment.

Seeing

For children with significant vision impairment, teacher responses on the Module were more accurate than parent responses. Of the children identified as having "a lot of difficulty" or "cannot do at all" by parents and teachers respectively, 56% and 77% had vision impairment (i.e. visual acuity <6/18). Of children rated as having "some difficulty" by parents/teachers respectively, 37%/27% had vision impairment and 57%/68% had no vision impairment. Of the 22 blind children, 82%/39% were rated by parents/teachers respectively as having just "some difficulty".

Hearing

Both parent and teacher responses on the Module showed some inconsistency with clinical assessments, with "some difficulty" being used to classify a high number of children with severe-profound hearing impairment. Of the children categorized as having "a lot of difficulty" or "cannot do at all" for hearing by parents/teachers respectively, 76/93% had moderate-profound hearing impairment, 3/3% had mild hearing impairment and 22/3% had no hearing impairment. Of the children categorized as having "some difficulty" hearing by parents/teachers respectively, 49/41% had no hearing impairment, 9/5% had mild hearing impairment, 19/18% had moderate hearing impairment, and 23/32% had severe-profound hearing impairment. Of the children with severe-profound hearing impairment, parents/teachers rated 56%/70% respectively as having "a lot of difficulty" or "cannot do at all".

Walking

Walking responses were more consistent than seeing and hearing and comorbid conditions appear to account for some of the false positives that were not picked up by the Rapid Assessment of Musculoskeletal Impairment. Both parents and teachers accurately reported approximately 90% of children with no mobility impairment as having "no difficulty" walking. Of the children with severe mobility impairment, the majority of parent and teacher responses were "a lot of difficulty" or "cannot do at all". Children recorded as having "some difficulty" walking generally had either none to moderate mobility impairment. Of the 12 children with no mobility impairment but who had "a lot of difficulty" or "cannot do at all" for walking, one was blind, one had moderate vision impairment and one had mild vision impairment. In addition, for 10 of the 12, the difficulty was in walking 500 m not 100 m, which could indicate that these children had difficulties related to asthma, heart conditions or fitness, which were not assessed by our reference assessment the Rapid Assessment of Musculoskeletal Impairment. Similarly, of the 27 children with no musculoskeletal impairment, rated "some difficulty" walking by parents, the majority had difficulty at 500 m not 100 m; for five of these children asthma, overweight and fatigue were named as reasons for the difficulty walking.

Inter-rater reliability of the Module

Inter-rater reliability between parents and teachers was assessed using intra-class correlation [36]. The intra-class correlation was "good" for seeing (0.66, 95% CI 0.58–0.72), "excellent" for hearing (0.82, 95% CI 0.78–0.85) and "excellent" for walking (0.77 95% CI 0.72–0.81) [37], indicating satisfactory consistency in the ratings between teachers and parents.

Diagnostic accuracy of the Module and optimal cut-off

Receiver operating characteristic curves were constructed to determine the area under the curve (AUC) and optimal cut-off points. AUCs ranged from 0.823 to 0.889 indicating "good" diagnostic accuracy [34] of the Module with both parents and teachers as respondents, shown in Table 3.

For parent responses, the AUC was 0.847–0.889 for all domains (seeing, hearing and walking). The Youden Index showed "some difficulty" as the optimal cut-off. At "some difficulty", sensitivity/specificity was: 0.80/0.89 (seeing), 0.78/0.88 (hearing) and 0.83/0.90 (walking). Higher cut-offs increase specificity but sensitivity is compromised considerably indicating that higher cut-offs will miss a large proportion of children with these impairments. On the other hand, the excellent specificity of the higher cut-offs indicate that they are able to correctly exclude children without impairments.

For teacher responses, the AUC ranged from 0.823 to 0.869 across the three domains with "some difficulty" the optimal cut-off based on the Youden Index. At this cut-off, sensitivity/specificity was: 0.71/0.90 (seeing), 0.72/0.95 (hearing) and 0.82/0.87 (walking). As with parent responses, higher cut-offs increase specificity to very high levels but sensitivity is excessively compromised. At the level of "a lot of difficulty" teacher responses show better sensitivity/specificity than parent responses for seeing (0.36/0.99 compared to 0.14/0.99) and hearing (0.50/0.99 compared to 0.41/0.97). However parent responses were more accurate than teachers for walking (0.60/0.97 compared to 0.49/0.98).

Positive likelihood ratios at the cut-offs "a lot of difficulty" and "cannot do at all" ranged from 10.69 to 149.7 across the domains, indicating "large and conclusive" [38] results. The smallest and most conclusive negative LRs are at the cut-off "some difficulty". A positive likelihood ratio means for example a parent response "a lot of difficulty" hearing was 16.22 times more likely in a child with hearing impairment than without hearing impairment. These results should be interpreted cautiously though because the confidence intervals for the higher cut-offs were very wide due to small sample sizes.

Figures 2–4 provides a visual representation of the receiver operating characteristic curves comparison between parent and teacher responses for seeing, hearing and walking respectively and Table 4 shows the difference between the areas under the curves between parents and teachers. The sample sizes for cases and controls are slightly lower for these comparative analyses because children for whom either parent or teacher data is missing were excluded. The difference between the AUCs of parent and teacher responses are small, not significant and the confidence intervals cross zero for all domains. This adds to the

Table 2. Cross tabulation: Child Functioning Module results by the results of the reference standard tests for vision impairment, hearing impairment and musculo-skeletal impairment.

CFM categories	Total *n* (%)		Impairment level based on reference standard assessments, *n* (%)									
			Controls				Cases					
Difficulty seeing	Parent (*n*=409)	Teacher (*n*=340)	No VI (≥6/9[a])		Mild VI (6/18 ≤ 6/12[a])		Moderate VI (6/36 ≤ 6/24[a])		Severe VI (4/60 ≤ 3/36[a])		Blind (NPL ≤ CF2m[a])	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	339 (82.9)	290 (85.3)	330 (97.3) (89.4)	280 (96.6) (91.2)	2 (0.6) (40.0)	2 (0.7) (40.0)	6 (1.8) (54.5)	4 (1.4) (50.0)	0 (0.00) (0.0)	1 (0.3) (50.0)	1 (0.3) (4.5)	3 (1.0) (16.7)
Some	61 (14.9)	37 (10.9)	35 (57.4) (9.5)	25 (67.6) (8.1)	3 (4.9) (60.0)	2 (5.4) (40.0)	4 (6.6) (36.4)	3 (8.1) (37.5)	1 (1.6) (50.0)	0 (0.0) (0.0)	18 (29.5) (81.8)	7 (18.9) (38.9)
A lot	7 (1.7)	10 (2.9)	3 (42.9) (0.8)	2 (20.0) (0.7)	0 (0.0) (0.0)	1 (10.0) (20.0)	1 (14.3) (9.1)	1 (10.0) (12.5)	1 (14.3) (50.0)	1 (10.0) (50.0)	2 (28.6) (9.1)	5 (50.0) (27.8)
Cannot do	2 (0.5)	3 (0.9)	1 (50.0) (0.3)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	1 (50.0) (4.5)	3 (100.0) (16.7)
Difficulty hearing	Parent (*n*=378)	Teacher (*n*=310)	No HI (<26 dBA)		Mild HI (26–40 dBA)h		Moderate HI (41–60 dBA)		Severe HI (61–80 dBA)		Profound HI (≥81 dBA)	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	293 (77.5)	259 (83.5)	263 (89.8) (88.9)	224 (86.5) (95.7)	17 (5.8) (73.9)	20 (7.7) (90.9)	9 (3.1) (39.1)	5 (1.9) (33.3)	3 (1.0) (37.5)	1 (0.4) (11.1)	1 (0.3) (3.6)	1 (0.4) (4.8)
Some	53 (14.0)	22 (7.1)	26 (49.1) (8.8)	9 (40.9) (3.8)	5 (9.4) (21.7)	1 (4.5) (4.5)	10 (18.9) (43.5)	4 (18.2) (26.7)	3 (5.7) (37.5)	1 (4.5) (11.1)	9 (17.0) (32.1)	6 (27.3) (28.6)
A lot	18 (4.8)	18 (5.8)	7 (38.9) (2.4)	0 (0.0) (0.0)	1 (5.6) (4.3)	1 (5.6) (4.5)	3 (16.7) (13.0)	2 (11.1) (13.3)	0 (0.0) (0.0)	5 (27.8) (55.6)	7 (38.9) (25.0)	10 (55.6) (47.6)
Cannot do	14 (3.7)	11 (3.5)	0 (0.0) (0.0)	1 (9.1) (0.4)	0 (0.0) (0.0)	0 (0.0) (0.0)	1 (7.1) (4.3)	4 (36.4) (26.7)	2 (14.3) (25.0)	2 (18.2) (22.2)	11 (78.6) (39.3)	4 (36.4) (19.0)
Difficulty walking[b]	Parent, (*n*=435)	Teacher, (*n*=368)	No MSI				Mild MSI (5–24%[c])		Moderate MSI (25–49%[c])		Severe MSI (50–90%[c])	
			Parent	Teacher			Parent	Teacher	Parent	Teacher	Parent	Teacher
No	361 (83.0)	292 (79.3)	354 (98.1) (90.1)	285 (97.6) (86.6)			5 (1.4) (55.5)	4 (1.4) (50.0)	2 (0.6) (14.3)	3 (1.0) (21.4)	0 (0.0) (0.0)	1 (0.0) (5.6)
Some	37 (8.5)	49 (13.3)	27 (73.0) (6.9)	36 (73.5) (10.9)			2 (5.4) (22.2)	4 (8.2) (50.0)	8 (21.6) (57.1)	8 (16.3) (57.1)	0 (0.0) (0.0)	1 (2.0) (5.6)
A lot	20 (4.6)	15 (4.1)	11 (55.0) (2.8)	7 (46.7) (2.1)			2 (10.0) (22.2)	0 (0.0) (0.0)	3 (15.0) (21.4)	3 (20.0) (21.4)	4 (20.0) (21.0)	5 (33.3) (27.8)
Cannot do	17 (3.9)	12 (3.3)	1 (5.9) (0.3)	1 (8.3) (0.3)			0 (0.0) (0.0)	0 (0.0) (0.0)	1 (5.9) (7.1)	0 (0.0) (0.0)	15 (88.2) (79.0)	11 (91.7) (61.1)

Reference standard assessments: VI: vision impairment; HI: hearing impairment; MSI: musculoskeletal impairment (mobility only).
[a]Visual acuity of better eye; NPL – no perception of light; CF2m – counting fingers at 2 m.
[b]Includes: difficulty walking for children who do not need equipment, plus those who require equipment but have difficulty walking without their equipment (this allows comparison with the Rapid Assessment of Musculoskeletal Impairment which tests function without equipment).
[c]Severity for the Rapid Assessment of Musculoskeletal Impairment was determined using the parameters for the percentage of function outlined in the International Classification of Functioning, Disability and Health (ICF) [42]. Percentage loss of the musculoskeletal systems ability to function as a whole.

evidence that teachers are equally effective proxy respondents for the Module in the domains of seeing, hearing and walking.

Discussion, limitations and further research

Research to ascertain the validity and reliability of disability measurement tools is critical to enable stakeholders to choose the right tool for their purpose [39]. In order to select a valid tool that would be useful to disaggregate the Fiji education management information system by disability, this study aimed to investigate the diagnostic accuracy of the recently developed UNICEF/Washington Group Child Functioning Module. This study reports findings of diagnostic accuracy and inter-rater reliability of the seeing, hearing and walking domains of the Module.

The first objective was to determine the diagnostic accuracy and optimal cut-off scores of the Module for predicting the presence of vision, hearing and mobility impairments in primary

Table 3. Diagnostic accuracy of the Child Functioning Module compared to reference standard assessments, parent versus teacher responses, at different cut-off levels.

Cut-off points	Sensitivity (Sn) (95% CI)	Specificity (Sp) (95% CI)	+LR (95% CI)	−LR (95% CI)
Seeing				
Parent	$n = 409$, cases = 35, AUC 0.848, SE[a]: 0.036, 95%CI[b] (0.809, 0.881), $p < 0.0001$, Youden index 0.688[c]			
Some difficulty[c]	0.80 (0.63, 0.92)	0.89 (0.85, 0.92)	7.12 (5.10, 9.90)	0.23 (0.10, 0.40)
A lot of difficulty	0.14 (0.04, 0.30)	0.99 (0.97, 1.00)	13.36 (3.80, 47.50)	0.87 (0.80, 1.00)
Cannot do at all	0.03 (0.00, 0.15)	1.00 (0.99, 1.00)	10.69 (0.70, 167.20)	0.97 (0.90, 1.00)
Teacher	$n = 340$, cases = 28, AUC 0.823, SE[a]: 0.046, 95%CI[b] (0.779, 0.862), $p < 0.0001$, Youden index 0.618[c]			
Some difficulty[c]	0.71 (0.51, 0.87)	0.90 (0.86, 0.93)	7.43 (4.90, 11.2)	0.32 (0.20, 0.60)
A lot of difficulty	0.36 (0.19, 0.56)	0.99 (0.97, 1.00)	37.14 (10.80, 127.20)	0.65 (0.50, 0.90)
Cannot do at all	0.11 (0.02, 0.28)	1.00 (0.99, 1.00)	–	0.89 (0.80, 1.00)
Hearing				
Parent	$n = 378$, cases = 59, AUC 0.847, SE[a]: 0.030, 95%CI[b] (0.806, 0.882), $p < 0.0001$, Youden index 0.657[c]			
Some difficulty[c]	0.78 (0.65, 0.88)	0.88 (0.84, 0.91)	6.38 (4.60, 8.80)	0.25 (0.20, 0.40)
A lot of difficulty	0.41 (0.28, 0.54)	0.97 (0.95, 0.99)	16.22 (7.70, 34.40)	0.61 (0.50, 0.80)
Cannot do at all	0.24 (0.14, 0.37)	1.00 (0.9, 1.00)	–	0.76 (0.70, 0.90)
Teacher	$n = 310$, cases = 54, AUC 0.846, SE[a]: 0.032, 95%CI[b] (0.801, 0.885), $p < 0.0001$, Youden index 0.675[c]			
Some difficulty[c]	0.72 (0.58, 0.84)	0.95 (0.92, 0.98)	15.41 (8.70, 27.40)	0.29 (0.20, 0.40)
A lot of difficulty	0.50 (0.36, 0.64)	0.99 (0.97, 1.00)	64.00 (15.7, 261.1)	0.50 (0.40, 0.70)
Cannot do at all	0.19 (0.09, 0.31)	1.00 (0.98, 1.00)	47.41 (6.20, 362.6)	0.82 (0.70, 0.90)
Walking				
Parent	$n = 435$, cases = 42, AUC 0.889, SE[a]: 0.031, 95%CI[b] (0.856, 0.917), $p < 0.0001$, Youden index 0.734[c]			
Some difficulty[c]	0.83 (0.69, 0.93)	0.90 (0.87, 0.93)	8.40 (6.10, 11.60)	0.19 (0.09, 0.40)
A lot of difficulty	0.60 (0.43, 0.74)	0.97 (0.95, 0.98)	19.49 (10.60, 35.90)	0.42 (0.30, 0.60)
Cannot do at all	0.38 (0.24, 0.54)	1.00 (0.99, 1.00)	149.71 (20.40, 1100.80)	0.62 (0.50, 0.80)
Teacher	$n = 368$, cases = 39, AUC 0.869, SE[a]: 0.034, 95%CI[b] (0.830, 0.901), $p < 0.0001$, Youden index 0.687[c]			
Some difficulty[c]	0.82 (0.67, 0.93)	0.87 (0.83, 0.90)	6.14 (4.50, 8.40)	0.21 (0.10, 0.40)
A lot of difficulty	0.49 (0.32, 0.65)	0.98 (0.95, 0.99)	20.04 (9.40, 42.70)	0.53 (0.40, 0.70)
Cannot do at all	0.28 (0.15, 0.45)	1.00 (0.98, 1.00)	92.79 (12.3, 699.60)	0.72 (0.60, 0.90)

AUC: area under receiver operating characteristic curve; CI: confidence interval; SE: standard error; Positive likelihood ratio (+LR = Sn/(1 − Sp); Negative likelihood ratio (−LR = (1 − Sn)/Sp).
[a]DeLong et al. [43].
[b]Binomial exact.
[c]Youden Index indicates the optimal cut-off point.

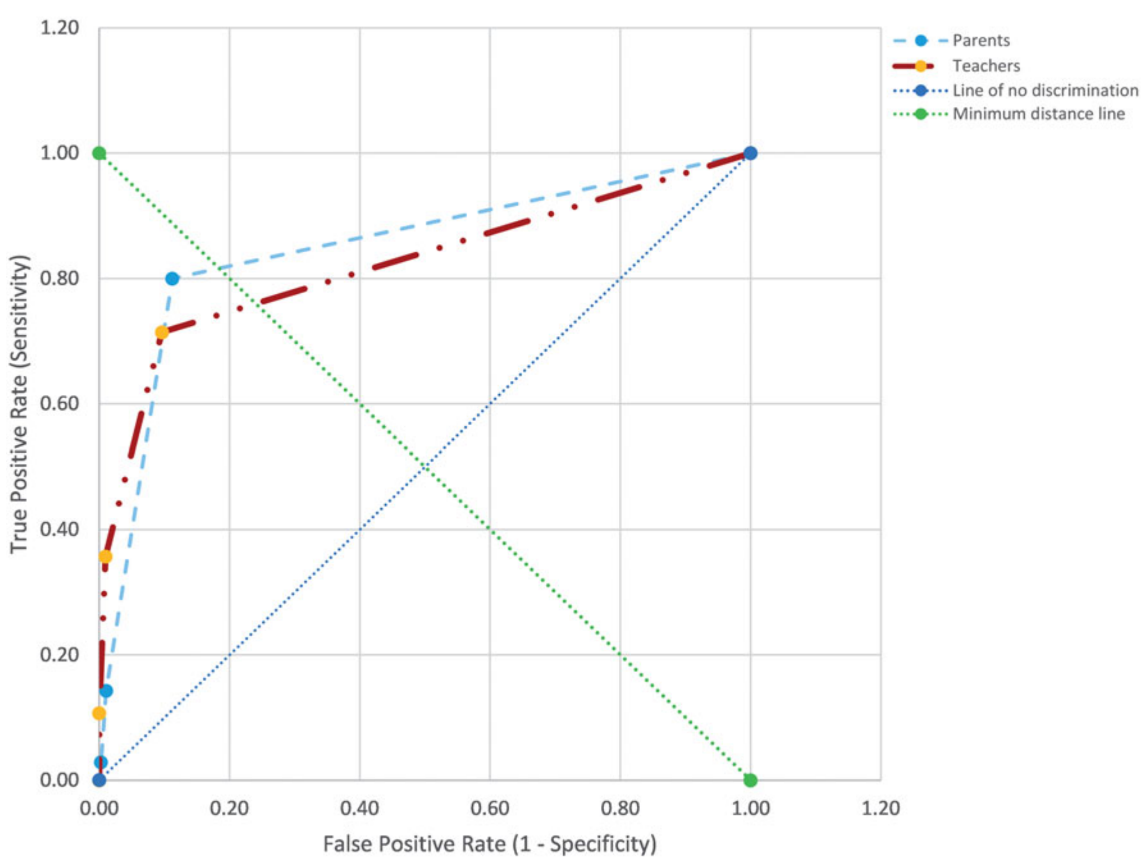

Figure 2. Receiver operating characteristic curves comparison – difficulty seeing.

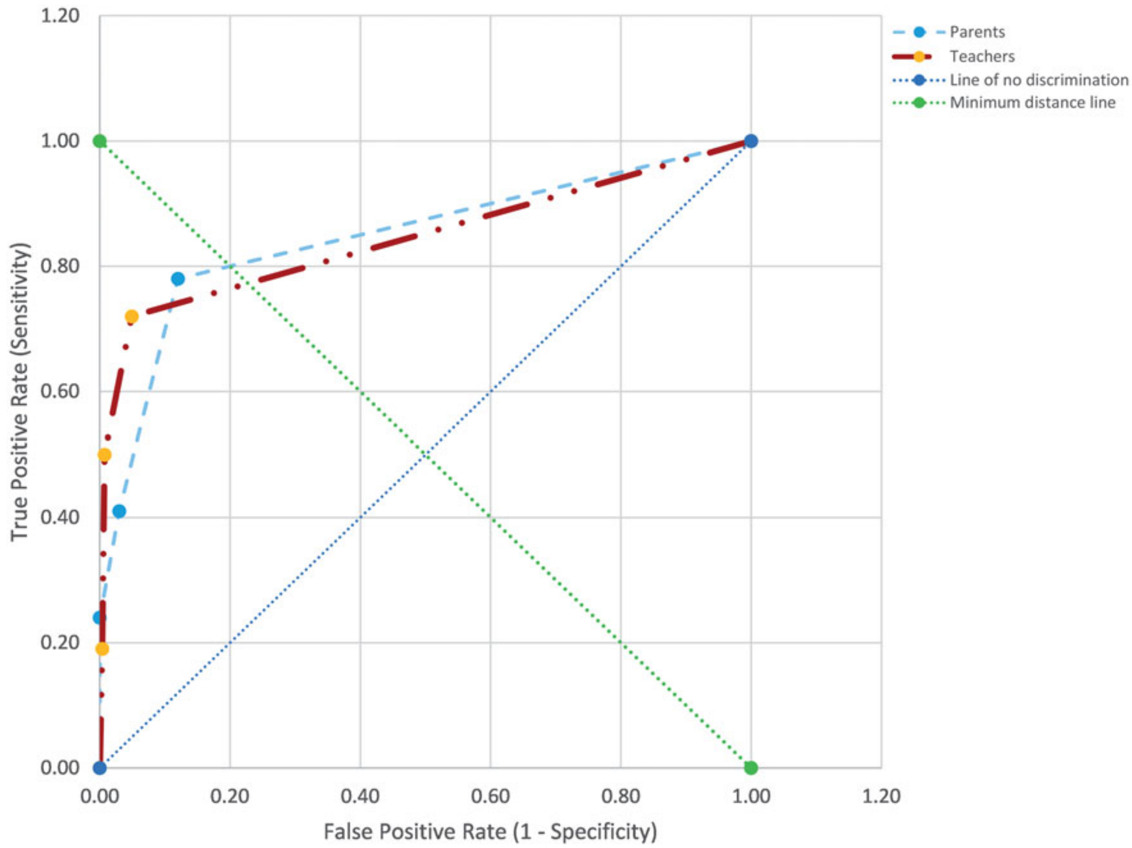

Figure 3. Receiver operating characteristic curves comparison – difficulty hearing.

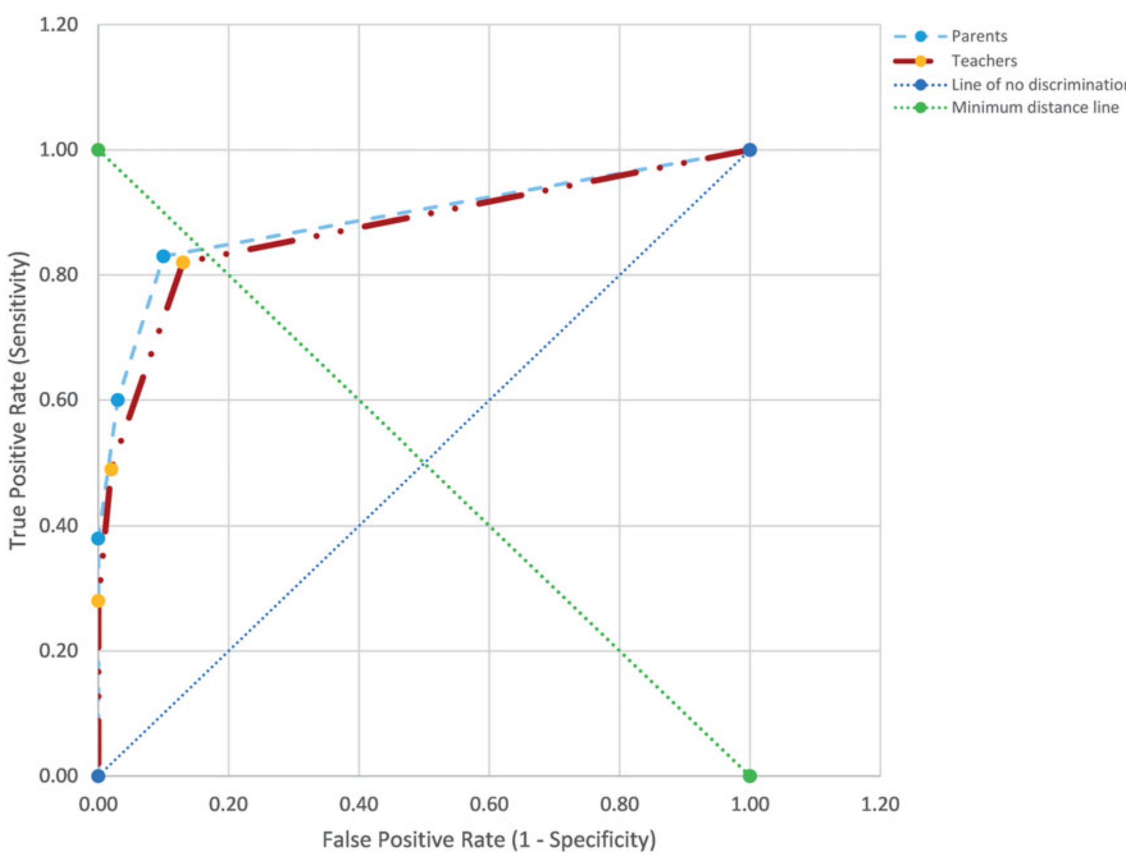

Figure 4. Receiver operating characteristic curves comparison – difficulty walking.

Table 4. Pairwise comparison of receiver operating characteristic curves of parent and teacher Child Functioning Module responses at the optimal cut-off points.

	Difference between AUC	SE[a]	95% CI[b]	Significance level
Parent v teacher – seeing				
$n = 335$, cases $= 28$	0.041	0.048	−0.054, 0.135	$p = 0.399$
Parent v teacher – hearing				
$n = 309$, cases $= 54$	0.009	0.024	−0.038, 0.055	$p = 0.721$
Parent v teacher – walking				
$n = 368$, cases $= 39$	0.009	0.037	−0.064, 0.082	$p = 0.812$

AUC: area under receiver operating characteristic curve; CI: confidence interval; SE: standard error.
[a]DeLong et al. [43].
[b]Binomial exact.

school aged children. Other disability domains will be reported in forthcoming papers. This study demonstrated the Module to have good overall diagnostic accuracy for all three disability domains when either parents or teachers are the proxy respondents. The second objective was to examine inter-rater reliability between teacher and parent responses on the Module. Our study showed "good" inter-rater reliability for seeing (0.66, 95% CI 0.58–0.72), "excellent" for hearing (0.82, 95% CI 0.78–0.85) and "excellent" for walking (0.77 95% CI 0.72–0.81) [37]. These findings signify that the Module may be a useful tool for teachers in Fiji to identify children with vision, hearing and mobility impairments. However, a more detailed look at the findings is critical. Our study found that the cut-off "some difficulty" has the optimal sensitivity and specificity for both parent and teacher responses and that using the cut-off "a lot of difficulty", as recommended by UNICEF/ Washington Group for disaggregating outcome indicators by disability status [21], would miss unacceptably high numbers of children with disabilities.

The only comparable research which reports sensitivity/specificity of the Module by disability domain is Mactaggart's doctoral thesis [40]. Whilst Mactaggart's analysis combines children through to adult data, the difference in sensitivity/specificity between "some" and "a lot of" difficulty shows strong similarities to our study. For example, vision impairment results from Cameroon, sensitivity/specificity = 0.79/0.80 ("some difficulty") compared to 0.31/0.99 ("lot of difficulty"); and India, sensitivity/ specificity = 0.84/0.78 ("some difficulty") compared to 0.39/0.99 ("lot of difficulty"). Comparable figures from our study are sensitivity/specificity = 0.80/0.89 ("some difficulty") compared to 0.14/0.99 ("lot of difficulty") for parent respondents and 0.71/0.90 ("some difficulty") compared to 0.36/0.99 ("lot of difficulty") for teacher respondents.

Loeb et al. [21] emphasise that the Module allows different severity levels to be identified for different data purposes. For Fiji's education system there are several intended purposes for the data: to alert teachers to individual children's potential learning support needs; information regarding eligibility for services and assessment accommodations; and to disaggregate the education management information system data for budgeting, policy tracking and reporting. Decisions regarding choice of cut-off and implementation of subsequent assessment services need to be considered in relation to contextual factors such as budget, policy, service and transport availability, and human resources. The priority for cut-off selection in Fiji places emphasis on sensitivity over specificity so that children are not at risk of missing out on services which would support inclusion.

However, simplistic application of the "some difficulty" cut-off is also problematic. Despite the sensitivity/specificity and Youden index in this study showing "some difficulty" as the optimal cut-off, the spread of clinical impairments amongst children in this category revealed a very mixed picture. The majority of children categorized as "some difficulty" for seeing or hearing either have no clinical impairment or have levels of impairment one might expect to be reported as at least "a lot of difficulty". In line with recommendations from Mactaggart et al. [22], our findings suggest that children identified by either parent or teacher as having "some difficulty" should have further clinical assessment. However, Mactaggart et al recommended subsequent clinical assessment in the *same domain* of functioning identified as "some difficulty" on the Module. Whereas our study recommends clinical assessment that is wide ranging enough to pick up unidentified and unexpected impairments. For example a number of children reported on the Module to have difficulty walking were found through clinical assessments not to have mobility impairment but instead to have vision impairment.

A notable limitation in this paper was the high proportion of children from special schools, which was necessary due to the limited number of children with vision, hearing and mobility impairments at mainstream schools. One might expect this to result in teacher responses more closely matched to clinical data as special school teachers may be more experienced at detecting impairments than teachers in regular schools. However, the data indicated a large number of children in special schools with significant clinical impairments were reported as only having "some difficulty". It could be possible that in special schools these difficulties are perceived to be less severe than how they would be perceived in the general population but additional research is needed to investigate this further. Forthcoming papers examine the data related to children with difficulties in other disability domains for which the sample were more spread across special and mainstream schools.

We only addressed three functioning domains in this paper and our analysis was domain-specific. Whilst it is important to ascertain how well the Module separately identifies disability domains, the Module was fundamentally designed to be used as a whole to identify children at risk of disability. To illustrate the significance of this, four children who were reported by parents to have a "lot of difficulty" seeing or "cannot (see) at all" actually had no vision impairment but in fact had learning difficulties. In domain-specific analysis of the seeing question these children are false positives, whereas if the Module were analysed as a whole these children would correctly be identified as true positives for disability. In our broader study the Module was undertaken in its entirety and analysis comparing all disability domains is forthcoming.

Besides further research to understand how respondents inherently answer the Module questions, research to identify means of actively improving response accuracy is important. In their study examining the rating of ICF activities and participation codes to children with disabilities based on standard paediatric functional assessment measures, Ogonowski et al. [41] initially found that inter-rater reliability was far poorer than expected. However, inter-rater reliability dramatically improved when raters were provided with definitions and specified activities that exemplified each code. In the case of school systems, in which teachers form a long-term workforce, classification accuracy could very plausibly be improved by training teachers and providing guiding documents with descriptors of function for each level. Indeed, this was one of the actions that occurred following this research. Further research to investigate the usefulness of the training and guidance would be valuable.

The Module does not specifically identify upper limb difficulties, which is an important limitation in a school context where fine motor skills underpin many learning activities. A large number of children with upper limb impairment also had difficulty walking and were therefore picked up by the Module walking questions, but there were four children with clinically significant upper limb impairments who were not identified by the Module walking questions. Two of them had "some difficulty" responses on the Module self-care question. This implies that when used in its entirety, the Module may pick up most children with upper limb impairments through identifying difficulty in a different functional domain. Unless further assessment were undertaken upper limb difficulties would not be isolated, which is important for planning activities to overcome functional difficulties and for providing appropriate learning supports. It is recommended that a separate question is included in education management information systems on difficulty with fine motor actions; this is consistent with recommendations in UNICEF's guidelines on disability disaggregation of education management information systems [2].

There were some limitations in using the Rapid Assessment of Musculoskeletal Impairment as the reference standard to examine the Module walking questions. Firstly, the Rapid Assessment of Musculoskeletal Impairment relies on the physiotherapist's opinion to classify severity of musculoskeletal impairment and a degree of variation is possible across the three therapists in this study. Secondly it assesses musculoskeletal impairment and therefore does not pick up other health conditions that may result in difficulty walking such as asthma, heart disease and vision impairment, which would have increased the number of false positives and reduced the specificity. However, a known bias in two-gate diagnostic accuracy studies is "limited challenge" whereby the exclusion of participants with alternative diagnoses can lead to reduced false-positive rates and higher specificity [24]. The representative sampling in our study aimed to overcome the risk of this bias and hopefully contribute to more conservative estimates of sensitivity/specificity.

Conclusions

The diagnostic accuracy of the Module seeing, hearing and walking questions appears acceptable with either parents or teachers as proxy respondents. For the Fiji education system, use of the cut-off "some difficulty" with accompanying clinical assessment may be important to capture children who require services and learning supports and avoid potentially misleading categorization.

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6.3 Paper Three: Speech results

This section presents the results from the speaking domain in the CFM, or more specifically, being understood when speaking. The results address objective one – the diagnostic accuracy and optimal cut-off levels of the CFM, using the Intelligibility in Context Scale (216) as the reference standard; and objective two – the inter-rater reliability between teacher and parent CFM responses.

The results are presented here in the form of a peer reviewed journal article published in the International Journal of Speech-Language Pathology (229).

> Sprunt B, Marella M. Measurement accuracy: Enabling human rights for Fijian students with speech difficulties. International Journal of Speech-Language Pathology. 2018;20(1):89-97.

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Measurement accuracy: Enabling human rights for Fijian students with speech difficulties

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Abstract

Purpose: The Universal Declaration of Human Rights enshrines the rights to communication and education and measuring access to these rights for children with disabilities is fundamental. The UNICEF/Washington Group Child Functioning Module (CFM) is being promoted to measure progress against the Sustainable Development Goals for children with disabilities. This cross-sectional diagnostic accuracy study in Fiji compares parent and teacher CFM responses to the Intelligibility in Context Scale for 463 primary-aged students with and without speech difficulties.
Method: Receiver operating characteristic curves were constructed to analyse CFM accuracy and determine optimal cut-off points; inter-rater reliability between teachers and parents was calculated.
Result: Parent responses to the CFM speech questions achieved an area under the curve of 0.98, indicating “excellent” diagnostic accuracy. Teachers achieved 0.92 (“very good”). The Youden Index identified the optimal cut-off as “some difficulty”.
Conclusion: The CFM appears effective when used by parents or teachers for distinguishing between children with and without speech difficulties. While identified as the optimal cut-off statistically, the “some difficulty” category identifies too many children without speech difficulties to be simplistically applied to funding eligibility. The CFM should be used as a screening tool, followed by further assessment to confirm eligibility.

Keywords: *Universal Declaration of Human Rights*; *United Nations*; *Article 19*; *disability*; *disaggregation*; *Child Functioning Module*; *Education Management Information System*

Introduction

The rights to communication and education, originally outlined in the Universal Declaration of Human Rights (United Nations, 1948), were reinforced in the Convention on the Rights of Persons with Disabilities (United Nations, 2006). The current global development framework, the Sustainable Development Goals, strongly supports these rights for children with disabilities and encourages all countries to prioritise spending to achieve the goals. The government of Fiji ratified the Convention on the Rights of Persons with Disabilities in March 2017 and is committed to inclusive and quality education. For children with speech difficulties, this includes providing learning support needs such as augmentative and alternative communication and access to communication specialists such as speech-language pathologists. However, providing resources requires means of estimation and accountability, for which accurate numbers are required. Methods to identify children with disabilities in schools in Fiji have been relatively *ad hoc* and standardised clinical assessments are seldom performed (Sprunt, Hoq, Sharma, & Marella, 2017).

This study was undertaken within an education sector strengthening program funded by the Australian government. An intention of the Fiji government and the program was to establish a means for disability-disaggregation of the government's Education Management Information System, which collects and integrates information about education activities. The government recognised the need for a valid and reliable disability identification tool feasible for urban, rural and remote schools. The tool selected as a candidate for this purpose was the Child Functioning Module (CFM) as it is relatively short, can be administered

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without medical expertise, and enables categorisation by severity of functional difficulty.

Child Functioning Module

To improve international comparability of child disability statistics, UNICEF and the Washington Group on Disability Statistics developed the CFM (available from www.washingtongroup-disability.com). It was designed as an interviewer-administered tool for parents/caregivers for incorporating into population censuses and surveys (Crialesi, De Palma, & Battisti, 2016). There is consensus by United Nations agencies and disability peak bodies that the CFM be used to compare children with and without disabilities to disaggregate the Sustainable Development Goal indicators (UNDP et al., 2016).

The CFM was developed with the International Classification of Functioning, Disability and Health for Children and Youth (World Health Organization, 2007) as its conceptual framework and includes 24 questions covering 14 functioning domains, including communication. Items are scored on a Likert scale of severity: no difficulty, some difficulty, a lot of difficulty and cannot do at all, and children are considered at risk of disability if the proxy has responded "a lot of difficulty" or "cannot do at all" to any one item.

The CFM has undergone extensive cognitive testing (Massey, Chepp, Zablotsky, & Creamer, 2014; Mont, Alur, Loeb, & Miller, 2016) and field testing (Crialesi et al., 2016). Detailed domain-specific field tests are unpublished. Visser et al. (2016) assessed diagnostic accuracy of the CFM in a population of 2–4 year olds in rural South Africa, using access to a care dependency grant as the proxy for the reference standard test as it is based on a medical assessment of disability. Sensitivity/specificity of the full CFM was 0.60/0.84. However, transferability of these findings is questionable as the study only had five children with disabilities. In the context of a population survey (Mactaggart, Cappa, Kuper, Loeb, & Polack, 2016; Mactaggart, Kuper, Murthy, Oye, & Polack, 2016), the 2014 draft CFM was tested in Cameroon and India against clinical tests for vision, hearing, musculoskeletal impairment and history of epilepsy. Findings for the full CFM highlighted a large proportion of people with disabilities were missed at the "a lot of difficulty" cut-off level. Authors recommended that people identified having "some difficulty" should receive subsequent clinical assessments to identify a higher proportion of people with disabilities. This study did not test the CFMs ability to identify children with speech difficulties.

Data used in Education Management Information Systems are completed by schools, so it is critical that the CFM performs acceptably when used by teacher respondents; this has not been tested previously. In order to ensure communication and education rights of children with speech difficulties are met, it is critical they are identified in data systems. This study aimed to test the validity of the CFM in identifying children with speech difficulties and reliability between teacher and parent responses.

Study objectives

This paper reports findings from within a broader study that examined the entire Child Functioning Module (Sprunt et al., 2017). Study objectives for this paper were:

(1) To determine the diagnostic accuracy and optimal cut-off level of the CFM in identifying primary school children with speech difficulties in Fiji compared to a reference standard, the Intelligibility in Context Scale.
(2) To determine the inter-rater reliability of the CFM between teachers and parents in Fiji for identifying primary school children with speech difficulties.

Method

Study design and sampling

Approvals were obtained from the University of Melbourne's Human Research Ethics Committee and the Fiji Ministry of Education's ethics committee and all subjects had written consent. This study required responding to two questionnaires (see Procedures); respondents were parents/caregivers and teachers of each child. This paper uses the CFM speech questions plus additional questionnaire items on learning support needs, assistive technology and hearing examination results.

A cross-sectional study was undertaken in Fiji from March–July 2015. Children were recruited from five mainstream schools and 10 special schools in Fiji covering the four administrative divisions. Sample size was estimated based on minimum number required to achieve sensitivity or specificity of 0.85 (Flahault, Cadilhac, & Thomas, 2005). A minimum of 52 children with speech difficulties (cases) and 52 children without speech difficulties (controls) were required. All children (5–15 years) in the special schools and all children in the mainstream schools previously identified by the school to have disabilities, plus selected controls with no disabilities matched by age, sex, ethnicity and location were invited to participate.

Participant demographics

The sample included 463 children with mean $\pm$ SD age of 10.2 ± 2.6 years (range: 5–15) in classes 1–8. Of these, 55.3% ($n = 256$) were male and 63.5% ($n = 294$) were from i-Taukei (Fijian) ethnic background (Table I). Of the parents/caregivers, more than half were mothers (57.7%, $n = 267$), 22.5% ($n = 104$) fathers and 19.9% ($n = 92$) grandparents,

Table I. Demographic characteristics of student participants ($n = 463$).

Participant characteristics	*n*	%
Sex		
Male	256	55.3
Female	207	44.7
Age (years)		
5–7 years	94	20.3
8–9 years	102	22.0
10–11 years	99	21.4
12–13 years	108	23.3
14–15 years	60	13.0
Ethnicity		
i-Taukei (Fijian)	294	63.5
Indo-Fijian	150	32.4
Other	19	4.1
Type of school		
Special	227	49.0
Mainstream primary	236	51.0
Parent/guardian respondent		
Mother	267	57.7
Father	104	22.5
Other*	92	19.9
Highest level of education of parent ($n = 448$)		
Primary	106	22.9
Secondary	268	57.9
Higher education	74	16.5
Area of Residence		
Urban	106	22.9
Peri-urban	177	38.2
Rural	119	25.7
Remote	61	13.2

*Other: grandparent, aunty, uncle, guardian.

aunties, uncles and guardians. Ninety-nine teachers participated.

Procedure

Index test: Child Functioning Module

The index test was the Child Functioning Module (CFM, 5–17 years) draft current at February 2015, with permission from UNICEF and the Washington Group. The wording of the two questions on speaking are: (1) "When (*child's name*) speaks, does he/she have difficulty being understood by people inside of this household?", and (2) "When (*child's name*) speaks, does he/she have difficulty being understood by people outside of this household?". The questions aim to distinguish between people who are more familiar and less familiar to the child. For each question, the interviewer states: "Would you say (*name*) has: no difficulty, some difficulty, a lot of difficulty or cannot do at all?"

The CFM was translated from English to Fijian and Fiji-Hindi by two separate bilingual speakers for each language, back-translated, then pretested according to the guidelines of the Washington Group (UNESCAP, 2010) using cognitive interviews with 10 teachers and 10 parents of children with disability. On the teacher questionnaire, questions were adapted to: (1) "When (*child's name*) speaks, does he/she have difficulty being understood by people inside of his/her main classroom?", and (2) "When (*child's name*) speaks, does he/she have difficulty being understood by people outside of his/her main classroom?", which distinguishes between understanding by people more familiar and less familiar to the child.

Reference Standard Test: Intelligibility in Context Scale

The Intelligibility in Context Scale (ICS) (McLeod, Harrison, & McCormack, 2012), administered to parents, was the reference standard test. This comprises seven questions related to frequency with which different people understand the child, using a Likert scale from "always" to "never". English, Fijian and Fiji-Hindi versions (available http://www.csu.edu.au/research/multilingual-speech/ics) were used.

The ICS was selected for several reasons: at time of data collection, there were no speech-language pathology services in Fiji and no speech assessment tools developed or validated in Fiji (Hopf, McLeod, & McDonagh, 2017). It can be administered by non-specialists. It can be used irrespective of language or number of languages spoken by the child (McLeod, Crowe, & Shahaeian, 2015; Washington, McDonald, McLeod, Crowe, & Devonish, 2017), which is important in Fiji where many people are multilingual (Hopf, McLeod, & McDonagh, 2018). It assesses intelligibility and comprehensibility, which are comparable constructs to CFM questions on difficulty being understood when speaking. The ICS had already been rigorously translated into Fijian and Fiji-Hindi and has been widely used both with children with speech sound disorders (McLeod et al., 2012; Ng, To, & McLeod, 2014) and with typically developing speech (McLeod et al., 2012; Ng et al., 2014; Phạm, McLeod, & Harrison, 2017). It has good internal consistency, sensitivity, and a significant difference in scores between children with and without speech sound disorders (McLeod et al., 2015). The Hopf, McLeod, and McDonagh (2017) Fijian ICS validation study with 65 typically developing children aged 5–10 showed mean scores of 4.6 for main language and 4.4 for Fiji-English, which were not influenced by age, gender, school year, main language spoken or socioeconomic indicators.

The ICS has some limitations as a reference standard for this diagnostic accuracy study. It is usually used with 4–5 year olds. Correlation coefficients for criterion validity were weak to moderate (Evans, 1996) across a range of ICS studies (McLeod et al., 2015; McLeod et al., 2012; Neumann, Rietz, & Stenneken, 2016; Ng et al., 2014). In the only study reporting ICS sensitivity and specificity using receiver operating characteristic (ROC) curve analysis (Ng et al., 2014), diagnostic accuracy of the ICS was 0.69, which is below the ≥ 0.70 cut-off for the category labelled "fair" (Hsieh, 2012). That study included

72 Cantonese-speaking pre-school children (39 with and 33 without speech sound disorders) and the reference standard was the Hong Kong Cantonese Articulation Test. Implications of these limitations relate to the importance of diagnostic certainty of the ICS and presented some challenges in using the ICS to distinguish cases from controls.

Determination of cases and controls using the ICS

The ICS must convincingly distinguish cases from controls to enable measurement of sensitivity and specificity of the index test, the CFM. To achieve diagnostic certainty, the meaning of the ICS scores in the sample was interrogated by analysing five variables from the dataset. Four variables were from the parent and teacher questionnaires (learning support needs, assistance required with communication, levels of difficulty being understood and use of relevant assistive devices) and the fifth being presence of hearing impairment identified in audiometric assessment (>40dBA) (Sprunt et al., 2017). If children scored positively on one or more of these variables, they were coded as "potential speech sound disorder". Of the 263 children coded "potential speech sound disorder", 97.7% scored positively on more than one variable. The spread of "potential speech sound disorder" across the ICS scores was examined to identify an ICS cut-off score, which distinguished cases from controls.

The ICS cut-off for cases and controls was determined *a posteriori* and the data and method used to determine the cut-offs are presented together for clarity. Figure 1 series 1 shows the distribution of all student scores on the ICS ($n = 463$), where 5 indicates the highest and 1 the lowest score of intelligibility. Figure 1 series 2 shows the percentage of the 263 children with "potential speech sound disorder" across ICS scores. To illustrate, of the children with the lowest possible ICS score (1.0), 100% had a "potential speech sound disorder", whereas of the children with the highest ICS score (5.0), only 2% had a "potential speech sound disorder".

This distribution identified three distinct groupings: Group 1 ($n = 71$, 96% with potential speech sound disorder) scored < 2.5; Group 2 ($n = 134$, 42.5% with potential speech sound disorder) scored 2.5 < 4.0; and Group 3 ($n = 257$, 3.1% with potential speech sound disorder) scored ≥ 4.0. As seen from the percentages in each group, Group 1 (cases) and Group 3 (controls) provide clear classification, but Group 2 is a mixture of children with and without potential speech sound disorder, who would require further assessment to avoid diagnostic uncertainty. Group 2 was excluded to reduce uncertainty in case/control allocation.

Implementation of index test and reference standard

Data were collected through assessment camps over two to five days at each school. The CFM and ICS were interviewer-administered with a parent/caregiver for each child, using the parents' preferred language. The parent was requested to consider the ICS in relation to the child's main language, similar to work by Hopf, McLeod, and McDonagh (2017). Teachers self-administered the CFM during the camp or within a week. Teachers and parents were blinded to each other's responses.

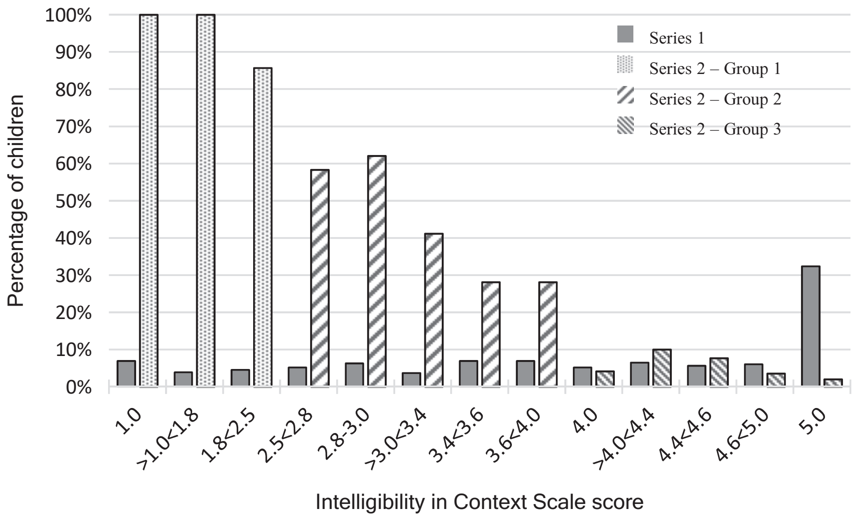

Figure 1. Series 1 shows the distribution of Intelligibility in Context Scale scores across the whole sample ($n = 463$). Series 2 shows the percentage of children with potential speech sound disorder (Group 1, Group 2, Group 3), distributed across Intelligibility in Context Scale scores ($n = 263$).

Analysis

Estimating and comparing measures of diagnostic accuracy

Using IBM SPSS Statistics 24, descriptive statistics were calculated for participant demographics and cross-tabulations used to explore distribution of CFM responses across cases and controls. Spearman's Rho correlation coefficient was used to analyse the relationship between parent responses on being understood by people inside (more familiar) and outside (less familiar) the household, and similarly between teacher responses on being understood by people inside (more familiar) and outside (less familiar) the main classroom. It was also used to analyse the relationship between parent and teacher responses using a combined variable (recommended by the Washington Group), which took the highest level of difficulty reported for inside or outside. Correlation coefficients were classified as very high (0.90–1.00), high (0.70 < 0.90), moderate (0.50 < 0.70), low (0.30 < 0.50) and negligible (0.00 < 0.30) (Hinkle, Wiersma, & Jurs, 2003).

Sensitivity was calculated as proportion of children identified by the CFM (at different cut-offs) having difficulty being understood, out of the total number of "cases" (children with ICS score < 2.5). Specificity was calculated as proportion of children identified by the CFM (at different cut-offs) not having difficulty being understood, out of the total number of "controls" (children with ICS score ≥ 4.0).

ROC curves were constructed separately for parent and teacher responses to determine the area under the curve, which is an overall figure of diagnostic accuracy combining sensitivity and specificity. Area under the curve interpretations were classified as excellent (0.96–1.0), very good (0.9 < 0.96), good (0.8 < 0.9), fair (0.7 < 0.8), poor (0.6 < 0.7), and useless (0.5 < 0.6) (Hsieh, 2012). ROC curves used dichotomous clinical variables, differentiated as case or control. The Youden Index, based on the optimal balance between sensitivity and specificity on the ROC curve, was calculated to determine cut-off points for each question and respondent type (parent/teacher). Sensitivity, specificity and likelihood ratios were calculated for each respondent type, for each of the two CFM questions (inside/outside) and for the combined variable. Likelihood ratios indicate how many times more (or less) likely a test result of a given level is obtained when the target condition is present than when it is absent. Likelihood ratios are independent of prevalence of the target condition (Spitalnic, 2004) and were therefore used instead of predictive values.

Result

Parent responses were available for 71 cases and 257 controls and teacher responses for 67 cases and 203 controls.

Correlations

There was "very high" correlation between the two questions on the parent version ($n = 328$; $r = 0.91$; $p < .001$) and a "high" correlation between the two questions on the teacher version ($n = 270$; $r = 0.80$; $p < .001$). Using the combined variable (inside and outside), parent responses showed a "high" correlation with teacher responses ($n = 269$; $r = 0.73$; $p < .001$).

Cross tabulation of the CFM results by the ICS results

Table II presents the spread of CFM responses across the ICS scores. *Parents* reported the vast majority of controls as having "no difficulty" being understood by people inside the household (93.0%) and outside the household (89.1%) and more than

Table II. Cross tabulation of Child Functioning Module (CFM) results by Intelligibility in Context Scale (ICS) results for Group 1 (cases, with speech difficulties) and Group 3 (controls, with typical speech).

	Intelligibility in Context Scale score, n(%)			
	1.0–2.43 (Group 1)		4.0–5.0 (Group 3)	
Child Functioning Module	Inside	Outside	Inside	Outside
Parent ($n = 328$)*				
No difficulty	4 (5.6%)	0 (0.0%)	239 (93.0%)	229 (89.1%)
Some difficulty	20 (28.2%)	18 (25.4%)	17 (6.6%)	26 (10.1%)
A lot of difficulty	17 (23.9%)	22 (31.0%)	1 (0.4%)	2 (0.8%)
Cannot do at all	30 (42.3%)	31 (43.7%)	0 (0.0%)	0 (0.0%)
Total	71 (100.0%)	71 (100.0%)	257 (100.0%)	257 (100.0%)
Teacher ($n = 270$)#				
No difficulty	17 (25.4%)	4 (6.0%)	164 (80.8%)	159 (78.3%)
Some difficulty	21 (31.3%)	22 (32.8%)	35 (17.2%)	40 (19.7%)
A lot of difficulty	19 (28.4%)	32 (47.8%)	4 (2.0%)	4 (2.0%)
Cannot do at all	10 (14.9%)	9 (13.4%)	0 (0.0%)	0 (0.0%)
Total	67 (100.0%)	67 (100.0%)	203 (100.0%)	203 (100.0%)

*Level of difficulty being understood by people: inside the household/outside the household.
#Level of difficulty being understood by people: inside the main classroom/outside the main classroom.

66% of the cases had “a lot of difficulty” (23.9% inside; 31.0% outside) or “cannot do at all” (42.3% inside; 43.7% outside). “Some difficulty” described over 25% of the cases and very few of the controls on the two questions.

Teachers reported cases as having lower levels of difficulty being understood by people inside and outside the main classroom than parents inside and outside the household (Table II). This may be due to teachers in special schools in this study having sign language and augmentative and alternative communication skills. On the other hand, teachers ranked controls as having slightly more difficulty being understood than parents. Teachers described nearly a third of cases and close to 20% of controls as having “some difficulty”.

Diagnostic accuracy of the CFM

Table III shows results of the ROC curve analysis. For *parent responses*, the area under the curve was ≥96% for all variables (inside, outside and combined variable), which means it is an “excellent” test in distinguishing between children, who score <2.5 and those who score ≥4.0 on the ICS, as a proxy for children with and without speech difficulties respectively. For each of these variables, the Youden Index showed “some difficulty” as the optimal cut-off. Higher cut-offs increase specificity but sensitivity is compromised considerably. The cut-offs “a lot of difficulty” and “cannot do at all” showed positive likelihood ratios (+LR) ranging from 64.2 to 116.3 indicating “large and conclusive” (OMERAD, 2008) results, however confidence intervals were very wide. Parent responses for “inside” show less convincing + LR, but still conclusive at 12.8 at the cut-off “some difficulty” with much narrower confidence intervals. The most conclusive –LRs are at the cut-off “some difficulty”.

For *teacher responses*, the area under the curve was lower than for parents, with 0.81 for inside, 0.92 for outside and 0.91 for the combined variable, signifying a “very good” test in distinguishing between children who score <2.5 and those who score ≥4.0 on the ICS, as a proxy for children with and without speech difficulties respectively. As with parent responses, the Youden Index showed “some difficulty” as the optimal cut-off for teacher responses. Again, higher cut-offs increase specificity, but sensitivity is appreciably compromised. +LRs only showed a “small increase in the likelihood” (OMERAD, 2008) of SD at the cut-off “some difficulty”, but show “large and conclusive” increases in the likelihood of SD at the cut-off “a lot of difficulty”. -LRs for teacher responses were more conclusive at the level of “some difficulty” but only when “outside the classroom” is utilised.

Figure 2 provides a visual representation of the ROC curve comparison. The combined parent variable performs similarly to the parent outside variable, offering the best diagnostic accuracy. The

Table III. Area under the curve, sensitivity, specificity, likelihood ratios and optimal cut-off points on the Child Functioning Module (CFM), parent vs. teacher responses.

Cut-off points	Sensitivity % (95% CI)	Specificity % (95% CI)	+LR (95% CI)	-LR (95% CI)
Parent ($n = 328$) Cases $n = 71$ (21.65%) Controls $n = 257$ (78.35%)				
Inside household	AUC 0.96, SE: 0.015[a], CI (0.93, 0.98)[b], $p < .0001$, Youden Index 0.870*			
≥Some difficulty*	0.94 (0.86–0.98)	0.93 (0.89–0.96)	12.81 (8.3–19.8)	0.06 (0.02–0.2)
≥A lot of difficulty	0.66 (0.54–0.77)	0.99 (0.97–1.00)	85.39 (21.3–343.0)	0.34 (0.2–0.5)
≥Cannot do at all	0.42 (0.31–0.55)	1.00 (0.98–1.00)	109.01 (15.1–785.6)	0.58 (0.5–0.7)
Outside household	AUC 0.98, SE: 0.00579 [a], CI (0.959, 0.992)[b], $p < .0001$, Youden Index 0.888*			
≥Some difficulty*	1.00 (0.95–1.00)	0.89 (0.84–0.92)	8.90 (6.3–12.5)	0.00
≥A lot of difficulty	0.75 (0.63–0.84)	0.99 (0.97–1.00)	64.20 (20.7–199.4)	0.26 (0.2–0.4)
≥Cannot do at all	0.44 (0.32–0.56)	1.00 (0.98–1.00)	112.65 (15.6–811.0)	0.57 (0.5–0.7)
Combined[c]	AUC 0.98, SE: 0.00582 [a], CI (0.958, 0.992)[b], $p < .0001$, Youden Index 0.880*			
≥Some difficulty*	1.00 (0.95–1.00)	0.88 (0.83–0.92)	8.32 (6.0–11.6)	0.00
≥A lot of difficulty	0.76 (0.65–0.85)	0.99 (0.97–1.00)	65.41 (21.1–203.0)	0.24 (0.2–0.4)
≥Cannot do at all	0.45 (0.33–0.57)	1.00 (0.98–1.00)	116.28 (16.2–836.3)	0.55 (0.4–0.7)
Teacher ($n = 270$) Cases $n = 67$ (24.81%) Controls $n = 203$ (75.19%)				
Inside classroom	AUC 0.81, SE: 0.0312[a], CI (0.761, 0.857)[b], $p < .0001$, Youden Index 0.554*			
≥Some difficulty*	0.75 (0.64–0.85)	0.81 (0.75–0.86)	3.88 (2.8–5.3)	0.31 (0.2–0.5)
≥A lot of difficulty	0.43 (0.31–0.56)	0.98 (0.95–1.00)	21.97 (8.0–60.2)	0.58 (0.5–0.7)
≥Cannot do at all	0.15 (0.07–0.26)	1.00 (0.98–1.00)	–	0.85 (0.8–0.9)
Outside classroom	AUC 0.92, SE: 0.0192[a], CI (0.881, 0.950)[b], $p < .0001$, Youden Index 0.724*			
≥Some difficulty*	0.94 (0.85–0.98)	0.78 (0.72–0.84)	4.34 (3.3–5.7)	0.08 (0.03–0.2)
≥A lot of difficulty	0.61 (0.49–0.73)	0.98 (0.95–1.00)	31.06 (11.6–83.5)	0.40 (0.3–0.5)
≥Cannot do at all	0.13 (0.06–0.24)	1.00 (0.98–1.00)	–	1.00 (1.0–1.0)
Combined[c]	AUC 0.91, SE: 0.0198[a], CI (0.874, 0.944)[b], $p < .0001$, Youden Index 0.699*			
≥Some difficulty*	0.94 (0.85–0.98)	0.76 (0.69–0.82)	3.90 (3.0–5.0)	0.08 (0.03–0.2)
≥A lot of difficulty	0.63 (0.50–0.74)	0.97 (0.94–1.00)	21.21 (9.4–47.7)	0.38 (0.3–0.5)
≥Cannot do at all	0.16 (0.09–0.28)	1.00 (0.98–1.00)	–	0.84 (0.8–0.9)

AUC: area under receiver operating characteristic curve; CI: confidence interval; positive likelihood ratio (+LR = Sn/(1-Sp); negative likelihood ratio (-LR = (1-Sn)/Sp; *Youden Index indicates the optimal cut-off point.
[a]DeLong, DeLong, and Clarke-Pearson (1988).
[b]Binomial exact.
[c]Responses to the questions on difficulty being understood inside or outside the household (parent) or classroom (teacher) are combined, using the highest level of difficulty reported on either question.

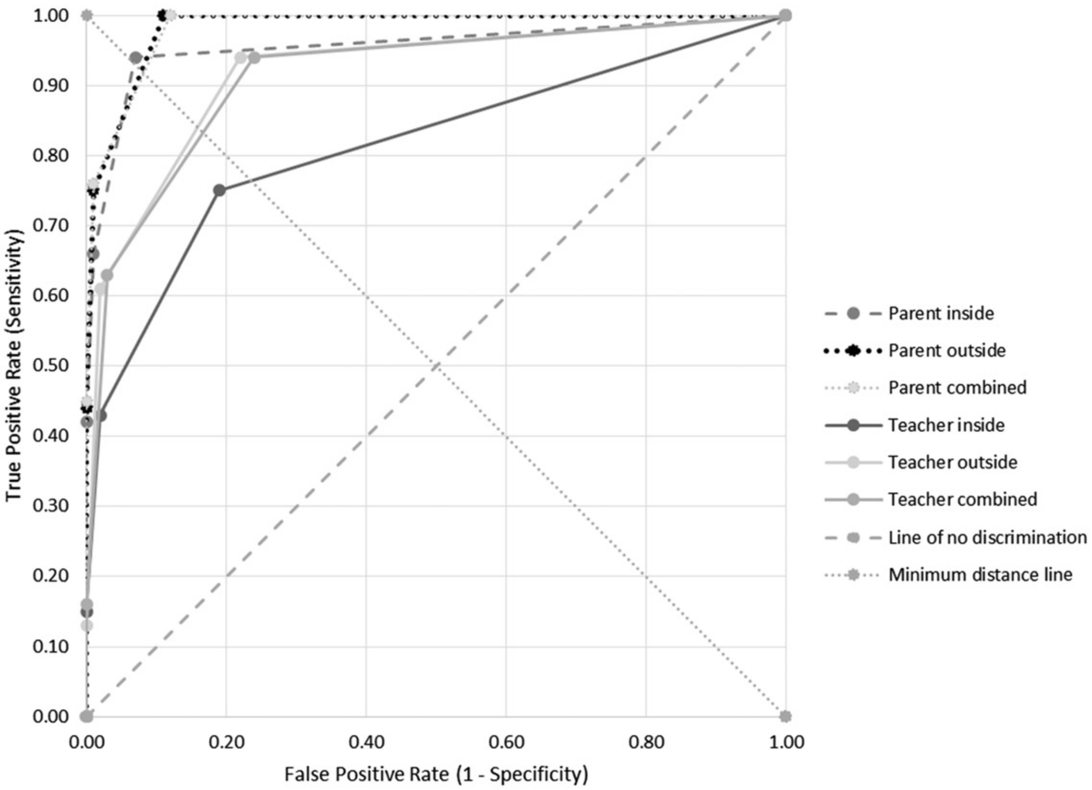

Figure 2. Receiver operating characteristic curves comparison of CFM questions on difficulty being understood.

most accurate teacher question is "outside the main classroom". The least accurate question is teacher responses to "inside the main classroom". The sensitivity of the "outside" question is higher than the "inside" question for both parent and teacher responses, which is logical. UNICEF/Washington Group (2015) note that children with speech difficulties may be able to communicate with household members attuned to their gestures or speech idiosyncrasies, but may face more significant difficulties with people less familiar to them. This means a child with moderate speech difficulty may not be identified by the "inside" question but is more likely to be identified by the "outside" question.

Discussion and conclusion

The CFM was designed to be undertaken with parents/caregivers in censuses and surveys. This study evaluated whether the CFM could be used for a different purpose – by teachers to identify children with speech difficulties, for the purpose of disability disaggregation of Fiji's Education Management Information System. The study investigated the accuracy of the CFM against a reference standard, the ICS.

Interpreting the diagnostic accuracy results requires consideration of the main study limitation – lack of certainty about whether children with ICS scores 2.5–3.86 should be regarded as a case or a control. This meant excluding 134 children with those scores, leaving 71 cases and 257 controls, resulting in analysis that is undoubtedly based on cases with higher levels of impairment. This increases the risk of "spectrum effect", a sampling bias that can lead to higher estimates of sensitivity and specificity (Rutjes, Reitsma, Vandenbroucke, Glas, & Bossuyt, 2005). For future use of the ICS as a reference test in limited resource settings, a subsequent speech assessment for children scoring between 2.5–3.86 would enable including all participants thus mitigating "spectrum effect", whilst avoiding the costs of conducting speech assessments with the entire sample.

Results showed the CFM has acceptable accuracy when used by either parents or teachers. For parent responses areas under the curve ranged from 0.96–0.98, indicating an "excellent test" for either the "inside" or "outside" questions or the combined variable, which takes the highest level of difficulty reported for either of these two questions. Whilst accuracy of teacher responses was lower than parents, the CFM still appears to be a "very good test" (area under the curve = 0.92) when undertaken by teachers using the "outside the main classroom" question or the combined variable. The "inside the main classroom" question has a lower accuracy (area under the curve = 0.81), which may imply redundancy of this question. Before assuming it is redundant, further work is needed to explore its use in informing learning support provision. The higher agreement amongst parent responses than teachers is consistent with findings in the Harrison, McLeod, McAllister, and McCormack (2017) study comparing parent and teacher responses on the Parent Evaluation of Developmental Status to clinical diagnosis by a speech-language pathologist. Further study is recommended to understand factors influencing the differences between teacher and parent accuracy.

Initial findings from this study suggest the "outside" question may be more sensitive than the "inside" question at all cut-off levels. The implication for national surveys and censuses, for which the CFM is designed, is that it may be reasonable to only include the "outside" question if cost per question is an imperative. Research on larger datasets is recommended to investigate this issue.

The optimal cut-off to identify children with speech difficulties was "some difficulty" for both parent and teacher responses as determined by the Youden Index. Negative likelihood ratios also pointed to "some difficulty" as the optimal cut-off, however, the positive likelihood ratios challenged these findings, indicating a far higher likelihood of children having speech difficulties at the cut-off "a lot of difficulty". However, as noted by Sonis (1999), likelihood ratios at extreme values can be imprecise due to sparse data resulting in wide confidence intervals, which was a limitation of this study. A larger sample size or further analysis collapsing the categories "a lot of difficulty" and "cannot do at all" may enable narrower confidence intervals and less ambiguousness around the likelihood ratios.

Providing support to teachers in using the CFM and instigating further assessment and referral processes are important features of a disability disaggregation system. These are highlighted by two issues in this study: (1) the large size of the "inconclusive" group ($n = 134$); and (2) despite the optimal cut-off being statistically identified as "some difficulty", this masks the reality that 22% of cases and 38% of controls were labelled "some difficulty" by teachers. That is, a policy that simply uses the cut-off "some difficulty" to identify children with speech difficulties is not satisfactory for determining funding allocations. To ensure that the rights and needs of all children with speech difficulties are met, and that resources are spent on children who meet eligibility standards, the MoE must continue to implement its recently developed system (Access to Quality Education Program, 2017) of further assessing relevant children identified through the student learning profile form. This form uses CFM as its basis and incorporates additional information on learning support needs. Research on effectiveness of this system is critical.

This study included participants with overlapping speech difficulties, hearing impairment and difficulties learning, the associations between which have been previously documented (Dittrich & Rona, 2008; McKean et al., 2017; McLeod & McKinnon, 2007). We did not attempt to test the accuracy of the CFM in identifying children with a diagnosable speech disorder, nor children with speech difficulties in the absence of concomitant conditions. Research comparing the CFM to full speech-language assessment results is recommended to establish which types of communication disorders are picked up through the CFM. As the Ministry of Education has instigated a policy with a conservative cut-off "some difficulty", which prompts further assessment, the detection of broader communication disorders will be enabled. Acknowledging the lack of permanent speech-language pathology services in Fiji (Hopf & McLeod, 2015; Hopf, McLeod, McDonagh, Wang, & Rakanace, 2017), wherever possible children with speech difficulties should be supported by communication specialists.

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Declaration of interest

No conflict of interest is reported.

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6.4 Learning, remembering and focusing attention results

This section presents the results from the cognitive domains of the CFM – learning, remembering and focusing attention, in relation to objective one – the diagnostic accuracy and optimal cut-off levels of the CFM, using the Cambridge Neuropsychological Test Automated Battery (CANTAB) as the reference standard; and objective two – the inter-rater reliability between teacher and parent CFM responses to these three CFM items.

The results are presented here in the form of a journal article which is in revision following peer review by the journal Disability and Rehabilitation.

> Sprunt B, Cormack F, Marella M. Measurement accuracy of Fijian teacher and parent responses to cognition questions from the UNICEF/Washington Group Child Functioning Module compared to computerised neuropsychological tests. Disability and rehabilitation. Under review.

Measurement accuracy of Fijian teacher and parent responses to cognition questions from the UNICEF/Washington Group Child Functioning Module compared to computerised neuropsychological tests

Purpose: This cross-sectional diagnostic accuracy study in Fiji compared parent and teacher responses on three cognition questions from the UNICEF/Washington Group *Child Functioning Module* (CFM) to results from the Cambridge Neuropsychological Test Automated Battery (CANTAB) for 225 primary-aged students with and without cognitive impairment.

Methods: Normative CANTAB data was developed, against which participant scores were compared to determine Overall Impairment Scores; these were the basis of case/control determination. Receiver operating characteristic curve analysis (depicting the trade-off between sensitivity and specificity) was undertaken on three Module questions: learning, remembering and focusing attention. Parent and teacher inter-rater reliability (IRR) was calculated.

Results: Teacher responses achieved areas under the curves of 0.822 (learning), 0.781 (remembering) and 0.686 (focusing attention), indicating “good”, “fair” and “poor” diagnostic accuracy respectively. Parents achieved 0.774 (learning), 0.663 (remembering) and 0.623 (focusing attention), indicating “fair” to “poor” diagnostic accuracy. IRR between parent and teacher responses was “good” (learning), “fair” (remembering) and “poor” (focusing attention). The optimal CFM cut-off was “some difficulty”.

Conclusion: The CFM appears more effective for distinguishing between children with and without cognitive impairments, as defined by CANTAB, when used by teachers than parents. The learning question performs best followed by the remembering question. Further work is recommended to explore differences between parent and teacher interpretation of the focusing attention question.

Introduction

A critical source of much of the data for tracking progress against education goals and related policies are Education Management Information Systems (EMIS). These are national school and student data systems generally run by Ministries of Education which must be disaggregated by disability to monitor progress towards disability-inclusive education (1).

Fiji’s Policy on Special and Inclusive Education (2)(p7) defines people with disability as people with “long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others”. Fiji has sparse access to disability and rehabilitation skills outside of the capital; even basic services such as school vision and hearing screening often only reach each school once in five years. The Ministry of Education needed as simple a system for identification of disability as possible, one which could be led by teachers and was valid and practical in the absence of clinical diagnosis. A tool was required to provide data for monitoring and reporting progress against commitments to national policies and international agreements including the Convention on the Rights of Persons with Disabilities and Sustainable Development Goal 4. An additional reason to identify children with disability was to provide appropriate resourcing and learning supports.

In the context of a broader study, results related to children with difficulties seeing, hearing, walking and speaking have been reported elsewhere (3, 4). This paper examines the results related to cognition.

The measurement and classification of intellectual disability involves very complex and challenging issues (5) and has been vigorously debated for decades. On the other hand, bureaucrats responsible for disability expenditure prefer a "clear and unambiguous metric to determine eligibility for resource allocation" (6)(p311) and as O'Donovan (7) points out, from a human rights and equity perspective, clarity, consistency and reliability of measures for disability are essential. Robertson et al. (8) lay out the challenge with a valuable but demanding list of criteria for screening tools to identify children with intellectual disabilities in low and middle income countries. The tools should be affordable, quick, acceptable in context, easy to use by community level workers, and have high specificity and sensitivity to balance the risks of cost-burden with false positives and adverse impacts on children's lives with false negatives.

It should be noted that the Ministry of Education was not seeking a tool to diagnose intellectual impairments. In Fiji, this is the purvey of the Ministry of Health, within which long-term plans and programs are underway to strengthen human resources related to neurodevelopmental paediatric and paramedical services. The Ministry of Education sought a simple tool to help teachers identify children with difficulties with cognitive functions.

Development and intended use of the UNICEF/Washington Group Child Functioning Module

An important new disability measurement tool, the UNICEF/Washington Group *Child Functioning Module*, is promoted as a key tool to disaggregate Sustainable Development Goal indicators relevant to children with disability. The Module (available at www.washingtongroup-disability.com) was developed by UNICEF and the Washington Group on Disability Statistics (WG) (9) with the International Classification of Functioning, Disability and Health for Children and Youth (10) as its conceptual framework. The Module was designed for incorporating into population censuses and surveys as an interviewer-administered tool with parents/caregivers as proxy respondents. The 5-17 year old version includes 24 questions covering seeing, hearing, mobilising, self-care, speaking, learning, remembering, focusing attention, behaviour, socialisation and mood (11). Items are scored on a Likert scale: no difficulty, some difficulty, a lot of difficulty and cannot do at all. Children are considered at risk of disability if the proxy has responded "a lot of difficulty" or "cannot do at all" to any one item.

The Module has been cognitively tested (12, 13) and field tested (9, 14-17). In a pilot diagnostic accuracy study in rural South Africa, Visser et al (18) reported the 2014 draft Module to have an overall sensitivity/specificity of 0.60/0.84, however, the sample only included five children with disabilities. Mactaggart (19) tested the Module within a population survey in India and Cameroon against clinical assessments for vision, hearing, musculoskeletal impairment and history of epilepsy. It did not include a test of cognitive functioning within these reference standard assessments.

Fiji's Ministry of Education together with an Australian government funded education aid program undertook a study into the validity and reliability of the Module to understand its potential for disaggregating Fiji's EMIS by disability. As the Module was designed to be interviewer-administered with the child's parent or primary caregiver, it is important to know the accuracy when teachers self-complete as the respondents for EMIS. Diagnostic accuracy of the Module's questions on difficulty seeing, hearing, walking (3) and speaking (20) indicate that in Fiji both teacher and parent responses identify the children with impairments (as determined by the clinical assessments) in these domains to an acceptable level, with follow up assessments recommended particularly for children categorised as "some difficulty". This is to ensure optimum identification of children with disabilities whilst mitigating the risk of incorrectly identifying disability in children without disability. There are no studies to date reporting diagnostic accuracy of the cognitive functioning questions of the Module either related to parent respondents or teachers.

Study objectives

This paper reports findings from within a broader study that examined the entire Module. The study objectives addressed in this paper were:

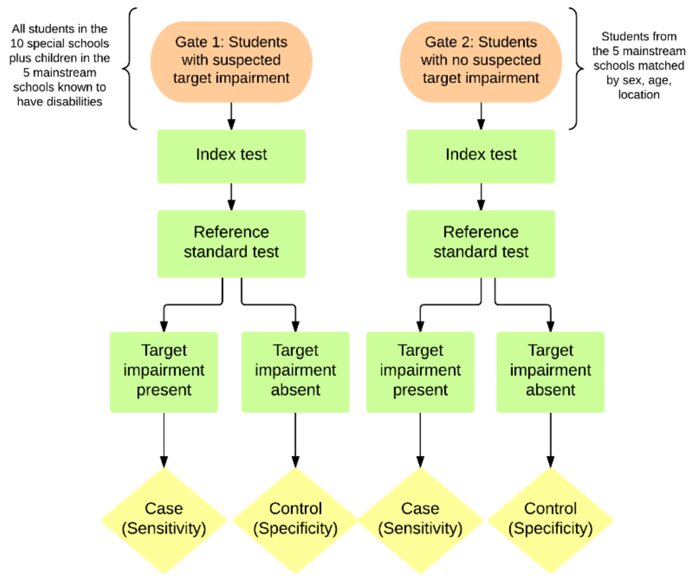
1. To determine the validity of different cut-off levels of the UNICEF/Washington Group Child Functioning Module (CFM) for predicting the presence of cognitive disability in primary school aged Fijian children compared to a standardised computer-based assessment of cognitive impairment.
2. To determine the inter-rater reliability between teacher and parent CFM responses.

Methods

Study design and sampling

A cross-sectional diagnostic accuracy study, two-gate design with representative sampling (21) was undertaken from March-July 2015 in Fiji. Ethics approvals were obtained from the University of Melbourne's Human Research Ethics Committee and the Fiji Ministry of Education's ethics committee and all subjects had written consent. Sampling was purposive regarding school selection and student participation. Participants for the study were recruited from ten special schools and five inclusive education (mainstream) schools from the four administrative divisions in Fiji. Children invited to participate were aged 5-15 years and included: (i) all children in the special schools and all children previously identified by the school to have disabilities in the mainstream schools, (ii) selected children without disability matched by age, sex, ethnicity and location (Figure 1), and (iii) additional students whose data was used to form a normative data set (see below).

Figure 1. Flowchart of participation



The sample included children with mild to profound impairment to minimise the chance of "spectrum effect", a sampling bias by which including only children with more significant impairment leads to higher estimates of sensitivity and specificity (21). At least 52 cases and 52 controls were required, which was estimated based on minimum number to achieve a sensitivity or specificity of 0.85 (prevalence 0.10, alpha 5%, 1-beta 80%; CI 95%, lower confidence limit 0.65) (22). Sampling for the additional children for the normative data was based on including children with a spectrum of cognitive skills, excluding children identified to have disability. Classroom teachers provided lists of children covering five levels of competency based on standardised national assessments. For example, the 1st level was children from the top 20% in the class and the 5th level was children from the bottom 20% in the class. A random selection of children drawn evenly from each of the five levels were invited to undertake the CANTAB battery and those with consent participated; these children were distinct from the controls selected to match cases.

Test methods

Index test – Child Functioning Module

The index test was the 5-17 years Module, draft current at February 2015, with permission from UNICEF and the WG. Of the 13 domains covered in the Module, the three domains analysed in this paper are learning, remembering and focusing attention (concentrating) (see Table 1 for wording of the Module questions). Translation and pretesting undertaken for this study is detailed elsewhere (3).

Table 1. Module questions analysed in this paper

Domain	Question	Response categories
Learning	"Compared with children of the same age, does (*name*) have difficulty learning things?"	1) No difficulty 2) Some difficulty 3) A lot of difficulty 4) Cannot do at all
Remembering	"Compared with children of the same age, does (*name*) have difficulty remembering things?"	
Focusing attention	"Does (*name*) have difficulty focusing on an activity that he/she enjoys doing?"	

Reference standard test - CANTAB

The reference standard test was the Cambridge Neuropsychological Test Automated Battery (CANTAB). CANTAB, designed to be non-linguistic and culturally independent, has been validated with children to assess a range of cognitive functions (23-26) and has been used with children in a range of settings globally including where English is not the first language (27, 28). Five sub-tests, recommended by Cambridge Cognition to provide an overall assessment of cognitive function, were implemented in this order: Motor screening (MOT), Paired Associates Learning (PAL), Spatial Working Memory (SWM), Stockings of Cambridge (SOC) and Reaction Time (RTI).

The MOT sub-test measures response speed and accuracy; it involves crosses presented at different locations on the screen one at a time which the participant must touch as quickly and accurately as possible. PAL measures episodic memory; it involves boxes displayed on the screen, some of which have patterns inside; patterns are then displayed in the centre of the screen and the subject must select the box in which the pattern was originally displayed. Outcome measures included number of errors, number of trials required to locate the pattern(s) correctly, memory scores and stages completed. SWM measures working memory and executive functions and involves the participant selecting boxes on the screen until a yellow square appears in a box, which is then moved to an empty vessel on the right side of the screen; using a process of elimination the subject must find all the yellow squares, avoiding revisiting boxes which have already been checked. Outcome measures included errors, strategy and latency. SOC measures spatial planning and spatial working memory and involves children moving coloured circles on the screen between three different vertical 'stockings' using a minimum number of moves to match a pattern shown at the top of the screen. Outcome measures include the number of problems solved on first choice, mean choices to correct, mean latency (speed of response) to first choice and mean latency to correct. RTI (simple movement and 5 choice movement) measures attention, motor and mental response speeds. It involves subjects holding down a button until a yellow circle dot appears on the screen and then quickly releasing the button and touching the circle on the screen. Outcome measures included reaction time, movement time, reaction time, and impulsivity.

Used in combination, the sub-tests cover a range of cognitive functions, including those which it was assumed would relate to the CFM questions regarding difficulty learning, remembering and focusing attention. This is a central assumption of this study and must be considered in interpreting the results.

Implementation of the index test and reference standard tests

Data were collected through assessment camps over two to five days at each school. A trained interviewer administered the Module to parents/caregivers using the parents' preferred language. Teachers self-administered the Module during the camp or within a week. Teachers and parents were blinded to each other's responses. CANTABeclipse version 3 was administered on a Motion Computing, 31cm touch-screen tablet with Windows 7 Professional operating system. A trained research assistant undertook the tests with children individually in a quiet room according to the standard protocol. For children whose preferred language was sign language, interpreters were present throughout the assessment battery to translate instructions for each sub-test.

Data analysis

Determination of cases and controls

The reference standard test (CANTAB) must positively discriminate between cases and controls to enable measurement of sensitivity and specificity of the index test, the CFM. This distinction was established through the following processes which occurred *a posteriori*.

Normative data was developed by analysing CANTAB data of a total of 185 purposively selected children, using non-linear quantile regression analysis (29). Following this, subjects' scores from the five CANTAB sub-tests were compared to the norms and converted to an impairment score based on the presence of impairment at each of three boundaries: 50th, 84th and 93rd centile. No impairment at the 50th centile = 1 (average/better than average); impairment at the 50th centile = 2 (low average); impairment at the 84th centile = 3 (impaired); at the 93rd centile = 4 (very impaired). An Overall Impairment Score was determined by the highest impairment score occurring on at least three of the following eight CANTAB outcome measures: MOT response time, MOT mean error, PAL, SWM errors, SWM strategy, SOC, RTI simple movement, and RTI 5 choice movement. For example, a student with the impairment scores 1, 2, 2, 1, 2, 1, 1, 4 would have an Overall Impairment Score of 2. Another student with impairment scores 4, 4, 2, 1, 3, 3, 4, 2 would have an Overall Impairment Score of 4.

Missing data were dealt with as follows. Assessor notes were reviewed for each child with missing data; children who aborted or could not complete the CANTAB tests because they found the tests too difficult were given an Overall Impairment Score of 5, interpreted as "very impaired". Missing data not explained in this way were further analysed. The RTI sub-test had the most missing data; it was the last test in the series and missing data were largely explained through reviewing assessor notes related to the earlier sub-tests which showed that those children had dropped out because the tests were too difficult. Of the children who completed previous tests but had missing RTI data, 19 were previously identified to have disability and 22 were not. Scores of these children's previous sub-tests showed an even spread from 1-4. On this basis, it appeared that unexplained missing data were not biased towards children with either higher or lower cognitive functioning.

Finally, parent and teacher narrative reports of each child's function were compared to Overall Impairment Scores to check that the reference standard test (CANTAB) reflected cognitive function as accurately as possible. Work by (30) and (31) highlight the importance for our study of cross-checking structured, performance-based measures such as CANTAB with observations based on more typical situations which parents and teachers would observe. Based on this comparison, the Overall Impairment Scores of twelve children were revised from 2 (low average) to 3 (impaired).

Subjects with Overall Impairment Scores of 3-5 were considered cases and Scores 1-2 were considered controls.

Statistical analyses
IBM SPSS Version 24 was used for statistical analysis. Descriptive statistics were calculated for participant demographics and independent t-test and chi-square tests were used to compare demographic characteristics of cases and controls. Cross-tabulations were used to explore distribution of CFM results across reference standard results. To evaluate the diagnostic accuracy of the CFM, Receiver Operating Characteristic (ROC) curves were constructed and the Area Under the ROC Curve (AUC) was determined, which is an overall figure of diagnostic accuracy combining sensitivity and specificity. AUC values were interpreted as excellent (0.96–1.0), very good (0.9≤0.96), good (0.8≤0.9), fair (0.7≤0.8), poor (0.6≤0.7), and useless (0.5–0.6)(32). ROC curves used dichotomous variables, differentiating cases (Overall Impairment Score 3-5) and controls (Overall Impairment Score 1-2). To explore the impact of differences in demographic variables between cases and controls, ROC analyses were undertaken in sub-cohorts, for example comparing younger age groups to older age groups.

Sensitivity and specificity were calculated for teachers and parents for each cut-off level for each Module question. Sensitivity was calculated as the proportion of children identified on the Module as having difficulty over the total number of cases. Specificity was calculated as the proportion of children identified on the Module as not having difficulty over the total number of controls. Youden's Index was calculated as Se + Sp – 1 and the highest value determined the optimal cut-off point for each Module question and respondent type.

Two-way random, absolute, average-measures intra-class correlations (ICC) were used to test inter-rater reliability between parents and teachers (33) with the criteria: "poor" (< 0.40), "fair" (0.40-0.59), "good" (0.60-0.74), and "excellent" (0.75-1.00) (34). Spearman's rho correlation coefficient was used to test association between responses on learning, remembering and focusing attention with the criteria: "very high" (0.90–1.00), "high" (0.7050.90), "moderate" (0.5050.70), "low" (0.3050.50) and "negligible" (0.0050.30) (35). Throughout the paper, results related to parents as proxy respondents are denoted by a subscript P and those by teachers by a subscript T.

Results

Participant demographics, distribution of impairments and comorbid conditions

Table 2 outlines participant demographics and clinical characteristics. The sample included 225 children with mean±SD age of 9.59±2.67 years (range: 5 to 15 years) in Classes 1 to 8, including 46% from special schools. Eighty-five teachers participated. Cases included 125 children with cognitive impairment. Cases and controls differed significantly on four variables: sex (p=0.047), influenced mainly by 49 more male cases than controls; age (p=0.011) with average age of cases 9.99±2.81 years and average age of controls 9.09±2.40 years; type of school (p=0.000) with 87 cases from special schools; and location (p=0.001) with 72.0% of cases and 56.0% of controls in peri/urban areas. The cohorts did not differ significantly on ethnicity (p=0.614).

Table 2. Demographic and clinical characteristics of the study sample (n=225)

		Cases (n=125, 55.6%)		Controls (n=100, 44.4%)	
Gender	Male	79	63.2%	50	50.0%
	Female	46	36.8%	50	50.0%
Age in years	5-7	27	21.6%	29	29.0%
	8-9	31	24.8%	31	31.0%
	10-11	22	17.6%	22	22.0%
	12-13	31	24.8%	14	14.0%
	14-15	14	11.2%	4	4.0%
Ethnicity	i-Taukei (Fijian)	81	64.8%	71	71.0%
	Indo-Fijian	38	30.4%	25	25.0%
	Other	6	4.8%	4	4.0%
Type of school	Special	87	69.6%	17	17.0%
	Mainstream primary	38	30.4%	83	83.0%
Parent/guardian respondent	Mother	76	60.8%	53	53.0%
	Father	21	16.8%	34	34.0%
*Other: grandparent, aunty, uncle, guardian	Other*	28	22.4%	13	13.0%
Highest level of education of parent	Primary	31	25.8%	14	14.9%
	Secondary	67	55.8%	66	70.2%
	Higher education	11	18.3%	14	14.9%
Area of Residence	Urban	25	20.0%	23	23.0%
	Peri-urban	65	52.0%	33	33.0%
	Rural	30	24.0%	25	25.0%
	Remote	5	4.0%	19	19.0%

Whilst comorbid conditions may interfere with test performance, creating false-positives or false-negatives, the inclusion of participants with comorbid conditions is important to increase generalisability to populations for whom the index test (CFM) may be used (21). Of the cases who completed the CANTAB tests, i.e. with an Overall Impairment Score of 3 or 4, one had moderate hearing impairment, seven had severe/profound hearing impairment, one had mild musculoskeletal impairment and two had moderate/severe musculoskeletal impairment.

Cross-tabulation of the index test results by the reference standard results

Table 3 presents the spread of Module responses across the reference standard (CANTAB) results.

<u>Learning</u>: For the question on difficulty learning, within the category "a lot of difficulty", both parent and teacher responses match well across the gradient of cognitive impairment level; of the children reported by parents/teachers to have "a lot of difficulty" learning, 3.2%$_P$/5.1%$_T$ had average (or better)

cognitive function, 6.5%$_P$/7.7%$_T$ were low average, 35.5%$_P$/25.6%$_T$ were impaired and 54.8%$_P$/72.2%$_T$ were very impaired. Among controls, the majority of parents/teachers identified them as having “no difficulty” (72.3%$_P$/82.5%$_T$) and “some difficulty” (26.4%$_P$/23.6%$_T$). Children with an Overall Impairment Score of 3, i.e. “impaired” were predominantly categorised by teachers as “some difficulty”, compared to those with a score of 4-5 who were spread across “some difficulty” and “a lot of difficulty”. This was the case for both mainstream and special schools. The response “cannot do at all” was used very sparingly, with only two children reported by parents and four reported by teachers in this category.

Remembering: Amongst controls, 28.0%$_P$/21.3%$_T$ (parent/teacher responses) are reported as having “some difficulty” remembering, compared to 0.0%$_P$/4.5%$_T$ with “a lot of difficulty”. Whereas of the cases, approximately 43.2%$_P$/59.2%$_T$ (parent/teacher responses) are reported as having “some difficulty”, compared to only 12.8%$_P$/16.7%$_T$ with “a lot of difficulty”. These figures are derived from but not shown in Table 3. As with difficulty learning, even children who are “very impaired" are reported by both parents and teachers as only having “some difficulty” remembering.

Focusing attention: Both parents and teachers are more inclined to report children with cognitive impairment using the category “some difficulty” rather than “a lot of difficulty”. However, teachers reported a greater level of difficulty with focusing attention amongst very impaired children than parents did. Amongst very impaired children, across the response categories “no difficulty”, “some difficulty” and “a lot of difficulty”, parents reported 55.8%, 37.7% and 3.9%, contrasting to teacher reports of 31.6%, 52.6% and 15.8% respectively.

Table 3. Cross tabulation: Child Functioning Module results by results of the reference standard test (CANTAB)

CFM questions	Total n (%)		Cognitive impairment level based on reference standard (CANTAB), n (%)							
			Controls				Cases			
Difficulty learning	Parent, n=225	Teacher, n=212	Average/better[@]		Low average[@]		Impaired[@]		Very impaired[@]	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	101 (44.9)	80 (37.7)	20 (19.8) (80.0)	17 (21.3) (73.9)	53 (52.5) (70.7)	49 (61.3) (71.0)	9 (8.9) (19.1)	5 (6.3) (11.4)	19 (18.8) (24.4)	9 (11.3) (9.9)
Some	91 (40.4)	89 (42.0)	4 (4.4) (16.0)	4 (4.5) (17.4)	20 (22.0) (26.7)	17 (19.1) (24.6)	27 (29.7) (57.4)	27 (30.3) (61.4)	40 (44.0) (51.3)	41 (46.1) (45.1)
A lot	31 (13.8)	54 (25.5)	1 (3.2) (4.0)	2 (5.1) (8.7)	2 (6.5) (2.7)	3 (7.7) (4.3)	11 (35.5) (23.4)	10 (25.6) (22.7)	17 (54.8) (21.8)	39 (72.2) (42.9)
Cannot do	2 (0.89)	4 (1.9)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	2 (50.0) (4.5)	2 (100.0) (2.6)	2 (50.0) (2.2)
Difficulty remembering	Parent, n=225	Teacher, n=209	Average/better		Low average		Impaired		Very impaired	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	126 (56.0)	90 (43.1)	21 (16.7) (84.0)	17 (18.9) (73.9)	51 (40.5) (68.0)	49 (54.4) (74.2)	20 (15.9) (42.6)	8 (8.9) (18.2)	34 (27.0) (43.6)	16 (17.8) (21.1)
Some	82 (36.4)	90 (43.1)	4 (4.9) (16.0)	5 (5.6) (21.7)	24 (29.3) (32.0)	14 (15.6) (21.2)	20 (24.4) (42.6)	30 (33.3) (68.2)	34 (41.5) (43.6)	41 (45.6) (53.9)
A lot	16 (7.1)	24 (11.5)	0 (0.0) (0.0)	1 (4.2) (4.3)	0 (0.0) (0.0)	3 (12.5) (4.5)	7 (43.8) (14.9)	5 (20.8) (11.4)	9 (56.3) (11.5)	15 (62.5) (19.7)
Cannot do	1 (0.4)	5 (2.4)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	1 (20.0) (2.3)	1 (100.0) (1.3)	4 (80.0) (5.3)
Difficulty focusing	Parent, n=224	Teacher, n=210	Average/better		Low average		Impaired		Very impaired	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	148 (66.4)	124 (59.0)	20 (13.4) (80.0)	20 (16.1) (87.0)	60 (40.3) (80.0)	52 (41.9) (77.6)	26 (17.4) (55.3)	28 (22.6) (63.6)	43 (28.9) (55.8)	24 (19.4) (31.6)
Some	63 (28.3)	68 (32.4)	4 (6.5) (16.0)	1 (1.5) (4.3)	13 (21.0) (17.3)	14 (20.6) (20.9)	16 (25.8) (34.0)	13 (19.1) (29.5)	29 (46.8) (37.7)	40 (58.8) (52.6)
A lot	10 (4.5)	18 (8.6)	1 (9.1) (4.0)	2 (11.1) (8.7)	2 (18.2) (2.7)	1 (5.6) (1.5)	5 (45.5) (10.6)	3 (16.7) (6.8)	3 (27.3) (3.9)	12 (66.7) (15.8)
Cannot do	2 (0.9)	0 (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	0 (0.0) (0.0)	2 (100.0) (2.6)	0 (0.0) (0.0)

[@] Categories based on CANTAB Overall Impairment Scores: Average/better = 1, Low average = 2, Impaired = 3, Very impaired = 4-5

Diagnostic accuracy of the Module and optimal cut-off

Figure 2 displays the ROC curves and Table 4 summarises these results comparing parent and teacher responses for learning, remembering and focusing attention. AUCs were higher for teacher responses to all three questions indicating greater accuracy.

Figure 2. Receiver operating characteristic curves comparison

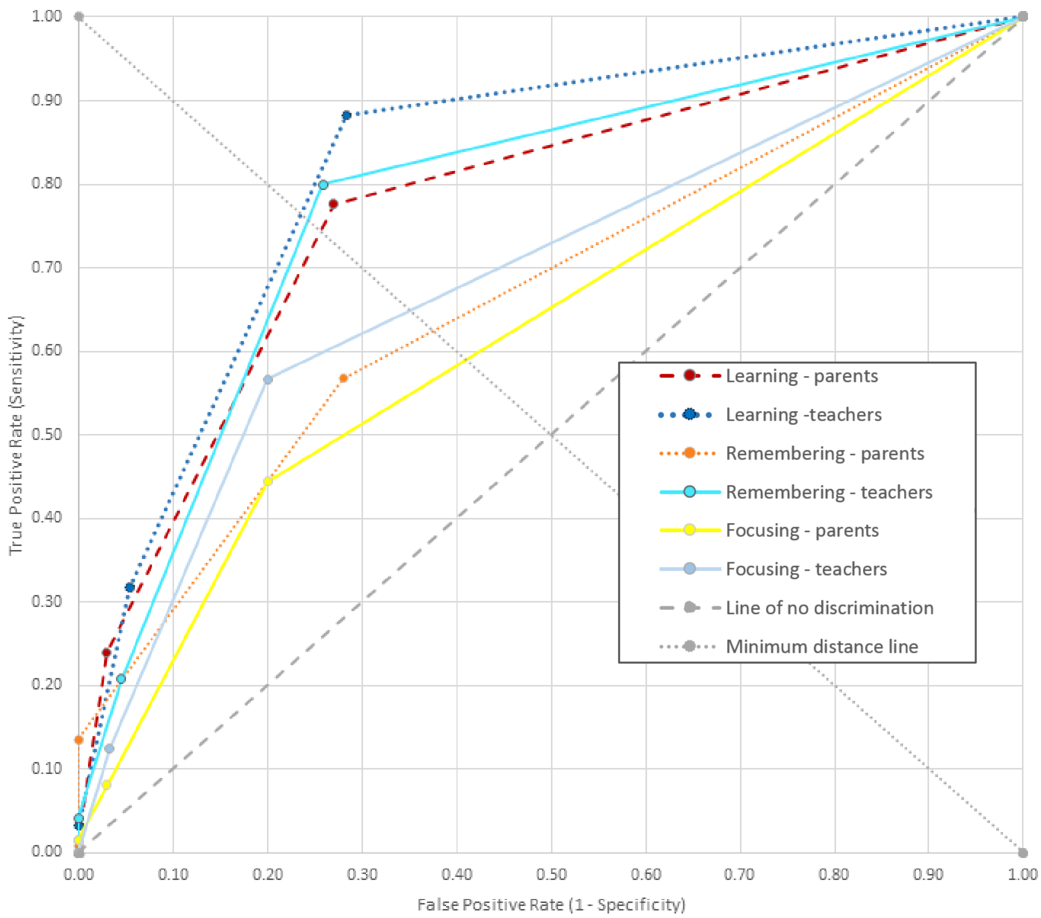


Table 4. Diagnostic accuracy of the Child Functioning Module compared to reference standard (CANTAB), parent versus teacher responses, at different cut-off levels

Cut-off points	Sensitivity (Sn) (95% CI)	Specificity (Sp) (95% CI)	Youden Index
LEARNING			
Parent	n=225, cases=125, AUC 0.774, SE[a]: 0.032, 95%CI [b] (0.712, 0.836), p<0.000		
Some difficulty	0.78 (0.69, 0.84)	0.73 (0.63, 0.81)	0.51**
A lot of difficulty	0.24 (0.17, 0.33)	0.97 (0.91, 0.99)	0.21
Cannot do at all	0.02 (0.00, 0.06)	1.00 (0.95, 1.00)	0.02
Teacher	n=212, cases=120, AUC 0.822, SE[a]: 0.030, 95%CI[b] (0.763, 0.881), p<0.000		
Some difficulty	0.88 (0.81, 0.93)	0.72 (0.61, 0.80)	0.60**
A lot of difficulty	0.32 (0.23, 0.41)	0.95 (0.87, 0.98)	0.27
Cannot do at all	0.03 (0.01, 0.09)	1.00 (0.95, 1.00)	0.03
REMEMBERING			
Parent	n=225, cases=125, AUC 0.663, SE[a]: 0.036, 95%CI [b] (0.593, 0.733, p<0.000		
Some difficulty	0.57 (0.48, 0.66)	0.72 (0.62, 0.80)	0.29**
A lot of difficulty	0.14 (0.08, 0.21)	1.00 (0.95, 1.00)	0.14
Cannot do at all	0.01 (0.00, 0.05)	1.00 (0.95, 1.00)	0.01
Teacher	n=209, cases=1210, AUC 0.781, SE[a]: 0.033, 95%CI [b] (0.716, 0.845), p<0.000		
Some difficulty	0.80 (0.72, 0.87)	0.74 (0.64, 0.83)	0.54**
A lot of difficulty	0.21 (0.14, 0.29)	0.96 (0.88, 0.99)	0.17
Cannot do at all	0.04 (0.02, 0.10)	1.00 (0.95, 1.00)	0.04
FOCUSING			
Parent	n=224, cases=124, AUC 0.623, SE[a]: 0.037, 95%CI[b] (0.550, 0.696), p<0.002		
Some difficulty	0.44 (0.36, 0.54)	0.80 (0.71, 0.87)	0.24**
A lot of difficulty	0.08 (0.04, 0.15)	0.97 (0.91, 0.99)	0.05
Cannot do at all	0.02 (0.00, 0.06)	1.00 (0.95, 1.00)	0.02
Teacher	N=210, cases=120, AUC 0.686, SE[a]: 0.037, 95%CI[b] (0.614, 0.758), p<0.000		
Some difficulty	0.57 (0.47, 0.66)	0.80 (0.70, 0.87)	0.37**
A lot of difficulty	0.13 (0.07, 0.20)	0.97 (0.90, 0.99)	0.10
Cannot do at all	0.00 (0.00, 0.04)	1.00 (0.95, 1.00)	0.00

AUC: area under receiver operating characteristic curve; CI: confidence interval; SE: standard error;
** The highest Youden Index indicates the optimal cut-off point.
[a] DeLong et al., 1988
[b] Binomial exact

For **difficulty learning**, diagnostic accuracy of parent responses was fair (AUC=0.774) and for teachers was good (AUC=0.822). The Youden Index showed "some difficulty" as the optimal cut-off. At "some difficulty", sensitivity/specificity was: $0.78/0.73_P$, $0.88/0.72_T$, compared to the higher cut-off "a lot of difficulty", $0.24/0.97_P$ and $0.35/0.95_T$.

For **difficulty remembering**, diagnostic accuracy of parent responses was poor (AUC=0.663) and for teachers was fair (AUC=0.781). Again, the Youden Index showed "some difficulty" as the optimal cut-off. At "some difficulty", sensitivity/specificity was: $0.57/0.72_P$, $0.80/0.74_T$, compared to the higher cut-off "a lot of difficulty", $0.14/1.00_P$ and $0.21/0.96_T$.

For **difficulty focussing attention**, diagnostic accuracy of parent responses was poor (AUC=0.623) and for teachers was poor (AUC=0.686). Again, the Youden Index showed "some difficulty" as the optimal cut-off. At "some difficulty", sensitivity/specificity was: $0.44/0.80_P$, $0.57/0.80_T$, compared to the higher cut-off "a lot of difficulty", $0.08/0.97_P$ and $0.13/0.97_T$.

Effects of cohort differences in demographic variables

To explore whether the significant differences between cases and controls in age, sex, school type and location had any effect on diagnostic accuracy of parent and teacher responses, separate ROC analyses were undertaken. No notable differences in accuracy were found based on sex or on location. Accuracy was compared between younger children (≤8 years) and older children (≥10 years). Age had no impact on the **learning** question. Accuracy of the **remembering** question was higher in older children (≤8-year olds AUC: 0.623_P, 0.744_T; ≥10-year olds AUC: 0.710_P, 0.824_T). Accuracy of the **focusing attention** question was higher for teachers in regard to younger children (≤8-year olds AUC: 0.585_P, 0.743_T), which may reflect the fact that teachers spend more time on tasks requiring concentration than parents do. However, in older children parents and teachers were similar (≥10-year olds AUC: 0.665_P, 0.625_T). Both parents and teachers of children in mainstream schools had higher accuracy on the learning question (AUC: 0.783_P, 0.851_T) than those of children in special schools (AUC: 0.617_P, 0.642_T). Similarly, teachers in mainstream schools had better accuracy (AUC=0.797) on the remembering question compared to those in special schools (AUC=0.633). Whilst sensitivity was slightly higher in special schools, specificity was distinctly lower due to a higher number of false positives. There was no notable difference in accuracy on the focusing attention question based on type of school.

Inter-rater reliability of the Module

Inter-rater reliability between parents and teachers was "good" for learning (ICC=0.61, 95% CI 0.52-0.68), "fair" for remembering (ICC=0.44, 95% CI 0.30-0.54) and "poor" for focusing attention (ICC=0.24 95% CI 0.08-0.38) (34).

Correlations

Teacher responses on learning and remembering had a high and significant correlation (r_s=0.758, p<0.000); with moderate but significant correlations between learning and focusing attention (r_s=0.502, p<0.000); and remembering and focusing attention (r_s=0.472, p<0.000). This contrasts with **parent** responses which all showed low but significant correlations: learning and remembering (r_s=0.498, p<0.000); learning and focusing attention (r_s=0.349, p<0.000); and remembering and focusing attention (r_s=0.304, p<0.000).

In order to explore whether the poor results of the question on "focusing attention" were due to this functional domain being masked within the Overall Impairment Score of CANTAB, analysis was undertaken to explore the sub-test Reaction Time (RTI) which is the sub-test most likely to identify difficulties with attention. RTI scores differed significantly between cases and controls (p<0.000), showing concurrent validity of the RTI test itself. However, there was no significant correlation between RTI scores and parent responses (p<0.102 for RTI simple movement; p<0.510 for RTI 5 choice attention response) or teacher responses (p<0.063 for RTI simple movement; p<0.495 for RTI 5 choice attention response) on the "focusing attention" question implying that the CANTAB RTI tests and the Module are measuring different constructs.

Discussion, limitations and further research

The study explores the diagnostic accuracy and optimal cut-off points of the Module for predicting the presence of cognitive impairment in primary school aged children and the inter-rater reliability between parents and teachers. We found that teacher responses were more accurate than parent responses for all three questions. Teacher accuracy was "good" for learning (AUC=0.822) and remembering (AUC=0.781) but "poor" for focusing attention (AUC=0.685). Parent accuracy was "fair" for learning (AUC=0.774) but poor for remembering (AUC=0.663) and focusing attention (AUC=0.623).

Inter-rater reliability between teacher and parent responses was “good” for learning (ICC=0.61, 95% CI 0.52-0.68), “fair” for remembering (ICC=0.44, 95% CI 0.30-0.54) and “poor” for focusing attention (ICC=0.24 95% CI 0.08-0.38). Given the poor accuracy of the focusing attention question for both parents and teachers and the poor accuracy of the remembering question for parents, it is not surprising that the inter-rater reliability for these domains is mixed.

These findings indicate that the Module may be a useful tool for teachers in Fiji to identify children with cognitive impairments. The questions perform best at the optimal cut-off of “some difficulty”, according to Youden’s Index. This cut-off was also found for Module questions related to seeing, hearing, walking (3, 19) and speaking (20). The cut-off recommended by the Washington Group for use of the Module in censuses and population surveys is “a lot of difficulty”, for which our study’s results for the learning question showed sensitivity/specificity as $0.35/0.95_T$ and $0.24/0.97_P$. The decision to set a cut-off is different for a Ministry of Education than for a Bureau of Statistics and implications of these results relate particularly to the decision about providing follow up assessments. The higher cut-off at “a lot of difficulty” would mean large numbers of children with disability missing out on services, yet using the “some difficulty” category leads to more false positives, increasing costs of follow up assessments of the large number of children who score “some difficulty”. In the case of Fiji, particularly from a policy and rights perspective, prioritising sensitivity and compromising specificity is important so that children have the greatest chance of being picked up by the screening tool. Fiji recently ratified the Convention on the Rights of Persons with Disabilities and developed a Special and Inclusive Education Policy Implementation Plan, so the political impetus is in favour of an expansive approach towards identifying children with disabilities.

Despite this imperative, costs and resourcing of follow-up assessments to confirm the presence of disability are inevitably a challenge and the large number of children identified by the category “some difficulty” was impractical for the Ministry of Education to consider. In response to the need to further narrow the list of children who require direct assessment, subsequent analysis led to the Module responses being combined with learning support needs data to form algorithms which identify a more accurate group of children for direct assessments. This analysis will be reported in a forthcoming paper. In addition to implementing algorithms within Fiji’s EMIS, the Ministry of Education has implemented widespread training for teachers to further increase accuracy and reliability in categorising children.

The poor diagnostic accuracy results for both parents and teachers on the ‘focusing attention’ question raised the matter of whether the CANTAB Overall Impairment Score was adequate for measuring the construct of attention/concentration. Subsequent analysis of the sub-test Reaction Time (RTI) showed a lack of correlation with the Module’s responses, implying that the attention/concentration construct being measured by CANTAB may indeed be different from that of the Module. This is not unexpected given that the WHO Working Group on the Classification of Mental Retardation acknowledged the numerous variations in patterns of intellectual impairment in neurodevelopmental syndromes, and the wide variation in results in subtest scores amongst people diagnosed with these syndromes (5). However, the poor inter-rater reliability for ‘focusing attention’ between teacher and parent Module responses implies that teachers and parents are interpreting the construct differently from each other, which does highlight the need for further exploration of what the Module’s ‘focusing attention’ question is actually measuring.

A central limitation in this study is the necessary assumption that the selected sub-tests of CANTAB provide a reference standard against which the Module’s three questions can be assessed.

Acknowledging the decades of debate and countless publications interrogating which cognitive processes can be measured by which instruments, the diagnostic accuracy findings of this study must be interpreted cautiously. It is uncertain the degree to which the cognitive processes measured by the CANTAB tests overlap with the constructs measured by the three Module questions. CANTAB provided a consistent reference standard assessment which allowed us confidence to compare diagnostic accuracy of parents versus teachers however the results should be interpreted cautiously if comparing sensitivity and specificity of the Module to other studies which may use different reference standard tools.

Another limitation of this study is the high proportion of cases from special schools (n=87) compared to mainstream schools (n=38). To achieve the required sample size, the primary ROC analyses were undertaken on the combined sample. However sub-cohort analyses indicated that parents and teachers of children in mainstream schools achieved greater accuracy on the ‘learning’ and ‘remembering’ questions than those in special schools, which may be related to the fact that teachers in mainstream schools are likely to compare children to a higher functioning student cohort and thereby identify cognitive difficulties against the norm more easily. It may also relate to a bias in special schools to assuming that children have higher levels of difficulty, and therefore higher support needs, than in mainstream schools. There was marginal difference in AUC results for the ‘focusing attention’ question. The implication is that if eligibility were simply based on results of the Module, it may appear that children in special schools have higher needs than equivalent children in mainstream schools, with resulting implications on funding and resources. This is a useful finding in its own right, however future research should note the prospect of different responses in these two cohorts and take this into account in sampling design.

This paper has looked at diagnostic accuracy of only three questions out of 24 and whilst it is important to understand the performance of individual questions, the Module is designed to be used in its entirety and it is critical to consider its diagnostic accuracy as a whole. These results are forthcoming (36).

Conclusions

The findings from this paper show that teacher responses to the Module questions on learning, remembering and focusing attention are more accurate than parent responses at identifying children with cognitive impairments as defined by CANTAB scores. This appears to be the case particularly for teachers in mainstream schools. The study showed that the “difficulty learning” and “difficulty remembering” questions both perform well for teachers, but that for parents only the “learning” question performs reasonably well.

In line with Robertson et al.’s (8) criteria for selecting screening tools for children with intellectual disabilities in low and middle income countries, the Module meets the criteria of affordability, rapidity, acceptability and relative ease of use by teachers. However, as this study shows, specificity and sensitivity vary greatly depending on which cut-off level is used. The strength of the Module is that it enables governments to readily see the difference in results from the different response categories and make decisions on cut-off level based on resources and measurement and policy objectives.

Parmenter advised that “we must move out of our psychometric laboratories and more sensitively observe the way this population lives their practical everyday lives…” (6),p.315. The Fiji Ministry of Education offers an exceptional example of moving out of the psychometric laboratory. It has used the Module for its strengths and overcome its limitations by incorporating learning support needs data to form algorithms which reduce false positives and by rolling out training programs to strengthen accuracy and reliability of teacher responses.

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Declaration of Interest

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6.5 Analysis of the CFM as a whole

This section presents the results from analysis of the overall CFM, in relation to objective one – the diagnostic accuracy and optimal cut-off levels of the CFM; and objective two – the inter-rater reliability between teacher and parent CFM responses. In contrast to sections 6.2, 6.3 and 6.4 which looked at specific disability domains, this section combines the five impairment assessments to review diagnostic accuracy of the CFM as a whole in distinguishing between children with and without disabilities. It also includes analysis of the items in the CFM which were not covered by the reference standard assessments, which were self-care, accepting changes to routine, making friends, anxiety/worry, depression/sadness, and controlling behaviour.

The results are presented here in the form of a journal article published in the International Journal of Environmental Research and Public Health.

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The UNICEF/Washington Group Child Functioning Module—Accuracy, Inter-Rater Reliability and Cut-Off Level for Disability Disaggregation of Fiji's Education Management Information System

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Abstract: This paper explores the validity (sensitivity and specificity) of different cut-off levels of the UNICEF/Washington Group Child Functioning Module (CFM) and the inter-rater reliability between teachers and parents as proxy respondents, for disaggregating Fiji's education management information system (EMIS) by disability. The method used was a cross-sectional diagnostic accuracy study comparing CFM items to standard clinical assessments for 472 primary school aged students in Fiji. Whilst previous domain-specific results showed "good" to "excellent" accuracy of the CFM domains seeing, hearing, walking and speaking, newer analysis shows only "fair" to "poor" accuracy of the cognitive domains (learning, remembering and focusing attention) and "fair" of the overall CFM (area under the Receiver Operating Characteristic curve: 0.763 parent responses, 0.786 teacher responses). Severe impairments are reported relatively evenly across CFM response categories "some difficulty", "a lot of difficulty" and "cannot do at all". Most moderate impairments are reported as "some difficulty". The CFM provides a core component of data required for disaggregating Fiji's EMIS by disability. However, choice of cut-off level and mixture of impairment severity reported across response categories are challenges. The CFM alone is not accurate enough to determine funding eligibility. For identifying children with disabilities, the CFM should be part of a broader data collection including learning and support needs data and undertaking eligibility verification visits.

Keywords: UNICEF/Washington Group Child Functioning Module; disability disaggregation; education management information system; validation; Fiji

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1. Introduction

It is critical that education data systems are disaggregated by disability to measure progress in achieving access to quality education for children with disabilities, and efforts to enable this are moving forward globally. Disability-disaggregated education data are required to track progress towards various frameworks including the Convention on the Rights of Persons with Disabilities (CRPD) [1], the Sustainable Development Goals (SDG) [2] and the Incheon Strategy to "Make the Right Real" for Persons with Disabilities in Asia and the Pacific [3]. There is widespread consensus on the urgency to support Ministries of Education (MoEs) to disaggregate their Education Management Information Systems (EMISs) by disability, and the importance of doing so using tools which are valid and internationally comparable [2,4,5]. Given the complexity of disability measurement, efforts to develop and agree upon tools for disability measurement that are valid, feasible and comparable have taken statisticians and researchers decades. Whilst debate remains lively, the urgency to gather baseline data for the SDGs has required consensus. In a statement titled *Disability data disaggregation* *joint statement by the disability sector* [6], peak disability agencies such as the International Disability Alliance, the World Health Organization, UNICEF, United Nations Development Programme, and the UN Partnership to Promote the Rights of Persons with Disabilities, amongst others, agreed that the Washington Group on Disability Statistics (WG) modules should be used to disaggregate data sets to measure SDG indicators; the WG Short Set of questions for adults and the UNICEF/WG Child Functioning Module (CFM) for children.

The CFM has been developed for measuring child functioning in surveys with parents/caregivers as proxy respondents for the child's functioning. It has been validated in different settings [7–16] and was finalised in 2016. The CFM is designed for children between two and 17 years and covers a range of areas for measuring functioning difficulties, including: seeing, hearing, walking, self-care, speaking, learning, remembering, anxiety/worry, depression/sadness, controlling behaviour, attention/concentrating, accepting changes in routine and making friends. Response categories for most questions are: "no difficulty", "some difficulty", "a lot of difficulty" and "cannot do it at all".

Recent advice from the United States Agency for International Development (USAID), a key donor, is that the WG Short Set and/or the CFM should be used wherever possible in USAID-funded education programs to disaggregate data sets [17]. This is a positive indication of donor commitment to measuring outcomes towards fundamental human rights. If the CFM is to be used to disaggregate EMISs, it is critical that its properties are understood when proxy respondents are teachers and to test its measurement accuracy when used for education systems.

There are various purposes for which disability identification is needed in data aimed at ensuring inclusion of children with disabilities. From determining funding eligibility at an organizational or an individual level, determining learning and support needs of a student, to comparing equalization of access to socioeconomic rights through disability-disaggregated census or household survey data. The purpose has implications for the approach to disability identification, and for the degree of accuracy required in the instrument that determines the classification of disability. Madden highlighted the importance of designing valid tools which take into account the evidence for and consequences of score interpretation and use, and establishing meaningful thresholds on the spectrum of disability experience [18].

Disability can be seen as a continuum ranging from minimal difficulties to fundamental impacts on a person's life. On an instrument designed to measure this functioning to disability continuum, the point along the span which is used to define someone as having a disability is referred to in this paper as a cut-off. It is critical that the rationale and implications of the cut-off are clearly understood. If for example the cut-off is relatively low on the continuum and includes mild disabilities (such as difficulty seeing which can be entirely overcome with glasses), the number of children counted as having disability will be high. Whereas if severe disability is the cut-off (having a great deal of difficulty with basic functions), the number of children counted as having disability will be comparatively low. The cut-off level must be appropriate to, and will alter depending on, the purpose for identifying disability. Education systems may consider it important to identify children with mild and moderate disability to enable early intervention and educational accommodations, whereas a scheme establishing eligibility for monetary benefits may target a higher level of disability [19].

The recommended criterion for identifying disability using CFM is having difficulty functioning at the level of at least "a lot of difficulty" [20], or "daily" for anxiety and depression questions. The USAID guidance document [17] states that *"for a more nuanced analysis of disability, the answers can be used as a regular scale, with "cannot do it at all" denoting severe disability while "some difficulty" denoting minor disability in each functional domain. Answers across all domains can also be combined into a larger scale."* (p. 4). However recent studies in Cameroon, India and Fiji [12,21–23] indicate that there is a significant variation in how parents choose response categories to report functioning difficulties and that the cut-off "a lot of difficulty" misses significant numbers of children with moderate to severe impairments. That is, this cut-off had low sensitivity in identifying disability. When used in large household surveys or censuses the importance of these differences may be considered within acceptable margins of error.

However, within an education system the tool is used for different purposes and a response cut-off with a high sensitivity is needed. Sensitivity and specificity are a trade-off and selecting a lower severity response category, for example "some difficulty", may result in lower specificity. That is, the chance increases of falsely identifying some children as disabled who do not have a disability.

In a rapidly modernising information technology age, EMISs are increasingly based on individual electronic data files [24]. Data from these systems are not only used to monitor and evaluate progress towards inclusive education at a large area level but are capable of and being used to determine individual student eligibility for funding related to disability status. A tool appropriate for national surveys may not also be reliable or valid in identifying individual students' levels of functioning. It is critical that people making decisions about incorporating disability within EMISs understand that tools they are being advised to use for national or large area monitoring may have limitations for individual level assessments.

This study was undertaken in the context of an Australian aid funded education sector project in Fiji. The required purposes for disability data in Fiji's EMIS included identification of children with disabilities, by disability type and severity, to enable resource allocation based on individual level data, and to enable monitoring, planning and reporting against policy and other commitments. The key question for the Fiji MoE was the extent to which the CFM is effective when used by teachers to identify the presence and severity of disability amongst children in Fiji. Validity and reliability of specific domains (seeing, hearing, walking, speech and cognition) were reported elsewhere [21–23]. This paper focuses on the performance of the CFM as a whole. With the overarching aim of identifying a valid, reliable and feasible method for Fiji to identify children with disabilities in schools to enable monitoring, planning and reporting against policy commitments, the objectives of this paper are to:

(1) Determine the validity (sensitivity and specificity) of different cut-off levels of the CFM for predicting the presence of disabilities in primary school aged Fijian children compared to standard clinical assessments of impairment.
(2) Determine the inter-rater reliability between teacher and parent CFM responses.

2. Materials and Methods

2.1. Study Design and Sampling

A cross-sectional diagnostic accuracy study, two-gate design with representative sampling [25] was undertaken from March-July 2015 in Fiji. In diagnostic accuracy studies, the index test whose accuracy is being investigated (CFM) is compared to reference standard (clinical) tests, sometimes termed "gold standards" [26,27]. The purpose of a diagnostic accuracy study is to evaluate the ability of the index test to correctly classify study participants into two categories, those with and without the 'target condition'. Diagnostic accuracy is based on measuring sensitivity and specificity values at each cut-off level. For the purpose of assessing the sensitivity and specificity of the CFM against the reference tests, we have essentially defined disability as clinically assessed impairment of a moderate or more severe level. There are inherent limitations in assuming that medical impairment assessments are "gold standards" for disability. However, this approach enabled a validated, consistent and objective means of measuring an aspect of disability, i.e., impairment, against which the self-report-based CFM could be compared.

Ethics approvals were obtained from the University of Melbourne's Human Research Ethics Committee (#1543942, 17/03/15) and the Fiji MoE's ethics committee (RA09/15, 5/03/15). All subjects had written consent and children's assent was obtained prior to each clinical assessment. Sampling was purposive regarding school selection and student participation. Participants for the study were 5–15 year old students recruited from ten special schools and five inclusive education (mainstream) schools from the four administrative divisions in Fiji. Children invited to participate included: all children in the special schools, and all children in the mainstream schools previously identified by the school to have disabilities, and selected controls matched by age, sex, ethnicity and location

(Table 1). The flowchart of participation is shown in Figure S1 (Supplementary Material). Invitations to parents were included in the information and consent process for participation of the children. Teachers in all study schools were informed of the research and given information and consent forms. After the children had been assessed and parents interviewed, respective teachers of the children were provided questionnaires to complete. Representative sampling focused on including cases with mild/moderate through to profound impairment to minimise "spectrum effect", whereby a sampling bias towards including only cases with more significant impairment can lead to higher estimates of sensitivity and specificity [25]. This was operationalized in two ways: (i) by keeping tallies on impairment levels of children throughout recruitment and working closely with schools to achieve a mixture of impairment severity levels; and (ii) by assessing large numbers of children who were not initially identified by schools as having disability, which resulted in a sample with a full spectrum of function/impairment, including those around the lower or borderline end, which was necessary to minimise "spectrum effect". Sample size was estimated based on minimum number to achieve a sensitivity or specificity of 0.85 (prevalence 0.10, alpha 5%, 1-beta 80%; CI 95%, lower confidence limit 0.65) [28]. A target of 52 cases and 52 controls were sought under each of five impairment domains (vision, hearing, musculoskeletal, speech and cognition).

Table 1. Demographic characteristics of the study sample.

n = 472, Unless Otherwise Stated		**Cases (n = 231, 48.9%)**		**Controls (n = 241, 51.1%)**	
		n	**%**	**n**	**%**
Gender	Male	145	62.8	118	49.0
	Female	86	37.2	123	51.0
Age (years)	5–7	43	18.6	52	21.6
	8–9	52	22.5	53	22.0
	10–11	42	18.2	59	24.5
	12–13	51	22.1	57	23.7
	14–15	43	18.6	20	8.3
Ethnicity	i-Taukei (Fijian)	141	61.0	159	66.0
	Indo-Fijian	75	32.5	78	32.4
	Other	15	6.5	4	1.7
Type of school	Special	176	76.2	56	23.2
	Mainstream primary	55	23.8	185	76.8
Parent/guardian respondent	Mother	130	56.3	144	59.8
	Father	44	19.0	61	25.3
	Other *	57	24.7	36	14.9
Highest level of education of parent	Primary	57	25.4	52	22.3
	Secondary	125	55.8	146	62.7
	Higher education	42	18.8	35	15.0
Area of Residence	Urban	63	27.3	44	18.3
	Peri-urban	112	48.5	68	28.2
	Rural	45	19.5	79	32.8
	Remote	11	4.8	50	20.7

* Other: grandparent, aunty, uncle, guardian.

2.2. Test Methods

2.2.1. Index Test—Child Functioning Module

This study used a draft of the CFM (5–17 year age group) current at February 2015, with permission from UNICEF and the Washington Group. Appendix A lists the differences between the version used in the study and the final version of the CFM, which is available from www.washingtongroup-disability.

com. Translation and pretesting processes are described in [21]. For the diagnostic accuracy analysis in this paper, only seven CFM domains are included (seeing, hearing, walking, speaking, and three cognitive domains—learning, remembering and focusing attention) as these relate directly to constructs measured in the clinical assessments.

For clarity, the term "CFM-7" is used throughout this paper when referring to this group of domains. For other analysis in the paper the remaining domains (self-care, anxiety/worry, sadness/depression, controlling behaviour, accepting changes to routine and making friends) are included and the term "CFM-13" is used to refer to the entire module. Table 2 provides the wording of the CFM questions and response categories and illustrates the domains referred to by the terms CFM-7 and CFM-13.

Table 2. CFM domains, question wording and response categories; coded to indicate which group of domains was used in the various analyses in this paper.

Code Used in This Paper		Domain	CFM Question	Response Categories
CFM-13	CFM-7	Seeing	** Does (*child's name)* have difficulty seeing?	(1) No difficulty (2) Some difficulty (3) A lot of difficulty (4) Cannot do at all
		Hearing	** Does (*child's name)* have difficulty hearing sounds like peoples' voices or music?	
		Walking	** Does (*child's name)* have difficulty walking 100 metres on level ground? Does (child's name) have difficulty walking 500 metres on level ground?	
		Speaking	When (child's name) speaks does he/she have any difficulty being understood by: • People inside this household • People outside this household	
		Learning	Compared with children of the same age, does (*name*) have difficulty learning things?	
		Remembering	Compared with children of the same age, does (*name*) have difficulty remembering things?	
		Focusing attention	Does (*name*) have difficulty focusing on an activity that he/she enjoys doing?	
		Self-care	Does (*name*) have difficulty with self-care such as feeding or dressing him/herself?	
		Accepting changes to routine	Does (*name*) have difficulty accepting changes in his/her routine?	
		Making friends	Does (*name*) have difficulty making friends?	
		Anxiety/ worry	How often does (*name*) seem anxious, nervous or worried?	(1) Daily (2) Weekly (3) Monthly (4) A few times a year (5) Never
		Depression/sadness	How often does (*name*) seem sad or depressed?	
		Controlling behaviour	Compared with children of the same age, how much difficulty does (*name*) have controlling his/her behaviour?	(1) No difficulty (2) The same or less (3) More (4) A lot more

** The CFM includes questions to establish whether the child wears glasses, uses a hearing aid, or uses any equipment or receives assistance for walking. If the child does use the assistive device, the question for seeing is "When wearing his/her glasses, does *(name)* have difficulty seeing?" Similar questions are asked for hearing and walking. The CFM has separate questions for difficulty walking with and without equipment for children who need equipment. Analysis for this paper includes: difficulty walking for children who do not need equipment, plus those who require equipment but have difficulty walking without their equipment (this allows comparison with the Rapid Assessment of Musculoskeletal Impairment which tests function without equipment).

2.2.2. Reference Standard (Clinical) Tests

Clinical tests were undertaken for vision, hearing, musculoskeletal impairment, speech and cognition using reference standard (clinical) tests considered the best available tests regarding the conditions of interest [26,27]. The clinical tests for this study were selected based on international standards for vision and hearing and well validated tools for speech, musculoskeletal impairment and cognitive impairment. Detailed descriptions of these assessments and how they were implemented in this study are available elsewhere [22–24] and summarised in Appendix B.

Case definitions. Vision impairment: presenting visual acuity in the better eye <6/18 and ≥6/60 (moderate), <6/60 and ≥3/60 (severe) and <3/60 (blind) [29]. Hearing loss: 41–60 dBA (moderate), 61–80 dBA (severe) and ≥81 dBA (profound). Children identified on the Rapid Assessment of Musculoskeletal Impairment with structure impairment including "severe", "moderate" and "mild" effect on the musculoskeletal system's ability to function as a whole were identified as cases with mobility impairment [30]. Children identified to have impairment only affecting the upper limb were excluded to enable comparison with the CFM question on walking. Speech impairment: Intelligibility in Context Scale [23,31] scores: 1.8 to <2.5 (moderate) and 1.0 to <1.8 (severe). Cognitive impairment: assessed using the Cambridge Neuropsychological Test Automated Battery (CANTAB) [32], subjects with Overall Impairment Scores of 3 (moderate) and 4–5 (severe) [22].

2.2.3. Implementation of the Index Test and Clinical Tests

Assessment camps were run over two to five days at each school in rooms set up with multiple assessment stations. Parents/caregivers attended the screening camp where an interviewer administered the CFM in a location separate from the reference standard assessments, using either the Fijian, Fijian-Hindi or English version depending on parent preference. Interviewers had received a half-day training in administration of the questionnaire. In-situ training also occurred during the early stages of data collection, with the lead researcher providing clarification about administration as questions arose. It was self-completed by teachers either during the camp or within the following week; teachers received no training other than instructions to carefully follow the skip-prompts in the questionnaire. The clinical team were blinded to the CFM results and teachers and parents were blinded to each other's CFM responses and to clinical results.

2.3. Data Analysis

Statistical analysis was undertaken using SPSS Version 24 (IBM, Armonk, NY, USA) and MedCalc v.17.6 (MedCalc Software, Ostend, Belgium). Descriptive statistics were calculated for participant demographics and CFM-7 results were cross-tabulated by clinical results. To analyse diagnostic accuracy of the CFM-7, the case definition was: child has impairment in at least one of the five clinical assessments (see "Case definitions" above). The definition to determine CFM-7 response was the highest level of difficulty reported against any of the seven domains. For example, for a child assessed as having "a lot of difficulty" seeing and "some difficulty" speaking, the overall CFM response would be recorded as "a lot of difficulty".

Sensitivity (Sn), specificity (Sp) and likelihood ratios (LR) were calculated for each respondent type (parent or teacher) for each cut-off level. True positives are children with impairments (assessed using the reference standard (clinical) assessments, defined by the case definitions in Section 2.2.2), who are correctly identified by the CFM as having difficulty in the respective functioning domain. True negatives are children without impairments who are correctly identified by the CFM as not having difficulty in the respective domain. False positives are children without impairments who are incorrectly identified by the CFM as having difficulty. False negatives are children with impairments who are incorrectly identified by the CFM as not having difficulty. Positive (and negative) LRs indicate how many times more likely a positive (or negative) test result is obtained when the target condition is present than when it is absent:

Sn = true positives/total cases
Sp = true negatives/total controls
Positive LR = Sn/(false positives/total controls)
Negative LR = (false negatives/total cases)/Sp

Receiver operating characteristic (ROC) curves were constructed separately for parent and teacher CFM-7 responses to determine the Area Under the ROC Curve (AUC). ROC curves are constructed by plotting the false-positive rate (1—specificity) against the true-positive rate (sensitivity) at each cut-off value defined by the CFM and then drawing a line from x = 0, y = 0 through the values at each cut-off point; the AUC is an overall figure of diagnostic accuracy with a perfect test having a value of 1.0 and a value of 0.5 suggesting that the test result is no better than chance [33,34]. AUC interpretations were classified as excellent (0.96–1.0), very good (0.9 to <0.96), good (0.8 to <0.9), fair (0.7 to <0.8), poor (0.6 to <0.7), and useless (0.5 to <0.6) [33]. ROC curves used dichotomous clinical variables, differentiating cases and controls based on definitions outlined earlier.

The Youden Index (YI) was calculated for each ROC curve to determine the statistically "optimal" cut-off level for each disability domain (seeing, hearing, walking, speaking, learning, remembering and focusing attention) and respondent type. The YI is the maximum vertical distance between the ROC curve and the line of random chance ([x = 0, y = 0] to [x = 1, y = 1]) and is calculated as maximum (Sn + Sp − 1). That is, the cut-off point at which (sensitivity + specificity − 1) is maximal, is taken to be the "optimal" cut-off point [35]. Importantly, the YI gives equal weight to false positive and false negative values, which means that it does not vary based on the context or aim of the test. For the purpose of this study, it is a useful index to provide consistency in our comparisons between disability domains, the CFM as a whole, and respondent types. For determining the best choice, or contextually "optimal", cut-off level for Fiji's MoE, the advantages and disadvantages of valuing sensitivity or specificity more highly are considered in depth in the Discussion.

Throughout the paper, results related to parents as proxy respondents are denoted by a subscript P and those by teachers by a subscript T.

For the domains without clinical reference standards in this study (self-care, anxiety, depression, controlling behavior, accepting changes to routine, and making friends), proportions of the sample reported as ≥ "some difficulty" and ≥ "a lot of difficulty" were compared. These two cut-off values were compared because the recommendation from the WG is to use "a lot of difficulty" [20,36] but previous results have raised concerns about the low sensitivity of this cut-off [13,21,23]. Also, a comparison of the clinical impairments of children identified at both cut-offs was undertaken, comparing "some difficulty" to ≥ "a lot of difficulty" on the CFM-13.

Inter-rater reliability between parents and teachers was tested using a two-way random, absolute, average-measures intra-class correlation (ICC) [37]). Using Cicchetti's classification [38], IRR interpretations were classified as: poor (<0.40), fair (0.40–0.59), good (0.60–0.74), and excellent (0.75–1.00). Cicchetti is slightly more generous than other classifications [39,40].

Spearman's rho correlation coefficient was used to test correlations between age, gender, and school type and CFM items, using the criteria: very high (0.90–1.00), high (0.70 < 0.90), moderate (0.50 < 0.70), low (0.30 < 0.50) and negligible (0.00 < 0.30) [41].

Unless otherwise noted the two CFM questions on difficulty being understood when speaking by people: (1) inside the household, and (2) outside the household, have been combined as per the WG recommendation - to use the most severe response reported for either question [20].

3. Results

3.1. Participant Demographics and Distribution of Impairments

The sample included 472 children with mean ± SD age of 10.2 ± 2.6 years (range: 5 to 15 years) in Classes 1 to 8, including approximately half from special and half from mainstream schools (Table 1). There were 231 cases in the study and 241 controls, determined by clinical assessments. Cases included

35 children with vision impairment ranging from moderate vision impairment to total blindness, 60 children with hearing impairment from moderate hearing loss to profound deafness, 42 children with mild to severe mobility impairments, 71 children with moderate to severe speech impairment, and 125 children with moderate to severe cognitive impairment (Table S1). The mean age of cases was 10.15 years and controls was 9.71 years. Females made up 37.2% of cases and 51.0% of controls. Ninety-eight teachers participated, of whom 69% were female. Of the parents/guardians of the cases: 56% were mothers, 19% fathers, and 25% other (grandparent, aunty, uncle, guardian); the highest level of education was primary for 25%, secondary for 56% and higher education for 19%. Of the parents/guardians of the controls: 60% were mothers, 25% fathers, and 15% other; the highest level of education was primary for 22%, secondary for 63% and higher education for 15%.

3.2. Validity (Sensitivity and Specificity) of Different Cut-Off Levels of the CFM

3.2.1. Diagnostic Accuracy of the CFM

Table S2 presents values of area under the curve (AUC), sensitivity, specificity, the Youden Index for the optimal cut-off points and likelihood ratios from the construction of ROC curves. Table 3 provides a summary of key data from Table S2.

Table 3. Diagnostic accuracy of the Child Functioning Module (CFM-7); parent versus teacher responses, comparing two cut-off levels: "some difficulty" to "a lot of difficulty".

Domain	AUC		Youden Index "some difficulty"		Youden Index "a lot of difficulty"	
	Parent	Teacher	Parent	Teacher	Parent	Teacher
Overall CFM-7	0.763	0.786	0.31	0.38	0.36	0.39
Seeing	0.848	0.823	0.69	0.61	0.13	0.35
Hearing	0.847	0.846	0.66	0.67	0.38	0.49
Walking	0.889	0.869	0.73	0.69	0.57	0.47
Speaking	0.975	0.909	0.88	0.70	0.75	0.60
Learning	0.774	0.822	0.51	0.60	0.21	0.27
Remembering	0.663	0.781	0.29	0.54	0.14	0.17
Focusing attention	0.623	0.686	0.24	0.37	0.05	0.10

Domain-specific results shown in Table 3 (eg., seeing, hearing) are discussed elsewhere and provided here to enable comparison with the overall CFM-7 result (see Table 2 for definition of CFM-7). In summary, the accuracy (AUC) of the CFM items on seeing, hearing, walking and speaking were higher than the items on learning, remembering and focusing attention. The lower levels for learning, remembering and focusing attention led to the CFM-7 as a whole having an AUC that was only "fair" (0.763_P/ 0.786_T); with slightly better overall accuracy by teachers. As shown in Table S2, levels of sensitivity were very consistent between parents and teachers across the cut-off levels, with "some difficulty" being $0.98_P/0.96_T$, "a lot of difficulty" being $0.55_P/0.57_T$, and "cannot do at all" being $0.23_P/0.22_T$. Whilst teachers had higher specificity than parents at the cut-off "some difficulty" ($0.33_P/0.42_T$), results were more consistent at the higher levels; "a lot of difficulty" being $0.80_P/0.82_T$, and "cannot do at all" being $0.99_P/0.99_T$.

3.2.2. Cross-Tabulation of CFM Results by Clinical Test Results

Table 4 presents the spread of CFM-7 responses across impairment levels - none, mild, moderate and severe. Table S3 provides an extended presentation of Table 4 showing cross-tabulation of the highest level of severity of the child on any of the five reference standard results (vision, hearing, musculoskeletal, speech, cognition) with the highest level of difficulty reported for that child on any CFM-7 response.

Table 4. Cross-tabulation: Child Functioning Module results (CFM-7) by level of impairment.

CFM	Total *n* (%)		Impairment Level Based on Reference (Clinical) Assessments *, *n* (%)							
Difficulty in any CFM-7 Domain *	Parent, *n* = 472	Teacher, *n* = 392	None		Mild		Moderate		Severe	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	84 (17.8)	85 (21.7)	78 (33.9)	74 (43.8)	2 (10.5)	2 (11.8)	3 (4.8)	6 (10.9)	1 (0.6)	3 (2.0)
Some	212 (44.9)	154 (39.3)	109 (47.4)	66 (39.1)	8 (42.1)	10 (58.8)	33 (52.4)	26 (47.3)	62 (38.8)	52 (34.4)
A lot	122 (25.8)	104 (26.5)	41 (17.8)	27 (16.0)	9 (47.4)	5 (29.4)	25 (39.7)	19 (34.5)	47 (29.4)	53 (35.1)
Cannot do	54 (11.4)	49 (12.5)	2 (0.9)	2 (1.2)	0 (0.0)	0 (0.0)	2 (3.2)	4 (7.3)	50 (31.3)	43 (28.5)

* Child is recorded in the highest level of difficulty from any of the CFM-7 questions on seeing, hearing, walking, being understood when speaking, learning, remembering and focusing attention, and in the highest level of severity from any of the five reference standard assessments for vision, hearing, musculoskeletal, speech and cognitive impairment.

There was strong consistency between parent and teacher results in the overall proportions of children categorised as having "a lot of difficulty" ($25.8\%_{P}/26.5\%_{T}$) and "cannot do at all" ($11.4\%_{P}/12.5\%_{T}$). Parents reported slightly more children as having "some difficulty" ($44.9_{P}/39.3\%_{T}$) and slightly fewer children as having "no difficulty" ($17.6\%_{P}/21.7\%_{T}$). Most moderate impairments are reported by parents and teachers as "some difficulty". Severe impairments are reported approximately evenly across three CFM response categories: "some difficulty", "a lot of difficulty" and "cannot do at all". Most children with no impairments are mainly reported as having "no difficulty" ($33.9\%_{P}/43.8\%_{T}$), or "some difficulty" ($47.4\%_{P}/39.1\%_{T}$). However, a notable proportion ($17.8\%_{P}/16.0\%_{T}$) are reported as having "a lot of difficulty", which is predominantly related to items on learning, remembering and focusing attention (as shown in Table S3). Children with mild impairments are mainly reported as having "some difficulty" ($42.1\%_{P}/58.8\%_{T}$) and "a lot of difficulty" ($47.4\%_{P}/29.4\%_{T}$).

Problematically, the response category "some difficulty" includes children with a wide range of functioning. Of children with moderate clinical impairments, $52.4\%_{P}/47.3\%_{T}$ are reported as just having "some difficulty", and of the children with severe impairments, $38.8\%_{P}/34.4\%_{T}$ are recorded as just "some difficulty".

3.2.3. ROC Curve Analysis Implications for Cut-Off Level

Table 3 (and Table S2) show the YI for parent and teacher responses at the cut-off levels "some difficulty" and "a lot of difficulty" for each domain-specific question and for the CFM-7. For all seven domain-specific questions, the YI for the cut-off "some difficulty", for both parent and teacher responses, is clearly higher than the YI for the cut-off "a lot of difficulty". However, when considering the accuracy results for the CFM-7 (that is, the combined results), this is reversed and the cut-off "a lot of difficulty" is the highest.

The positive likelihood ratio at the level of "some difficulty" is $1.46_{P}/1.66_{T}$, compared to $2.78_{P}/3.21_{T}$ at the level "a lot of difficulty". This means that the cut-off "some difficulty" provides a 'minimal increase' in the probability of the CFM-7 identifying disability in a child with disability compared to a child without. This is improved upon only somewhat by the cut-off "a lot of difficulty" which provides a 'small increase'. The negative likelihood ratios for the overall CFM-7 at the cut-off "some difficulty" indicate a 'large and often conclusive' decrease in the likelihood that a negative result comes from a child with disability than from a child without disability. Whereas at the cut-off "a lot of difficulty" there is only a 'small' to 'minimal decrease' in this likelihood. These results should be interpreted cautiously though because the confidence intervals for the higher cut-offs were very wide due to small sample sizes.

3.2.4. Domains without Clinical Reference Standard

Table 5 summarizes the analysis of CFM domains that did not have clinical reference standard tests—self-care, anxiety, depression, controlling behaviour, accepting changes, and making friends. It highlights the proportion of responses for each domain at the level of at least "some difficulty" compared to at least "a lot of difficulty". Parents and teachers reported a similar proportion having at least "some difficulty" with self-care (20.1%$_P$/21.6%$_T$), with "good" correlation between respondents (0.72). However, teachers reported a higher proportion having at least "a lot of difficulty" with self-care (2.3%$_P$/6.2%$_T$). Parents and teachers reported a similar proportion of the sample as feeling anxious or depressed "weekly", but correlation was "negligible" ($\leq$ to 0.26). Teachers reported a higher proportion of the sample as feeling anxious or depressed "daily". Whilst data are not shown here, teacher responses showed a high correlation between learning and remembering (0.758), and depression and anxiety (0.729), and a moderate correlation between accepting changes to routine and focusing attention (0.546), self-care and walking (0.520), learning and being understood outside (0.511), focusing attention and learning (0.502), and accepting changes to routine and learning (0.502). Parent correlations for the same domains were far lower, ranging from 0.152–0.527.

Table 5. Proportion endorsing each domain at the cut-off level "some difficulty" compared to "a lot of difficulty", and inter-rater reliability between parents versus teachers.

Cut-Off Level	≥ Some Difficulty/Weekly *					≥ Lot of Difficulty/Daily *				
Respondent	Parent *n* (%)	Teacher *n* (%)	ICC	95% CI	Sig.	Parent *n* (%)	Teacher *n* (%)	ICC	95% CI	Sig.
Self-care	95 (20.1)	84 (21.6)	0.72	0.66–0.77	0.000	11 (2.3)	24 (6.2)	0.42	0.30–0.53	0.000
Feeling anxious *	117 (24.8)	103 (26.9)	0.26	0.10–0.40	0.002	42 (8.9)	51 (13.3)	0.09	−0.02–0.25	0.186
Feeling sad *	121 (25.7)	89 (23.4)	0.19	0.01–0.34	0.021	36 (7.6)	35 (9.2)	0.08	−0.03–0.25	0.211
Controlling behaviour $^{\Omega}$	NA	NA	-	-	-	67 (14.2)	72 (18.8)	0.20	0.02–0.34	0.015
Accepting changes	232 (49.4)	153 (39.2)	0.14	−0.05–0.29	0.075	39 (8.3)	27 (6.9)	0.09	−0.12–0.25	0.190
Making friends	79 (16.8)	85 (21.9)	0.34	0.19–0.46	0.000	14 (3.0)	21 (5.4)	0.25	0.82–0.38	0.003

ICC = Intraclass correlation; $^{\Omega}$ = more difficulty and a lot more difficulty.

Overall, the proportions of children reported as "some difficulty" in the domains in Table 5 seem very high, but without a reference standard it is not possible to know whether this is reflective of disability.

3.2.5. Impairments Represented within Cut-Off Levels across the CFM-13

To further explore the rate of clinical impairments amongst children identified at the two cut-off levels ("some difficulty" and "a lot of difficulty"), Table 6 shows the frequencies of any impairment occurring amongst children reported as having "some difficulty" compared to ≥ "a lot of difficulty" on any question on the CFM-13. Table 7 is similar, but shows the frequencies of the individual impairments. As expected, with the larger number of questions on the CFM-13, slightly fewer children are missed compared to the CFM-7.

Table 6. Frequencies of any impairment occurring amongst children reported as having a highest level of difficulty of at least "some difficulty" compared to at least "a lot of difficulty" on any question on the CFM (CFM-13), comparing parent and teacher responses.

CFM-13 (Highest Level of Difficulty on Any Question)	Impairment Level Based on Reference Standard (Clinical) Assessments, *n*(%)									
	Controls						Cases			
	n		No Impairment		Mild Impairment		Moderate Impairment		Severe Impairment	
	P	T	Parent *n* = 230	Teacher *n* = 169	Parent *n* = 19	Teacher *n* = 17	Parent *n* = 63	Teacher *n* = 55	Parent *n* = 160	Teacher *n* = 151
Some difficulty	189	117	113 (59.8)	62 (53.0)	7 (3.7)	6 (5.1)	25 (13.2) *(39.7)*	18 (15.4) *(33.3)*	44 (23.3) *(27.5)*	31 (26.5) *(20.5)*
≥ Lot of difficulty	231	198	70 (30.3)	40 (20.2)	11 (4.8)	9 (4.5)	35 (15.2)	32 (16.2)	115 (49.8)	117 (59.1)
Intraclass correlation, 95% confidence intervals, significance			ICC = 0.61 (95%CI 0.47–0.71, 0.000)		ICC = 0.85 (95%CI 0.58–0.94, 0.000)		ICC = 0.06 (95%CI −0.62–0.46, 0.408)		ICC = 0.55 (95%CI 0.38–0.68, 0.000)	

Table 7. Frequencies of five types of impairment occurring amongst children reported as having a highest level of difficulty of at least "some difficulty" compared to at least "a lot of difficulty" on any question on the CFM (CFM-13), comparing parent and teacher responses.

CFM-13 (Highest Level of Difficulty on Any Question)	Impairment Level Based on Reference Standard (Clinical) Assessments, *n*(%)									
	Controls						Cases			
	n		No Vision Impairment (≥6/9 ¥)		Mild VI (<6/9 ≥6/18 ¥)		Moderate VI (<6/18 ≥6/60 ¥)		Severe-Blind (<6/60 ¥)	
	P	T	Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
Some difficulty	169	109	149 (88.2)	101 (92.7)	2 (1.2)	2 (1.8)	4 (2.4)	1 (0.9)	14 (8.3)	5 (4.6)
≥ Lot of difficulty	196	157	176 (89.8)	134 (85.4)	3 (1.5)	2 (1.3)	7 (3.6)	7 (4.5)	10 (5.1)	14 (8.9)
	n		No Hearing Impairment(<26 dBA)		Mild HI (26–40 dBA)		Moderate HI (41–60 dBA)		Severe-Profound HI (≥61 dBA)	
	P	T	Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
Some difficulty	164	103	138 (84.1)	85 (82.5)	15 (9.1)	11 (10.7)	8 (4.9)	4 (3.9)	3 (1.8)	3 (2.9)
≥ Lot of difficulty	145	132	110 (66.3)	78 (59.1)	15 (9.0)	16 (12.1)	12 (7.2)	11 (8.3)	29 (17.5)	27 (20.5)
	n		No musculoskeletal impairment (MSI) ^		Mild MSI (5–24%) ^		Moderate MSI (25–49%) ^		Severe MSI (50–90%) ^	
	P	T	Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
Some difficulty	175	111	169 (96.6)	105 (94.6)	3 (1.7)	2 (1.8)	3 (1.7)	3 (2.7)	0 (0.0)	1 (0.9)
≥ Lot of difficulty	208	185	172 (82.7)	152 (82.2)	6 (2.9)	6 (3.2)	11 (5.3)	11 (5.9)	19 (9.1)	16 (8.6)
	n		No speech impairment (4.0–5.0 ICS) ₱		Inconclusive speech function (2.5 < 4.0 ICS) ₱		Moderate speech impairment (1.8 < 2.5 ICS) ₱		Severe speech impairment (1.0 < 1.8 ICS) ₱	
	P	T	Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
Some difficulty	185	114	141 (76.2)	72 (63.2)	38 (20.5)	31 (27.2)	4 (2.2)	3 (2.6)	2 (1.1)	8 (7.0)
≥ Lot of difficulty	226	194	71 (31.4)	71 (36.6)	90 (39.8)	68 (35.1)	17 (7.5)	16 (8.2)	48 (21.2)	39 (20.1)
	n		Average/better cognitive function		Low average cognitive function		Moderate cognitive Impairment		Severe cognitive impairment	
	P	T	Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
Some difficulty	91	67	14 (15.4)	6 (9.0)	35 (38.5)	27 (40.3)	14 (15.4)	16 (23.9)	28 (30.8)	18 (26.9)
≥ Lot of difficulty	108	102	5 (4.6)	3 (2.9)	24 (22.2)	16 (15.7)	30 (27.8)	25 (24.5)	49 (45.4)	58 (56.9)

VI = Vision impairment; HI=Hearing impairment; MSI = Musculoskeletal impairment (mobility only); ¥ Visual Acuity of better eye; NPL—no perception of light; CF2m—counting fingers at 2metres. ^ Severity for the Rapid Assessment of Musculoskeletal Impairment was determined using the parameters for the percentage of function outlined in the International Classification of Functioning (ICF) [42]. Percentage loss of the musculoskeletal systems ability to function as a whole. ₱ Intelligibility in Context Scale—scores between 1.0–2.43 (detailed in [23]. For this paper, severe vision impairment and blindness are combined in one category and severe and profound hearing impairment are combined in one category. Results with these severities separately reported is available in [21].

Table 7 shows that children with moderate impairments that would be missed if the cut-off were "a lot of difficulty" are spread across all types of impairments, however it is the cognitive impairments that are missed more than other impairment domains.

Using the "a lot of difficulty" cut-off, 39.7%$_P$/33.3%$_T$ of the children with moderate impairments and 27.5%$_P$/20.5%$_T$ of the children with severe impairments would be missed. Of all the types of impairment, those with moderate or severe cognitive impairment form the greatest proportion of children who would be missed if the cut-off were "a lot of difficulty". These results do not indicate how many children with other impairments such as psychosocial or behavioural (which require other clinical assessments) may be missed.

3.3. Inter-Rater Reliability of the CFM

Inter-rater reliability between parents and teachers, assessed using ICC, varied considerably across disability domains as shown in Figure 1.

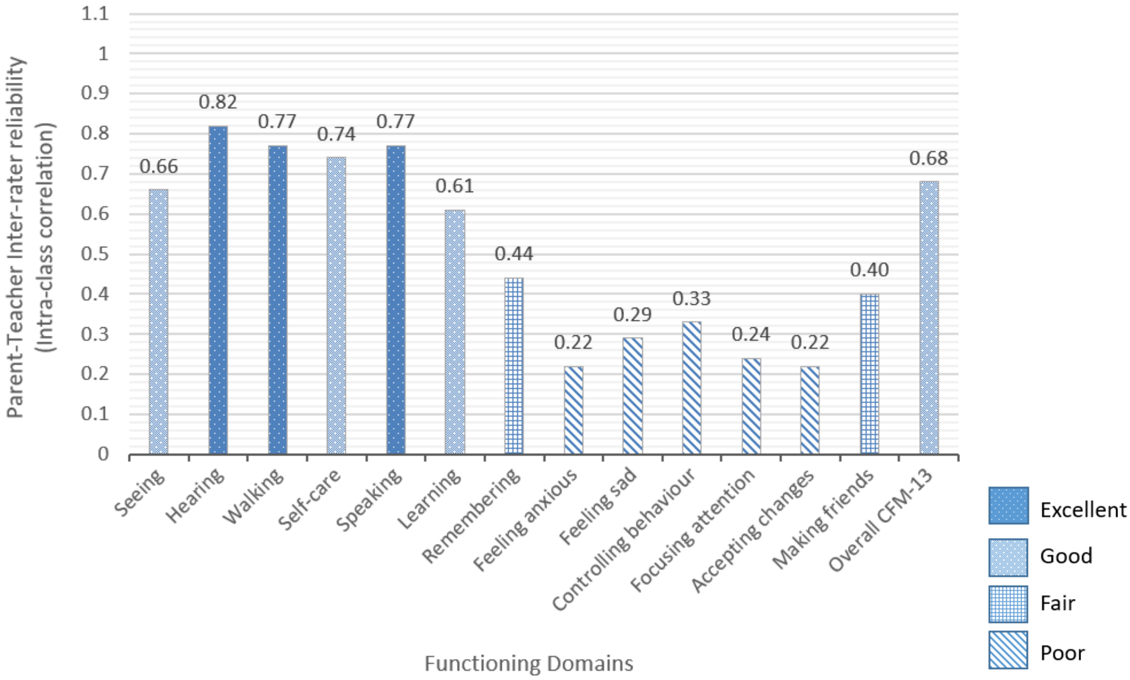

Figure 1. Inter-rater reliability between parents and teachers of the overall CFM (CFM-13) and of individual domains.

For the overall CFM-13 it was 0.68 (95% CI 0.60–.73). The range of ICC was 0.22–0.82 across the individual domains. Domains with better ICC (0.61–0.82 were hearing, walking, speaking, self-care, seeing and learning. Domains with lower ICC (0.22–0.33) were anxiety, sadness, controlling behaviour, focusing attention and accepting changes to routine. Table 6 shows better correlations for overall categorisation of children with no impairment (0.61) and mild impairment (0.85) across the categories "some difficulty" and "a lot of difficulty". However, correlations are worse for children with moderate impairment (0.06, not significant) and severe impairment (0.55). On the whole, correlations between teachers and parents were variable.

4. Discussion, Limitations and Further Research

This study identified that the CFM is a useful core aspect of data required for disability disaggregation of Fiji's EMIS and that teachers are adequately accurate proxy respondents to the CFM. However, the mixture of severity of impairments reported across CFM response categories and ambiguity in the choice of cut-off level, in both parent and teacher results, are limitations of the CFM and indicate that the CFM may not be accurate enough to be used as the sole method for identifying children with disabilities.

The first objective of this study was to determine the validity (sensitivity and specificity) of the CFM, which is operationally defined as the extent to which an overall score on the CFM at a given cut-off level identifies children who have an impairment as assessed using reference standard, or "gold standard", clinical measures. For assessing sensitivity and specificity of the CFM, this paper effectively defines disability as clinically assessed impairment of a moderate or more severe level. There is debate about this medical perspective but for our purposes, it provides an objective assessment (in the sense of being made independently of those who stand to gain or lose from the assessment, or might perceive that they do), and so we have accepted it as the best available reference standard.

Overall diagnostic accuracy (a combined value of sensitivity and specificity) of the CFM was found to be just "fair" based on combined results from seeing, hearing, walking, speaking, learning, remembering and focusing attention, i.e., CFM-7. This is substantially lower than the previously reported accuracy of individual domain-specific questions on speaking, walking, seeing and hearing [21,23], which are perhaps more observable functions. The cognitive domains had "fair" to "poor" accuracy (22). Given the variation in accuracy across the different domains in the module ranging from excellent to poor, it is not surprising that overall accuracy is only "fair". This finding indicates that CFM-7 may not be accurate enough to be used as the sole method for identifying children with disabilities.

Whilst diagnostic accuracy of parent observations related to seeing, walking and speaking is stronger than that of teachers, teacher accuracy is acceptable, ranging from "good" to "very good" (between 0.823–0.909). Conversely, for the domains learning, remembering and focusing attention, teacher results are stronger than parent results. For hearing, the accuracy is high and very similar between respondent types.

To disaggregate Fiji's EMIS by disability, it is important to identify the appropriate cut-off level of the CFM. The field testing of CFM as part of population-based surveys in Samoa, Mexico and Serbia showed that the "some difficulty" cut-off estimates a very high prevalence compared to the "a lot of difficulty" cut-off [15]. The cut-off recommended by UNICEF/ Washington Group is "a lot of difficulty" [20]. However, in our study a significant proportion of children with moderate or higher clinical impairment were reported as having only "some difficulty" on CFM-7, comprising seeing, hearing, walking, speaking, learning, remembering and focusing attention domains (Table 3). These children would therefore miss out on services if the cut-off were "a lot of difficulty". Based just on these domains, approximately half of children with moderate clinical impairments ($52.4\%_P/47.3\%_T$) and a third of children with severe impairments ($38.8\%_P/34.4\%_T$) would miss out on services if the cut-off level were "a lot of difficulty". However, when CFM-13 was considered (which includes the additional 6 questions), not surprisingly the chance of missing children is reduced, and the proportions were reduced to some extent. Despite this, $39.7\%_P/33.3\%_T$ of children with moderate clinical impairments and $27.5\%_P/20.5\%_T$ of children with severe impairments would be missed. When domain-specific findings are considered, it is the children with moderate-severe cognitive impairments who miss out in greatest numbers [21–23]. The decision to select a cut-off must also consider the fact that $47.8\%_P/39.1\%_T$ of children with no clinical impairment are reported as having "some difficulty". Our findings indicate that children reported as having "some difficulty" can neither be ignored nor be assumed to have disability.

The cross-tabulation also highlights the fact that the three CFM response categories—"some difficulty", "a lot of difficulty" and "cannot do at all"—do not relate to the same levels of severity across different functioning domains. This is in contrast with the recommendations on the interpretation of these categories by UNICEF/Washington Group [20] and USAID [17]. Whilst most moderate impairments are reported as "some difficulty", children with severe impairments are showing up relatively evenly across the three response categories, and the response categories do not have the same meaning across different domains. For example, the category "cannot do at all" picks up a large proportion of children with severe musculoskeletal impairment yet it picks up only approximately 2% of children with severe cognitive impairment. This extreme response category is used to a small extent for questions on hearing, walking, speaking and seeing, but almost never used for questions on learning, remembering and focusing attention.

The CFM is described as being able "to determine the proportion of those who have mild difficulties (at least *some difficulty* on one or more domains of functioning), or moderate levels of difficulty (those who respond at least *a lot of difficulty*) or those with severe difficulties (those who respond *cannot do at all*)" [36] (p. 487). However, our findings suggest that this interpretation of the CFM response categories across disability domains would not work in Fiji. Mitra emphasised the value of using a "trichotomy" (severe, moderate and no difficulty), in which classification of people with moderate functional difficulty was based on "some difficulty" in at least one domain with no higher levels of difficulty recorded [43]. This is consistent with our finding that the cut-off "some difficulty" included most of our children with moderate impairments, however the challenge remains that many children without impairments were also recorded as having "some difficulty".

The ROC curve results from earlier reports were complicated and varied across domains and methods, including sensitivity, specificity, the Youden Index and likelihood ratios. For the domains seeing, hearing, walking and speaking, "some difficulty" was a far more accurate cut-off than other levels [21,23]. The cognitive domains learning, remembering and focusing attention also indicate the cut-off "some difficulty" as the best, with teacher results being superior to parents at identifying children with cognitive impairments [22].

However, contrary to the individual domain-specific results, the diagnostic accuracy results for the CFM-7 showed "a lot of difficulty" as the best cut-off, albeit only marginally better. This is because at "some difficulty" sensitivity is excellent ($0.98_P/0.96_T$) but specificity is very poor ($0.33_P/0.42_T$). At the cut-off "a lot of difficulty" specificity was much better ($0.80_P/0.82_T$) but sensitivity dropped significantly ($0.55_P/0.57_T$). Notably, the Youden Index for the overall CFM was quite low at either cut-off ($0.31_P/0.40_T$ for "some difficulty" and $0.36_P/0.39_T$ "a lot of difficulty"). This was not surprising given the disappointing diagnostic accuracy of the CFM-7 as only "fair". These results further highlight an important shortcoming in diagnostic accuracy of the CFM-7: there is no clear and strong cut-off response category for the overall CFM and the cut-off which performs best for individual functional domains is different from that for the overall module.

The high proportion of children reported as having "some difficulty" on the six domains without a clinical reference standard highlights the need for further research to understand the impact of the cut-off level on identifying children with difficulties in these domains.

The second objective was to determine the inter-rater reliability between teacher and parent CFM responses. Our study showed that IRR of the CFM-13 is "good" (0.68), which in theory contributes to the case that the CFM can be used with teachers as respondents. However, there is great variation in IRR across domains [21–23]. The potentially more observable domains (hearing, walking and speaking) have "excellent" IRR followed by "good" IRR for self-care, seeing and learning.

However, IRR needs to be considered in relation to accuracy. For example, if both respondents are equally "wrong", the IRR may be high but this does not mean the tool is useful. Or, if parent responses are "wrong", a low IRR could be positively interpreted in terms of teacher use of the tool. Considering accuracy together with IRR between parents and teachers, the most accurate and reliable CFM questions relate to the domains of seeing, hearing, walking and speaking. Of the CFM questions for which this study does not have clinical reference standards (and therefore no diagnostic accuracy analysis)—self-care, anxiety, sadness, controlling behaviour, accepting changes and making friends—it is harder to interpret the largely poor IRR results. This may reflect poorly on the questions or may imply varying perspectives and accuracy between parents and teachers; teachers may be in a better position to make a relative judgment for some of these items. The higher correlations between teacher results for domains which might be expected (anxiety and depression; learning and remembering; changes to routine and focusing attention) provide some indication that teachers are observing these functional domains more consistently than parents and that teacher results may be more accurate in these domains. In relation to anxiety and depression, the results highlight a potentially important role for teachers in Fiji in identifying children at risk of psychosocial distress. These issues both point to important areas for future research. Research is required to investigate parent and teacher response accuracy for these domains.

Fiji's MoE has committed to provide inclusive education in a way which leaves no one behind [44] and following this study commenced disability inclusion grants to schools, calculated by number of children with disabilities. Messick [45] and Shepard [46] championed the importance of undertaking "consequential validity", or investigation and prediction of positive and negative social consequences of a test. The implication of Fiji's policy, in relation to this study, is that if a cut-off level has a low sensitivity it misses out eligible children, which would be the case if "a lot of difficulty" were used. Hence to ensure children are not missed the cut-off "some difficulty" must be used. However, given the significant proportion of children classified as "some difficulty" who do not have disability, follow-up assessments are required to verify presence of disability (and to identify children for whom referral services are required).

Conversely the low specificity of the "some difficulty" cut-off has cost implications regarding verification visits. Travelling to remote areas to assess children simply based on a self-reported "some difficulty" response would be cost-prohibitive and an inefficient use of already stretched MoE staff time. A solution to this challenge may be found in another series of results from the study, to be discussed in a subsequent paper, showing that the combination of CFM data and learning and support needs data enables a much more accurate estimation of disability. This would reduce false positives on the list of children who need verification visits.

An essential feature of the CFM to highlight, in relation to assessing disability for funding eligibility, is the self-report nature of the tool. Whether the respondent is a parent/caregiver or a teacher, the results can be biased if there is perceived financial advantage in reporting higher levels of difficulty. The disability verification visit is necessary to pre-empt over-reporting. These visits involve qualified MoE district officers visiting the schools to discuss the results with teachers and undertake basic tests with the identified children, such as visual acuity tests (Snellen chart), observations of gross and fine motor function, classroom observation, review of student records, etc. The visit offers the chance for monitoring and mentoring of efforts towards disability-inclusive education.

Limitations

An important limitation common to all diagnostic accuracy studies is the assumption that the clinical assessment standards are 100% sensitive and specific themselves. That is, that the tests for vision, hearing, musculoskeletal impairment, speech and cognition are indeed "gold standards" against which the CFM can be measured. The justification for selection of the five clinical assessments along with measures to ensure accuracy of the tests and to reduce classification bias [47] have been presented in detail elsewhere [21–23] and is summarised in Appendix B.

The five clinical assessments did not cover all the functioning constructs that are covered by the whole CFM (the CFM-13), specifically self-care, anxiety/worry, depression/sadness, behaviour and socialisation. We attempted to overcome this limitation by making interpretations based on IRR and simple proportions reported in different severity levels of the CFM-13. However, an outstanding recommendation for further research is for a diagnostic accuracy study which adequately covers these constructs.

A relatively high proportion of cases were from special schools (76.2%) due to the limited numbers of children with disabilities in mainstream schools. To achieve the required sample size across all five impairment groups, recruitment had to allow for this imbalance. Despite this, the target sample of 52 in each clinical impairment category was not reached for children with vision impairments (n = 35) and musculoskeletal impairments (n = 42). Future research should aim to rectify this sampling disparity and shortfall.

An important limitation relates to generalizing the findings to other populations. Of the parents/caregivers of the cases, 19% had attained a tertiary education, which is higher than the national average [48]. The level amongst controls was 15%, which is closer to average. This highlights potential differences related to parents of children in special schools, but importantly raises the question of difference between parents of children with disabilities in school compared to those who are out of school. Future research should include out-of-school children with disabilities, whose parents may respond differently to the CFM questions.

Another limitation is that 62.8% of cases were male compared to 49.0% of controls and the mean age of cases was 10.15 years compared to 9.71 years amongst controls. However, correlations between age, sex and the CFM questions were explored, and the impact of these variations appears to be negligible. Age had significant but negligible correlation with the domains learning (0.164), remembering (0.118) and depression (0.097). Sex had significant but negligible correlation with the domains speaking (0.092), learning (0.144), controlling behaviour (0.156), focusing attention (0.096) and making friends (0.097).

Finally, the authors acknowledge the limitations of categorizing IRR values into the classifications "excellent/good/fair/poor" because it is dependent on the purpose for which the test is to be used. For the purpose of this study however, the categories provide a convenient means of comparing individual domains and the overall CFM-13.

5. Conclusions

The UNICEF/WG Child Functioning Module is an important new instrument for disability disaggregation of datasets particularly considering the urgency to collect baseline information for the SDGs. When evaluated as a whole it achieved only a "fair" level of accuracy to identify children with disabilities in Fiji. This contrasts with earlier domain-specific findings which showed "good" to "excellent" accuracy for seeing, hearing, walking and speaking.

The choice of cut-off level and the mixture of severity of impairments reported across response categories are particular challenges for the CFM. Specifically, the response category "some difficulty" includes children with severe impairments as well as children with no impairments, with uneven results across disability domains. In the context of Fiji's education system, children reported as having "some difficulty" can neither be ignored nor be assumed to have disability. There is no clear and strong cut-off response category for the overall CFM and the cut-off which performs best for individual functional domains is different from that for the overall module. While the CFM provides useful data for Fiji's EMIS, the CFM is not accurate enough on its own for identifying children with disability for the purpose of determining funding eligibility.

We recommend that children with disabilities are identified using CFM plus additional data on learning and support needs and that verification visits are undertaken to confirm funding eligibility.

Supplementary Materials: The following are available online at http://www.mdpi.com/1660-4601/16/5/806/s1, Figure S1: Flowchart of participation, Table S1: Clinical characteristics of the study sample, Table S2: Extended data for Table 3—Diagnostic accuracy of the CFM-7 compared to five reference standard assessments, parent versus teacher responses, at different cut-off levels, Table S3: Extended data for Table 4—Cross-tabulation: Child Functioning Module results (CFM-7) by the results of the reference standard tests for vision, hearing, musculoskeletal, speech and cognition.

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Appendix A. Differences between the CFM Draft Version Used in this Study and the Final Version

(1) The draft version did not include reference to contact lenses, which is now in the final version, as shown in italics in the question: When wearing his/her glasses *or contact lenses*, does (name) have difficulty seeing?

(2) The word "focusing" has been replaced by "concentrating" in the final version.

"Does (*name*) have difficulty concentrating on an activity that he/she enjoys doing?"

(3) The question on difficulty controlling behaviour has been changed from the draft version used in this study:

"Compared with children of the same age, how much difficulty does (name) have controlling his/her behaviour?" with response options: No difficulty/The same or less/More/A lot more

To the final version: "Compared with children of the same age, does (name) have difficulty controlling his/her behaviour?" with response options: No difficulty/Some difficulty/A lot of difficulty/Cannot do at all.

(4) The word "very" has been inserted in the questions on anxiety and depression in the final version.

"How often does (*name*) seem very anxious, nervous or worried?"
"How often does (*name*) seem very sad or depressed?"

(5) The sequence of the last 8 questions has been changed in the final version.

In the draft version the CFM questions were in this sequence: learning, remembering, anxiety, depression, controlling behaviour, focusing attention, accepting changes in routine, and making friends.

In the final version the CFM questions are in this sequence: learning, remembering, concentrating (formerly focusing attention), accepting changes in routine, controlling behaviour, making friends, anxiety and depression.

Appendix B. Description and Implementation of the Assessments

The reference standard (clinical) tests for this study were selected based on international standards for vision and hearing and well validated tools for speech, musculoskeletal impairment and cognitive impairment. The clinical team consisted of trained vision and hearing technicians and physiotherapists.

Vision assessment was performed with torchlight examination, visual acuity with Snellen chart, pinhole testing and refraction using a Topcon autorefractor. The following levels of vision impairment were included as cases: presenting visual acuity in the better eye <6/18 and $\geq$6/60 (moderate), <6/60 and $\geq$3/60 (severe) and <3/60 (blind) [21].

Hearing assessment was performed by observation with otoscope and air conduction audiometer. The pure-tone audiometry values for four frequencies in each ear, including 0.5, 1, 2 and 4 kHz, were averaged and the threshold level of the better ear was used to determine cut-off for cases. The following levels of hearing loss were included as cases: 41–60 dBA (moderate), 61–80 dBA (severe) and $\geq$81 dBA (profound). Greater than 30 or 31 dBA is commonly used as a criterion for hearing impairment in children [49,50], however >40 dBA was used in this study to identify children with clinically relevant hearing impairment due to the ambient noise levels in the assessment rooms in the schools. This is consistent with the extensive prior experience of the hearing assessors in Fiji and with other studies in developing countries [51,52]. Children found to have impacted wax or foreign bodies in the ear had this removed and were tested for hearing after removal.

Musculoskeletal assessment was undertaken using the Rapid Assessment of Musculoskeletal Impairment (RAMI) [30]. Through consultations with the Ministry of Health senior physiotherapist, it was established that there is no standard assessment used or validated for children of this age group for Fiji. Based on a literature review of assessment tools, the RAMI was deemed to be the best available method for establishing presence or absence of mobility impairments in this study setting [53]. The RAMI includes an initial set of five questions, such as, "Do you have any difficulty using your legs?", with corresponding questions about duration indicating that it has lasted more than one month or is permanent. This is followed by observation of a series of gross and fine motor activities. In children where one or more of the five questions was answered positively, and one or more of the duration questions was "Yes", and one or more of the observations indicated difficulty with the activities, children were assessed further for the extent of the effect on the musculoskeletal system. The RAMI does not consider functioning with equipment. Children identified on the RAMI to have impairment only affecting the upper limb were excluded for this analysis on walking difficulty. Children identified on the RAMI with structure impairment including "severe", "moderate" and "mild" effect on the musculoskeletal system's ability to function as a whole were identified as cases with mobility impairment [30].

Speech was assessed by administering the Intelligibility in Context Scale (ICS) [31] to parents. The ICS was selected as the tool to identify children with speech difficulties for several reasons: at time of data collection, there were no speech-language pathology services in Fiji and no speech assessment tools developed or validated in Fiji [54]. It can be administered by non-specialists. It can be used irrespective of language or number of languages spoken by the child [55,56], which is important in Fiji where many people are multilingual [57]. It assesses intelligibility and comprehensibility, which are comparable constructs to CFM questions on difficulty being understood when speaking. The ICS had already been rigorously translated into Fijian and Fiji-Hindi and has been widely used both with children with speech sound disorders [31,58] and with typically developing speech [32,58,59]. For our study, case definition for speech difficulties were ICS scores: 1.8 to <2.5 (moderate) and 1.0 to <1.8 (severe).

Cognitive impairment was assessed using the Cambridge Neuropsychological Test Automated Battery (CANTAB) [32] and cases included subjects with CANTAB Overall Impairment Scores of 3 (moderate) and 4–5 (severe). CANTAB, designed to be non-linguistic and culturally independent, has been validated with children to assess a range of cognitive functions [32,60–62] and has been used with children in a range of settings globally including where English is not the first language [63,64]. Five sub-tests, recommended by Cambridge Cognition to provide an overall assessment of cognitive function, were implemented in this order: Motor screening (MOT), Paired Associates Learning (PAL), Spatial Working Memory (SWM), Stockings of Cambridge (SOC) and Reaction Time (RTI).

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Supplementary Material

The UNICEF/Washington Group Child Functioning Module—Accuracy, Inter-Rater Reliability and Cut-Off Level for Disability Disaggregation of Fiji's Education Management Information System

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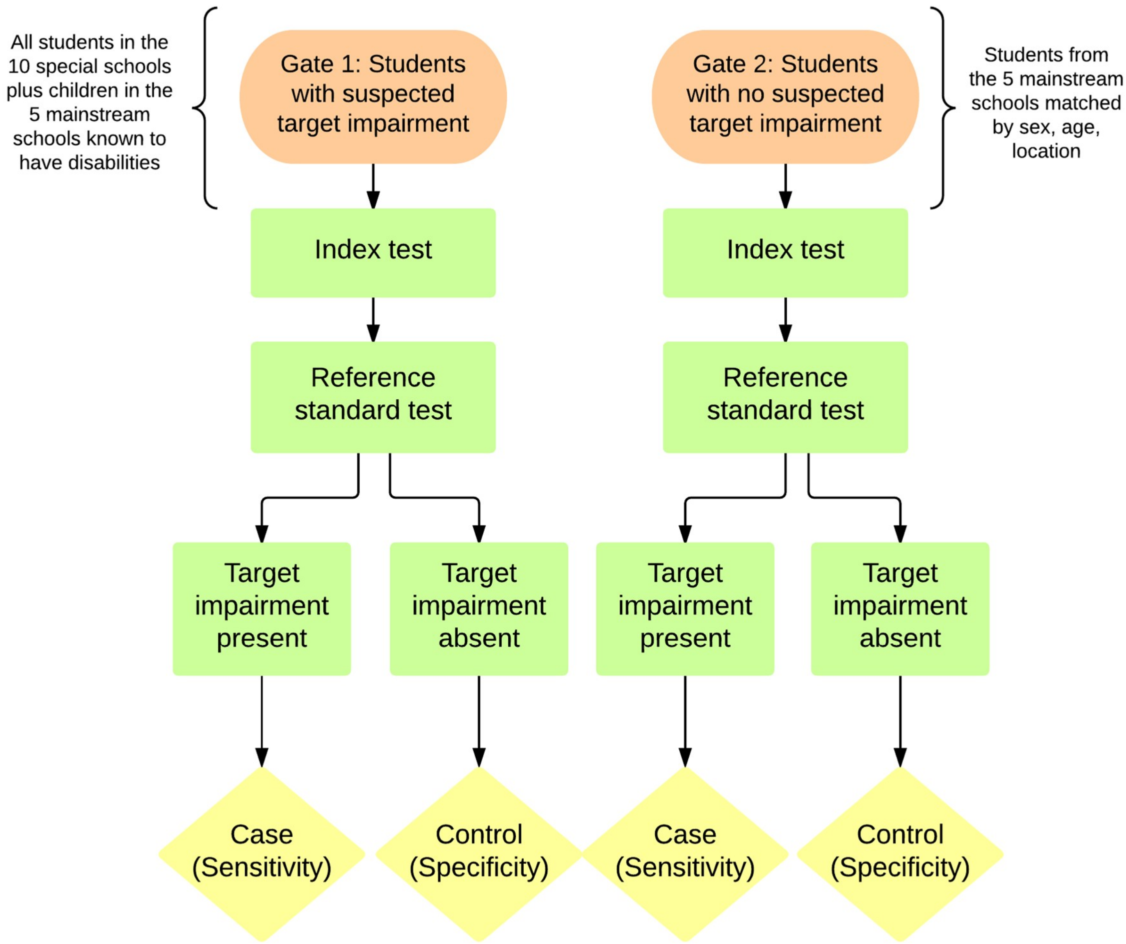

Figure S1. Flowchart of participation.

Table S1. Clinical characteristics of the study sample.

	Cases highlighted in grey	*n*	%
Vision impairment (n = 416)	None (≥6/9 ¥)	376	90.4
	Mild (<6/9 ≥6/18 ¥)	5	1.2
	Moderate (<6/18 ≥6/60 ¥)	11	2.6
	Severe (<6/60 ≥3/60 ¥)	2	0.5
	Blind (<3/60 ¥)	22	5.3
Hearing impairment (n = 381)	None (<26dBA)	298	78.2
	Mild (26-40dBA)	23	6.0
	Moderate (41-60dBA)	24	6.3
	Severe (61-80dBA)	8	2.1
	Profound (≥81dBA)	28	7.3
Musculoskeletal impairment (n = 435)^	None	393	90.3
	Mild (5–24%)	9	2.1
	Moderate (25–49%)	14	3.2
	Severe (50–90%)	19	4.4
Speech impairment (n = 462)	None (4.0-5.0 ICS score)	257	55.6
	Inconclusive speech function (2.5<4.0 ICS score)	134	29.0
	Moderate (<2.5 ≥1.8 ICS score)	21	4.5
	Severe (<1.8 ICS score)	50	10.8
Cognitive impairment (n = 225)	Average/better cognitive function	25	11.1
	Low average cognitive function	75	33.3
	Moderate impairment (Overall Impairment Score 3)	47	20.9
	Severe impairment (Overall Impairment Score 4 or 5)	78	34.7

¥ Visual Acuity of better eye; NPL – no perception of light; CF2m – counting fingers at 2metres.
^Severity for the Rapid Assessment of Musculoskeletal Impairment was determined using the parameters for the percentage of function outlined in the International Classification of Functioning (ICF). Percentage loss of the musculoskeletal systems ability to function as a whole. Participants categorised as 'mild' were included as cases based on detailed consideration of each assessment; diagnoses in the mild category included: club foot, head injury, epilepsy, limb pain limiting function, developmental delay, knock knees, and 'other neurological'. 5 of the 9 mild cases had a 2nd diagnosis.
Shaded area represents the numbers of cases according to study definitions.

Table S2. Extended data for Table 3 - Diagnostic accuracy of the CFM-7 compared to five reference standard assessments, parent versus teacher responses, at different cut-off levels.

Data on individual disability domains (sections in the table below the CFM-7 combined results) have been previously published and are reproduced here for comparability. Seeing, hearing and walking [21]; speaking [23]; learning, remembering and focusing attention [22].

Cut-off points	Sensitivity (Sn) (95% CI)	Specificity (Sp) (95% CI)	Youden Index (Se+Sp-1)	+LR (95% CI)	-LR (95% CI)
CFM-7 – combined results					
Parent	AUC 0.763, SE a: 0.021, 95%CI b (0.721, 0.804), p<0.0001, n=472, cases=231				
Some difficulty	0.98 (0.95, 0.99)	0.33 (0.27, 0.39)	0.31	1.46 (1.34, 1.60)	0.05 (0.02, 0.14)
A lot of difficulty	0.55 (0.49, 0.62)	0.80 (0.74, 0.85)	0.36**	2.78 (2.11, 3.68)	0.56 (0.48, 0.64)
Cannot do at all	0.23 (0.17, 0.29)	0.99 (0.96, 1.00)	0.21	18.08 (5.73, 57.09)	0.79 (0.73, 0.84)
Teacher	AUC 0.786, SE a: 0.023, 95%CI b (0.742, 0.831), p<0.0001, n=392, cases=212				
Some difficulty	0.96 (0.92, 0.98)	0.42 (0.35, 0.50)	0.38	1.66 (1.46, 1.88)	0.10 (0.05, 0.19)
A lot of difficulty	0.57 (0.50, 0.64)	0.82 (0.76, 0.87)	0.39**	3.21 (2.30, 4.49)	0.52 (0.45, 0.61)
Cannot do at all	0.22 (0.17, 0.29)	0.99 (0.96, 1.00)	0.21	19.95 (4.92, 81.00)	0.79 (0.73, 0.85)
Seeing					
Parent	AUC 0.848, SE a: 0.036, 95%CI b (0.809, 0.881), p<0.0001, n=409, cases=35				
Some difficulty	0.80 (0.63, 0.92)	0.89 (0.85, 0.92)	0.69**	7.12 (5.10, 9.90)	0.23 (0.10, 0.40)
A lot of difficulty	0.14 (0.04, 0.30)	0.99 (0.97, 1.00)	0.13	13.36 (3.80, 47.50)	0.87 (0.80, 1.00)
Cannot do at all	0.03 (0.00, 0.15)	1.00 (0.99, 1.00)	0.03	10.69 (0.70, 167.20)	0.97 (0.90, 1.00)
Teacher	AUC 0.823, SE a: 0.046, 95%CI b (0.779, 0.862), p<0.0001, n=340, cases=28				
Some difficulty	0.71 (0.51, 0.87)	0.90 (0.86, 0.93)	0.61**	7.43 (4.90, 11.2)	0.32 (0.20, 0.60)
A lot of difficulty	0.36 (0.19, 0.56)	0.99 (0.97, 1.00)	0.35	37.14 (10.80, 127.20)	0.65 (0.50, 0.90)
Cannot do at all	0.11 (0.02, 0.28)	1.00 (0.99, 1.00)	0.11	-	0.89 (0.80, 1.00)

Hearing					
Parent	AUC 0.847, SE [a]: 0.030, 95%CI [b] (0.806, 0.882), p<0.0001, n=378, cases=59				
Some difficulty	0.78 (0.65, 0.88)	0.88 (0.84, 0.91)	0.66**	6.38 (4.60, 8.80)	0.25 (0.20, 0.40)
A lot of difficulty	0.41 (0.28, 0.54)	0.97 (0.95, 0.99)	0.38	16.22 (7.70, 34.40)	0.61 (0.50, 0.80)
Cannot do at all	0.24 (0.14, 0.37)	1.00 (0.9, 1.00)	0.24	-	0.76 (0.70, 0.90)
Teacher	AUC 0.846, SE [a]: 0.032, 95%CI [b] (0.801, 0.885), p<0.0001, n=310, cases=54				
Some difficulty	0.72 (0.58, 0.84)	0.95 (0.92, 0.98)	0.67**	15.41 (8.70, 27.40)	0.29 (0.20, 0.40)
A lot of difficulty	0.50 (0.36, 0.64)	0.99 (0.97, 1.00)	0.49	64.00 (15.7, 261.1)	0.50 (0.40, 0.70)
Cannot do at all	0.19 (0.09, 0.31)	1.00 (0.98, 1.00)	0.19	47.41 (6.20, 362.6)	0.82 (0.70, 0.90)
Walking					
Parent	AUC 0.889, SE [a]: 0.031, 95%CI [b] (0.856, 0.917), p<0.0001, n=435, cases=42				
Some difficulty	0.83 (0.69, 0.93)	0.90 (0.87, 0.93)	0.73**	8.40 (6.10, 11.60)	0.19 (0.09, 0.40)
A lot of difficulty	0.60 (0.43, 0.74)	0.97 (0.95, 0.98)	0.57	19.49 (10.60, 35.90)	0.42 (0.30, 0.60)
Cannot do at all	0.38 (0.24, 0.54)	1.00 (0.99, 1.00)	0.38	149.71 (20.40, 1100.80)	0.62 (0.50, 0.80)
Teacher	AUC 0.869, SE [a]: 0.034, 95%CI [b] (0.830, 0.901), p<0.0001, n=368, cases=39				
Some difficulty	0.82 (0.67, 0.93)	0.87 (0.83, 0.90)	0.69**	6.14 (4.50, 8.40)	0.21 (0.10, 0.40)
A lot of difficulty	0.49 (0.32, 0.65)	0.98 (0.95, 0.99)	0.47	20.04 (9.40, 42.70)	0.53 (0.40, 0.70)
Cannot do at all	0.28 (0.15, 0.45)	1.00 (0.98, 1.00)	0.28	92.79 (12.3, 699.60)	0.72 (0.60, 0.90)
Speaking (combining variables on being understood by people inside and outside the house)					
Parent	AUC 0.975, SE: 0.00582 [a], CI (0.958, 0.992)[b], p<0.0001, n=328, cases=71				
Some difficulty	1.00 (0.95, 1.00)	0.88 (0.83, 0.92)	0.88**	8.32 (6.0, 11.6)	0.00
A lot of difficulty	0.76 (0.65, 0.85)	0.99 (0.97, 1.00)	0.75	65.41 (21.1, 203.0)	0.24 (0.2, 0.4)
Cannot do at all	0.45 (0.33, 0.57)	1.00 (0.98, 1.00)	0.45	116.28 (16.2, 836.3)	0.55 (0.4, 0.7)
Teacher	AUC 0.909, SE: 0.0198 [a], CI (0.874, 0.944)[b], p<0.0001, n=270, cases=67				
Some difficulty	0.94 (0.85, 0.98)	0.76 (0.69, 0.82)	0.70**	3.90 (3.0, 5.0)	0.08 (0.03, 0.2)
A lot of difficulty	0.63 (0.50, 0.74)	0.97 (0.94, 1.00)	0.60	21.21 (9.4, 47.7)	0.38 (0.3, 0.5)
Cannot do at all	0.16 (0.09, 0.28)	1.00 (0.98, 1.00)	0.16	-	0.84 (0.8, 0.9)
Learning					
Parent	AUC 0.774, SE[a]: 0.032, 95%CI [b] (0.712, 0.836), p<0.000, n=225, cases=125				
Some difficulty	0.78 (0.69, 0.84)	0.73 (0.63, 0.81)	0.51**	2.87 (2.05, 4.02)	0.31 (0.22, 0.43)
A lot of difficulty	0.24 (0.17, 0.33)	0.97 (0.91, 0.99)	0.21	8.0 (2.51, 25.45)	0.78 (0.71, 0.87)
Cannot do at all	0.02 (0.00, 0.06)	1.00 (0.95, 1.00)	0.02	Infinity (NA, Infinity)	0.98 (0.96, 10.1)
Teacher	AUC 0.822, SE[a]: 0.030, 95%CI[b] (0.763, 0.881), p<0.000, n=212, cases=120				
Some difficulty	0.88 (0.81, 0.93)	0.72 (0.61, 0.80)	0.60**	3.13 (2.24, 4.36)	0.16 (0.10, 0.27)
A lot of difficulty	0.32 (0.23, 0.41)	0.95 (0.87, 0.98)	0.27	5.83 (2.34, 14.23)	0.72 (0.64, 0.82)
Cannot do at all	0.03 (0.01, 0.09)	1.00 (0.95, 1.00)	0.03	Infinity (NA, Infinity)	0.97 (0.94, 1.00)
Remembering					
Parent	AUC 0.663, SE[a]: 0.036, 95%CI [b] (0.593, 0.733), p<0.000, n=225, cases=125				
Some difficulty	0.57 (0.48, 0.66)	0.72 (0.62, 0.80)	0.29**	2.03 (1.43, 2.88)	0.60 (0.48, 0.74)
A lot of difficulty	0.14 (0.08, 0.21)	1.00 (0.95, 1.00)	0.14	Infinity (NA, Infinity)	0.86 (0.81, 0.93)
Cannot do at all	0.01 (0.00, 0.05)	1.00 (0.95, 1.00)	0.01	Infinity (NA, Infinity)	0.99 (0.98, 1.01)
Teacher	AUC 0.781, SE[a]: 0.033, 95%CI [b] (0.716, 0.845), p<0.000, n=209, cases=1210				
Some difficulty	0.80 (0.72, 0.87)	0.74 (0.64, 0.83)	0.54**	3.10 (2.15, 4.45)	0.27 (0.19, 0.39)
A lot of difficulty	0.21 (0.14, 0.29)	0.96 (0.88, 0.99)	0.17	4.64 (1.67, 12.85)	0.83 (0.76, 0.91)
Cannot do at all	0.04 (0.02, 0.10)	1.00 (0.95, 1.00)	0.04	Infinity (NA, Infinity)	0.96 (0.92, 0.99)
Focusing Attention					
Parent	AUC 0.623, SE[a]: 0.037, 95%CI[b] (0.550, 0.696), p<0.002, n=224, cases=124				
Some difficulty	0.44 (0.36, 0.54)	0.80 (0.71, 0.87)	0.24**	2.21 (1.43, 3.44)	0.70 (0.59, 0.82)
A lot of difficulty	0.08 (0.04, 0.15)	0.97 (0.91, 0.99)	0.05	2.69 (0.76, 9.51)	0.95 (0.90, 1.00)
Cannot do at all	0.02 (0.00, 0.06)	1.00 (0.95, 1.00)	0.02	Infinity (NA, Infinity)	0.98 (0.96, 1.01)
Teacher	AUC 0.686, SE[a]: 0.037, 95%CI[b] (0.614, 0.758), p<0.000, N=210, cases=120				
Some difficulty	0.57 (0.47, 0.66)	0.80 (0.70, 0.87)	0.37**	2.83 (1.82, 4.41)	0.54 (0.44, 0.67)
A lot of difficulty	0.13 (0.07, 0.20)	0.97 (0.90, 0.99)	0.10	3.75 (1.12, 12.56)	0.91 (0.85, 0.97)
Cannot do at all	0.00 (0.00, 0.04)	1.00 (0.95, 1.00)	0.00	NA	1.00 (1.00, 1.00)

AUC: area under receiver operating characteristic curve; CI: confidence interval; SE: standard error; Positive likelihood ratio (+LR=Sn/(1-Sp); Negative likelihood ratio (-LR=(1-Sn)/Sp); **The highest Youden Index indicates the optimal cut-off point.

[a] DeLong et al., 1988; [b] Binomial exact

Case definition - child has impairment in at least one of: vision, hearing, musculoskeletal, speech or cognition.

CFM definition – the highest (most severe) response option selected in any one of the following questions: seeing, hearing, walking, speaking, learning, remembering, focusing attention. These questions are comparable to the impairment domains. CFM questions excluded from this ROC analysis include: self-care, anxiety, depression, controlling behaviour, accepting changes to routine and making friends.

Table S3. Extended data for Table 4 – Cross-tabulation: Child Functioning Module results (CFM-7) by the results of the reference standard tests for vision, hearing, musculoskeletal, speech and cognition.

CFM	Total n (%)		Impairment level based on reference standard (clinical) assessments, n (%)							
Difficulty in any CFM-7 domain*	Parent, n=472	Teacher, n=392	None		Mild		Moderate		Severe	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	84 (17.8)	85 (21.7)	78 (92.9) *(33.9)*	74 (87.1) *(43.8)*	2 (2.4) *(10.5)*	2 (2.4) *(11.8)*	3 (3.6) *(4.8)*	6 (7.1) *(10.9)*	1 (1.2) *(0.6)*	3 (3.5) *(2.0)*
Some	212 (44.9)	154 (39.3)	109 (51.4) *(47.4)*	66 (42.9) *(39.1)*	8 (3.8) *(42.1)*	10 (6.5) *(58.8)*	33 (15.6) *(52.4)*	26 (16.9) *(47.3)*	62 (29.2) *(38.8)*	52 (33.8) *(34.4)*
A lot	122 (25.8)	104 (26.5)	41 (33.6) *(17.8)*	27 (26.0) *(16.0)*	9 (7.4) *(47.4)*	5 (4.8) *(29.4)*	25 (20.5) *(39.7)*	19 (18.3) *(34.5)*	47 (38.5) *(29.4)*	53 (51.0) *(35.1)*
Cannot do	54 (11.4)	49 (12.5)	2 (3.7) *(0.9)*	2 (4.1) *(1.2)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	2 (3.7) *(3.2)*	4 (8.2) *(7.3)*	50 (92.6) *(31.3)*	43 (87.8) *(28.5)*
Difficulty Seeing	Parent, n=409	Teacher, n=340	No vision impairment (VI) (≥6/9[¥])		Mild VI (<6/9 ≥6/18[¥])		Moderate VI (<6/18 ≥6/60[¥])		Severe-Blind (<6/60[¥])	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	339 (82.9)	290 (85.3)	330 (97.3) *(89.4)*	280 (96.6) *(91.2)*	2 (0.6) *(40.0)*	2 (0.7) *(40.0)*	6 (1.8) *(54.5)*	4 (1.4) *(50.0)*	1 (0.3) *(4.2)*	4 (1.4) *(20.0)*
Some	61 (14.9)	37 (10.9)	35 (57.4) *(9.5)*	25 (67.6) *(8.1)*	3 (4.9) *(60.0)*	2 (5.4) *(40.0)*	4 (6.6) *(36.4)*	3 (8.1) *(37.5)*	19 (31.1) *(79.2)*	7 (18.9) *(35.0)*
A lot	7 (1.7)	10 (2.9)	3 (42.9) *(0.8)*	2 (20.0) *(0.7)*	0 (0.0) *(0.0)*	1 (10.0) *(20.0)*	1 (14.3) *(9.1)*	1 (10.0) *(12.5)*	3 (42.9) *(12.5)*	6 (60.0) *(30.0)*
Cannot do	2 (0.5)	3 (0.9)	1 (50.0) *(0.3)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	1 (50.0) *(4.2)*	3 (100.0) *(15.0)*
Difficulty Hearing	Parent, n=378	Teacher, n=301	No hearing impairment (HI) (<26dBA)		Mild HI (26-40dBA)h		Moderate HI (41-60dBA)		Severe-Profound HI (≥61dBA)	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	293 (77.5)	251 (83.4)	263 (89.8) *(88.9)*	224 (89.2) *(95.7)*	17 (5.8) *(73.9)*	20 (8.0) *(90.9)*	9 (3.1) *(39.1)*	5 (2.0) *(33.3)*	4 (1.4) *(11.1)*	2 (0.8) *(6.7)*
Some	53 (14.0)	21 (7.0)	26 (49.1) *(8.8)*	9 (42.9) *(3.8)*	5 (9.4) *(21.7)*	1 (4.8) *(4.5)*	10 (18.9) *(43.5)*	4 (19.0) *(26.7)*	12 (22.6) *(33.3)*	7 (33.3) *(23.3)*
A lot	18 (4.8)	18 (6.0)	7 (38.9) *(2.4)*	0 (0.0) *(0.0)*	1 (5.6) *(4.3)*	1 (5.6) *(4.5)*	3 (16.7) *(13.0)*	2 (11.1) *(13.3)*	7 (38.9) *(19.4)*	15 (83.3) *(50.0)*
Cannot do	14 (3.7)	11 (3.7)	0 (0.0) *(0.0)*	1 (9.1) *(0.4)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	1 (7.1) *(4.3)*	4 (36.4) *(26.7)*	13 (92.9) *(36.1)*	6 (54.5) *(20.0)*
Difficulty Walking[#]	Parent, n=435	Teacher, n=368	No musculoskeletal impairment (MSI)		Mild MSI (5–24%)		Moderate MSI (25–49%)		Severe MSI (50–90%)	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	361 (83.0)	292 (79.3)	354 (98.1) *(90.1)*	285 (97.6) *(86.6)*	5 (1.4) *(55.5)*	4 (1.4) *(50.0)*	2 (0.6) *(14.3)*	3 (1.0) *(21.4)*	0 (0.0) *(0.0)*	1 (0.0) *(5.6)*
Some	37 (8.5)	49 (13.3)	27 (73.0) *(6.9)*	36 (73.5) *(10.9)*	2 (5.4) *(22.2)*	4 (8.2) *(50.0)*	8 (21.6) *(57.1)*	8 (16.3) *(57.1)*	0 (0.0) *(0.0)*	1 (2.0) *(5.6)*
A lot	20 (4.6)	15 (4.1)	11 (55.0) *(2.8)*	7 (46.7) *(2.1)*	2 (10.0) *(22.2)*	0 (0.0) *(0.0)*	3 (15.0) *(21.4)*	3 (20.0) *(21.4)*	4 (20.0) *(21.0)*	5 (33.3) *(27.8)*
Cannot do	17 (3.9)	12 (3.3)	1 (5.9) *(0.3)*	1 (8.3) *(0.3)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	1 (5.9) *(7.1)*	0 (0.0) *(0.0)*	15(88.2) *(79.0)*	11 (91.7) *(61.1)*
Difficulty being understood by people inside	Parent[£] n=462	Teacher¥, n=387	No speech impairment (4.0-5.0 ICS)[₱]		Inconclusive speech function (2.5<4.0 ICS)[₱]		Moderate speech impairment (1.8<2.5 ICS)[₱]		Severe speech impairment (1.0<1.8 ICS)[₱]	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	303 (65.6)	241 (62.3)	239 (78.9)	167 (68.9) *(81.1)*	60 (19.8)	57 (23.9) *(50.0)*	3 (0.99) *(14.3)*	3 (1.2) *(15.8)*	1 (0.3) *(2.0)*	14 (5.8) *(29.2)*

			(93.0)		*(44.8)*					
Some	96 (20.8)	94 (24.3)	17 (17.7) *(6.6)*	35 (37.2) *(17.0)*	59 (61.5) *(44.0)*	38 (40.4) *(33.3)*	14 (14.58) *(66.7)*	7 (7.5) *(36.8)*	6 (6.3) *(12.0)*	14 (14.9) *(29.2)*
A lot	31 (6.7)	38 (9.8)	1 (3.2) *(0.4)*	4 (10.5) *(1.9)*	13 (41.9) *(9.7)*	15 (39.5) *(13.2)*	3 (9.68) *(14.3)*	6 (15.8) *(31.6)*	14 (45.2) *(28.0)*	13 (34.2) *(27.1)*
Cannot do	32 (6.9)	14 (3.6)	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	2 (6.3) *(1.5)*	4 (28.6) *(3.5)*	1 (3.13) *(4.8)*	3 (21.4) *(15.8)*	29 (90.6) *(58.0)*	7 (50.0) *(14.6)*
Difficulty being understood by people outside	Parent*, n=462	Teacher¥, n=384	No speech impairment (4.0-5.0 ICS)ᵖ		Inconclusive speech function (2.5<4.0 ICS)ᵖ		Moderate speech impairment (1.8<2.5 ICS)ᵖ		Severe speech impairment (1.0<1.8 ICS)ᵖ	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	264 (57.1)	214 (55.7)	229 (86.7) *(89.1)*	159 (74.3) *(78.3)*	35 (13.3) *(26.1)*	51 (23.8) *(44.7)*	0 (0.0) *(0.0)*	1 (0.5) *(5.3)*	0 (0.0) *(0.0)*	3 (1.4) *(6.3)*
Some	115 (24.9)	100 (26.0)	26 (22.6) *(10.0)*	40 (40.0) *(19.7)*	71 (61.7) *(53.0)*	38 (38.0) *(33.3)*	11 (9.3) *(52.3)*	9 (9.0) *(47.4)*	7 (6.1) *(14.0)*	13 (13.0) *(27.1)*
A lot	50 (10.8)	57 (14.8)	2 (4.0) *(0.8)*	4 (7.0) *(2.0)*	26 (52.0) *(19.4)*	21 (36.8) *(18.4)*	7 (14.0) *(33.3)*	6 (10.5) *(31.6)*	15 (30.0) *(30.0)*	26 (45.6) *(54.2)*
Cannot do	33 (7.1)	13 (3.4)	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	2 (6.1) *(1.5)*	4 (30.8) *(3.5)*	3 (9.1) *(14.3)*	3 (23.1) *(15.8)*	28 (84.5) *(56.0)*	6 (18.2) *(12.5)*
Difficulty Learning	Parent, n=225	Teacher, n=212	Average/better cognitive function®		Low average cognitive function®		Moderate cognitive Impairment®		Severe cognitive impairment®	
			Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	101 (44.9)	80 (37.7)	20 (19.8) *(80.0)*	17 (21.3) *(73.9)*	53 (52.5) *(70.7)*	49 (61.3) *(71.0)*	9 (8.9) *(19.1)*	5 (6.3) *(11.4)*	19 (18.8) *(24.4)*	9 (11.3) *(9.9)*
Some	91 (40.4)	89 (42.0)	4 (4.4) *(16.0)*	4 (4.5) *(17.4)*	20 (22.0) *(26.7)*	17 (19.1) *(24.6)*	27 (29.7) *(57.4)*	27 (30.3) *(61.4)*	40 (44.0) *(51.3)*	41 (46.1) *(45.1)*
A lot	31 (13.8)	54 (25.5)	1 (3.2) *(4.0)*	2 (5.1) *(8.7)*	2 (6.5) *(2.7)*	3 (7.7) *(4.3)*	11 (35.5) *(23.4)*	10 (25.6) *(22.7)*	17 (54.8) *(21.8)*	39 (72.2) *(42.9)*
Cannot do	2 (0.89)	4 (1.9)	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	2 (50.0) *(4.5)*	2 (100.0) *(2.6)*	2 (50.0) *(2.2)*
Difficulty Remembering	Parent, n=225	Teacher, n=209	Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	126 (56.0)	90 (43.1)	21 (16.7) *(84.0)*	17 (18.9) *(73.9)*	51 (40.5) *(68.0)*	49 (54.4) *(74.2)*	20 (15.9) *(42.6)*	8 (8.9) *(18.2)*	34 (27.0) *(43.6)*	16 (17.8) *(21.1)*
Some	82 (36.4)	90 (43.1)	4 (4.9) *(16.0)*	5 (5.6) *(21.7)*	24 (29.3) *(32.0)*	14 (15.6) *(21.2)*	20 (24.4) *(42.6)*	30 (33.3) *(68.2)*	34 (41.5) *(43.6)*	41 (45.6) *(53.9)*
A lot	16 (7.1)	24 (11.5)	0 (0.0) *(0.0)*	1 (4.2) *(4.3)*	0 (0.0) *(0.0)*	3 (12.5) *(4.5)*	7 (43.8) *(14.9)*	5 (20.8) *(11.4)*	9 (56.3) *(11.5)*	15 (62.5) *(19.7)*
Cannot do	1 (0.4)	5 (2.4)	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	1 (20.0) *(2.3)*	1 (100.0) *(1.3)*	4 (80.0) *(5.3)*
Difficulty Focusing	Parent, n=224	Teacher, n=210	Parent	Teacher	Parent	Teacher	Parent	Teacher	Parent	Teacher
No	148 (66.4)	124 (59.0)	20 (13.4) *(80.0)*	20 (16.1) *(87.0)*	60 (40.3) *(80.0)*	52 (41.9) *(77.6)*	26 (17.4) *(55.3)*	28 (22.6) *(63.6)*	43 (28.9) *(55.8)*	24 (19.4) *(31.6)*
Some	63 (28.3)	68 (32.4)	4 (6.5) *(16.0)*	1 (1.5) *(4.3)*	13 (21.0) *(17.3)*	14 (20.6) *(20.9)*	16 (25.8) *(34.0)*	13 (19.1) *(29.5)*	29 (46.8) *(37.7)*	40 (58.8) *(52.6)*
A lot	10 (4.5)	18 (8.6)	1 (9.1) *(4.0)*	2 (11.1) *(8.7)*	2 (18.2) *(2.7)*	1 (5.6) *(1.5)*	5 (45.5) *(10.6)*	3 (16.7) *(6.8)*	3 (27.3) *(3.9)*	12 (66.7) *(15.8)*
Cannot do	2 (0.9)	0 (0.0)	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	0 (0.0) *(0.0)*	2 (100.0) *(2.6)*	0 (0.0) *(0.0)*

*Child is recorded in the highest level of difficulty from any of the CFM-7 questions on seeing, hearing, walking, being understood when speaking, learning, remembering and focusing attention, and in the highest level of severity from any of the five reference standard assessments for vision, hearing, musculoskeletal, speech and cognitive impairment.
VI=Vision impairment; HI=Hearing impairment; MSI=Musculoskeletal impairment (mobility only);
¥ Visual Acuity of better eye; NPL – no perception of light; CF2m – counting fingers at 2metres.
^Severity for the Rapid Assessment of Musculoskeletal Impairment was determined using the parameters for the percentage of function outlined in the International Classification of Functioning (ICF)(43). Percentage loss of the musculoskeletal systems ability to function as a whole.

includes: difficulty walking for children who do not need equipment, plus those who require equipment but have difficulty walking without their equipment (this allows comparison with the Rapid Assessment of Musculoskeletal Impairment which tests function without equipment)
£ Parent: When speaking, level of difficulty being understood by people: inside the household / outside the household
¥ Teacher: When speaking, level of difficulty being understood by people: inside the classroom / outside the classroom
₱ Intelligibility in Context Scale - scores between 1.0-2.43, detailed in (23).
For this paper, severe vision impairment and blindness are combined in one category and severe and profound hearing impairment are combined in one category. Results with these severities separately reported is available in (21).

6.6 Interplay and associations between items on the CFM

The third objective of the research was to explore interplay and associations between CFM items. This was undertaken by analysing item correlations and exploring the co-occurrence of difficulties across functional domains. As discussed in paper one, commonly EMISs have recorded single disability categories or included a category termed “multiple disabilities” (105, 106). It is important for teachers and policy makers to understand what lies beneath the term “multiple disabilities”, including patterns of functional limitations and co-occurring difficulties. Additionally, exploring the correlations and co-occurrences was important to inform the interpretation of disability types and levels of severity in Fiji’s EMIS.

6.6.1 Correlation coefficients between items

Tables 5 and 6 present the correlation coefficients between domains for parent and teacher responses respectively. Teacher responses showed a high correlation between learning and remembering (0.758), and depression and anxiety (0.729), and a moderate correlation between accepting changes to routine and focusing attention (0.546), self-care and walking (0.520), learning and being understood outside (0.511), focusing attention and learning (0.502), and accepting changes to routine and learning (0.502). Parent correlations for the same domains were far lower, ranging from 0.152 – 0.527. As detailed in section 6.3 (229), both parent and teacher results showed a high correlation between the two questions on speaking: difficulty being understood by people inside and outside the house/classroom (0.869_P / 0.828_T).

Seeing, hearing and walking showed negligible correlations with domains on cognition (learning, remembering, focusing attention), mood (anxiety, depression), behaviour (controlling behaviour, accepting changes to routine) and socialisation (making friends); (range: $0.019\text{-}0.199_P$ / $0.035\text{-}0.270_T$).

Self-care showed “low” but significant correlations with speaking, learning, remembering, controlling behaviour, focusing attention, accepting changes to routine and making friends (range: $0.153\text{-}0.339_P$/$0.331\text{-}0.457_T$). Once again, teacher correlations were higher than parent correlations.

Except for the variables seeing, hearing and walking, teacher responses showed significant correlations between all variables and learning (0.349 – 0.758), remembering (0.358 – 0.758) and controlling behaviour (0.314 – 0.468). Teacher correlations between anxiety or depression and learning or remembering, whilst “low” (0.349 – 0.393), were significantly higher than parent correlations of the same (0.150 – 0.246).

The higher correlations between teacher results for domains which might be expected (anxiety and depression; learning and remembering; changes to routine and focusing attention) provide some indication that teachers are observing these functional domains more consistently than parents and that teacher results may be more accurate in these domains. In relation to anxiety and depression, the results highlight a potentially important role for teachers in Fiji in identifying children at risk of psychosocial distress. These issues both point to important areas for future research.

Table 4 - Correlation coefficients between domains, parent responses

Parent responses		Seeing	Hearing	Walking	Self-care	Being understood (inside)	Being understood (outside)	Learning	Remembering	Anxiety	Depression	Controlling behaviour	Focusing on an activity	Accepting changes to routine	Making friends
Seeing	CC	1.000	-0.048	0.016	0.123**	-0.010	0.020	0.180**	0.019	0.065	0.051	0.114*	0.128**	0.035	0.116*
	Sig. (2-tailed)		0.304	0.727	0.008	0.834	0.663	0.000	0.686	0.162	0.270	0.014	0.006	0.454	0.013
	N	463	461	463	463	462	462	462	462	462	462	462	462	461	462
Hearing	CC		1.000	-0.037	0.016	0.488**	0.474**	0.152**	0.148**	0.070	0.116*	0.189**	0.124**	0.135**	0.147**
	Sig. (2-tailed)			0.425	0.736	0.000	0.000	0.001	0.001	0.133	0.012	0.000	0.007	0.004	0.001
	N		468	468	468	467	467	467	467	467	467	467	467	466	467
Walking	CC			1.000	0.418**	0.104*	0.165**	0.063	0.067	0.113*	0.199**	0.140**	0.107*	0.120**	0.132**
	Sig. (2-tailed)				0.000	0.024	0.000	0.172	0.147	0.014	0.000	0.002	0.020	0.009	0.004
	N			472	472	471	471	471	471	471	471	471	471	470	471
Self-care	CC				1.000	0.288**	0.325**	0.323**	0.205**	0.161**	0.216**	0.315**	0.215**	0.153**	0.339**
	Sig. (2-tailed)					0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
	N				472	471	471	471	471	471	471	471	471	470	471
Being understood (inside)	CC					1.000	0.869**	0.375**	0.307**	0.125**	0.222**	.277**	0.192**	0.124**	0.257**
	Sig. (2-tailed)						0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.007	0.000
	N					471	471	471	471	470	470	470	470	469	470
Being understood (outside)	CC						1.000	0.409**	0.325**	0.158**	0.221**	.325**	0.248**	0.185**	0.273**
	Sig. (2-tailed)							0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
	N						471	471	471	470	470	470	470	469	470
Learning	CC							1.000	0.498**	0.180**	0.219**	.322**	0.349**	0.152**	0.243**
	Sig. (2-tailed)								0.000	0.000	0.000	0.000	0.000	0.001	0.000
	N							471	471	470	470	470	470	469	470
Remembering	CC								1.000	0.150**	0.246**	.282**	0.304**	0.286**	0.207**
	Sig. (2-tailed)									0.001	0.000	0.000	0.000	0.000	0.000
	N								471	470	470	470	470	469	470
Anxiety	CC									1.000	0.527**	.258**	0.080	0.197**	0.183**
	Sig. (2-tailed)										0.000	0.000	0.085	0.000	0.000
	N									471	471	471	471	470	471
Depression	CC										1.000	.326**	0.153**	0.207**	0.187**
	Sig. (2-tailed)		Very high (0.90-1.00)									0.000	0.001	0.000	0.000
	N		High (0.70<0.90)								471	471	471	470	471
Controlling behaviour	CC		Moderate (0.50<0.70)									1.000	0.273**	0.296**	0.305**
	Sig. (2-tailed)		Low (0.30<0.50)										0.000	0.000	0.000
	N		Neglible (0.00<0.30)									471	471	470	471
Focusing on an activity	CC		(Hinkle, Wiersma & Jurs, 2003)										1.000	0.258**	0.233**
	Sig. (2-tailed)													0.000	0.000
	N												471	470	471
Accepting changes to routine	CC													1.000	0.146**
	Sig. (2-tailed)														0.002
	N													470	470
Making friends	CC														1.000
	Sig. (2-tailed)														
	N														471

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 5 - Correlation coefficients between domains, teacher responses

Teacher responses		Seeing	Hearing	Walking	Self-care	Being understood (inside)	Being understood (outside)	Learning	Remembering	Anxiety	Depression	Controlling behaviour	Focusing on an activity	Accepting changes to routine	Making friends
Seeing	CC	1.000	0.049	0.098	0.061	0.077	0.075	.186**	0.055	.166**	0.075	.127*	.125*	0.083	-0.040
	Sig. (2-tailed)		0.338	0.054	0.227	0.126	0.136	0.000	0.284	0.001	0.145	0.013	0.013	0.102	0.436
	N	391	390	387	390	391	391	387	388	382	380	382	388	389	387
Hearing	CC		1.000	.178**	0.047	.260**	.385**	.162**	.203**	0.093	0.035	.178**	0.043	0.078	0.061
	Sig. (2-tailed)			0.000	0.358	0.000	0.000	0.001	0.000	0.070	0.491	0.000	0.394	0.124	0.228
	N		391	387	390	391	391	387	388	382	380	382	388	389	387
Walking	CC			1.000	.520**	.263**	.356**	.226**	.252**	.149**	.186**	.209**	.222**	.270**	.261**
	Sig. (2-tailed)				0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000
	N			388	387	388	388	384	385	379	377	379	385	386	384
Self-care	CC				1.000	.434**	.457**	.428**	.389**	.177**	.257**	.331**	.412**	.431**	.382**
	Sig. (2-tailed)					0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
	N				391	391	391	387	388	382	380	382	388	389	387
Being understood (inside)	CC					1.000	.828**	.490**	.425**	.249**	.238**	.345**	.334**	.359**	.407**
	Sig. (2-tailed)						0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	N					392	392	388	389	383	381	383	389	390	388
Being understood (outside)	CC						1.000	.511**	.437**	.208**	.226**	.357**	.353**	.356**	.391**
	Sig. (2-tailed)							0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	N						392	388	389	383	381	383	389	390	388
Learning	CC							1.000	.758**	.349**	.369**	.468**	.502**	.502**	.405**
	Sig. (2-tailed)								0.000	0.000	0.000	0.000	0.000	0.000	0.000
	N							388	385	379	377	379	386	386	385
Remembering	CC								1.000	.358**	.393**	.422**	.474**	.479**	.423**
	Sig. (2-tailed)									0.000	0.000	0.000	0.000	0.000	0.000
	N								389	380	378	380	388	387	385
Anxiety	CC									1.000	.729**	.347**	.331**	.409**	.177**
	Sig. (2-tailed)										0.000	0.000	0.000	0.000	0.001
	N									383	380	375	380	381	379
Depression	CC										1.000	.335**	.287**	.387**	.235**
	Sig. (2-tailed)		Very high (0.90-1.00)									0.000	0.000	0.000	0.000
	N		High (0.70<0.90)								381	373	378	379	377
Controlling behaviour	CC		Moderate (0.50<0.70)									1.000	.367**	.443**	.314**
	Sig. (2-tailed)		Low (0.30<0.50)										0.000	0.000	0.000
	N		Neglible (0.00<0.30)									383	380	381	379
Focusing on an activity	CC		(Hinkle, Wiersma & Jurs, 2003)										1.000	.546**	.408**
	Sig. (2-tailed)													0.000	0.000
	N												389	387	386
Accepting changes to routine	CC													1.000	.417**
	Sig. (2-tailed)														0.000
	N													390	386
Making friends	CC														1.000
	Sig. (2-tailed)														
	N														388

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

6.6.2 Co-occurrence of functional domains

Tables 7 and 8 show the co-occurrence of domains of difficulty. The cut-off ≥ "a lot of difficulty" was used to identify children with difficulties in each domain, against which co-occurring difficulties were cross-tabulated, showing the numbers and proportions of children who have only "some difficulty" compared to those with ≥ "a lot of difficulty". The number and proportion of children with no co-occurring difficulties is also presented, in the first column, "No other difficulty".

Table 6 - Co-occurring reported difficulties – parent responses

Co-occurrence with other module responses n (%) (*S: some difficulty*; L: ≥lot of difficulty; D: daily; *W: weekly*; M: more difficulty; LM: lot more difficulty).

Parent responses	n	No other difficulty		Seeing		Hearing		Walking		Self-care		Speaking		Learning		Remembering		Anxiety		Depression		Behaviour		Focusing attention		Accepting changes		Making friends	
≥ Lot of difficulty		*S*	L	*S*	L	*S*	L	*S*	L	*S*	L	*S*	L	*S*	L	*S*	L	*W*	D	*W*	D	M	LM	*S*	L	*S*	L	*S*	L
Seeing	11	*0 (0.00)*	5 (45.45)			*1 (9.09)*	0 (0.00)	*0 (0.00)*	1 (9.09)	*2 (18.18)*	0 (0.00)	*2 (18.18)*	2 (18.18)	*5 (45.45)*	4 (36.36)	*2 (18.18)*	2 (18.18)	*0 (0.00)*	2 (18.18)	*1 (9.09)*	1 (9.09)	1 (9.09)	0 (0.00)	*3 (27.27)*	1 (9.09)	*7 (63.64)*	1 (9.09)	*5 (45.45)*	0 (0.00)
Hearing	38	*1 (2.63)*	2 (5.26)	*2 (5.26)*	0 (0.00)			*1 (2.63)*	2 (5.26)	*4 (10.53)*	2 (5.26)	*6 (15.79)*	29 (76.32)	*16 (42.11)*	9 (23.68)	*14 (36.84)*	4 (10.53)	*5 (13.16)*	3 (7.89)	*8 (21.05)*	2 (5.26)	6 (15.79)	4 (10.53)	*11 (28.95)*	2 (5.26)	*17 (44.74)*	2 (5.26)	*9 (23.68)*	3 (7.89)
Walking	42	*0 (0.00)*	13 (30.95)	*6 (14.29)*	1 (2.38)	*5 (11.90)*	2 (4.76)			*24 (57.14)*	7 (16.67)	*14 (33.33)*	14 (33.33)	*15 (35.71)*	12 (28.57)	*15 (35.71)*	7 (16.67)	*10 (23.81)*	6 (14.29)	*9 (21.43)*	8 (19.05)	9 (21.43)	2 (4.76)	*12 (28.57)*	6 (14.29)	*17 (40.48)*	5 (11.90)	*9 (21.43)*	5 (11.90)
Self-care	11	*0 (0.00)*	0 (0.00)	*3 (27.27)*	0 (0.00)	*1 (9.09)*	2 (18.18)	*1 (9.09)*	7 (63.64)			*4 (36.36)*	4 (36.36)	*3 (27.27)*	6 (54.55)	*3 (27.27)*	4 (36.36)	*1 (9.09)*	1 (9.09)	*1 (9.09)*	3 (27.27)	4 (36.36)	1 (9.09)	*3 (27.27)*	2 (18.18)	*3 (27.27)*	3 (27.27)	*3 (27.27)*	2 (18.18)
Speaking	85	*1 (1.18)*	17 (20.00)	*10 (11.76)*	2 (2.35)	*19 (22.35)*	29 (34.12)	*8 (9.41)*	14 (16.47)	*29 (34.12)*	4 (4.71)			*38 (44.71)*	32 (37.65)	*36 (42.35)*	19 (22.35)	*15 (17.65)*	9 (10.59)	*18 (21.18)*	8 (9.41)	15 (17.65)	8 (9.41)	*28 (32.94)*	11 (12.94)	*39 (45.88)*	11 (12.94)	*23 (27.06)*	6 (7.06)
Learning	70	*0 (0.00)*	13 (18.57)	*17 (24.29)*	4 (5.71)	*13 (18.57)*	9 (12.86)	*6 (8.57)*	12 (17.14)	*31 (44.29)*	6 (8.57)	*21 (30.00)*	32 (45.71)			*30 (42.86)*	28 (40.00)	*12 (17.14)*	10 (14.29)	*17 (24.29)*	11 (15.71)	20 (28.57)	7 (10.00)	*25 (35.71)*	18 (25.71)	*32 (45.71)*	13 (18.57)	*17 (24.29)*	9 (12.86)
Remembering	42	*0 (0.00)*	7 (16.67)	*9 (21.43)*	2 (4.76)	*10 (23.81)*	4 (9.52)	*6 (14.29)*	7 (16.67)	*14 (33.33)*	4 (9.52)	*10 (23.81)*	19 (45.24)	*13 (30.95)*	28 (66.67)			*7 (16.67)*	10 (23.81)	*10 (23.81)*	7 (16.67)	12 (28.57)	6 (14.29)	*13 (30.95)*	13 (30.95)	*19 (45.24)*	9 (21.43)	*14 (33.33)*	7 (16.67)
Anxiety	42	*2 (4.76)*	12 (28.57)	*7 (16.67)*	2 (4.76)	*3 (7.14)*	3 (7.14)	*5 (11.90)*	6 (14.29)	*14 (33.33)*	1 (2.38)	*16 (38.10)*	9 (21.43)	*20 (47.62)*	10 (23.81)	*15 (35.71)*	10 (23.81)			*7 (16.67)*	20 (47.62)	8 (19.05)	6 (14.29)	*16 (38.10)*	4 (9.52)	*16 (38.10)*	12 (28.57)	*8 (19.05)*	3 (7.14)
Depression	36	*0 (0.00)*	5 (13.89)	*10 (27.78)*	1 (2.78)	*4 (11.11)*	2 (5.56)	*8 (22.22)*	8 (22.22)	*14 (38.89)*	3 (8.33)	*16 (44.44)*	8 (22.22)	*16 (44.44)*	11 (30.56)	*17 (47.22)*	7 (19.44)	*5 (13.89)*	20 (55.56)			9 (25.00)	5 (13.89)	*13 (36.11)*	2 (5.56)	*17 (47.22)*	9 (25.00)	*5 (13.89)*	6 (16.67)
Behaviour (≥More)	67	*0 (0.00)*	16 (23.88)	*14 (20.90)*	1 (1.49)	*12 (17.91)*	10 (14.93)	*8 (11.94)*	11 (16.42)	*27 (40.30)*	5 (7.46)	*21 (31.34)*	23 (34.33)	*26 (38.81)*	27 (40.30)	*30 (44.78)*	18 (26.87)	*13 (19.40)*	14 (20.90)	*19 (28.36)*	14 (20.90)			*30 (44.78)*	12 (17.91)	*35 (52.24)*	16 (23.88)	*20 (29.85)*	8 (11.94)
Focusing attention	27	*0 (0.00)*	2 (7.41)	*10 (37.04)*	1 (3.70)	*8 (29.63)*	2 (7.41)	*5 (18.52)*	6 (22.22)	*8 (29.63)*	2 (7.41)	*9 (33.33)*	11 (40.74)	*7 (25.93)*	18 (66.67)	*9 (33.33)*	13 (48.15)	*6 (22.22)*	4 (14.81)	*7 (25.93)*	2 (7.41)	6 (22.22)	6 (22.22)			*10 (37.04)*	11 (40.74)	*10 (37.04)*	3 (11.11)
Accepting changes	39	*1 (2.56)*	9 (23.08)	*4 (10.26)*	1 (2.56)	*6 (15.38)*	2 (5.13)	*9 (23.08)*	5 (12.82)	*22 (56.41)*	3 (7.69)	*13 (33.33)*	11 (28.21)	*10 (25.64)*	13 (33.33)	*19 (48.72)*	9 (23.08)	*5 (12.82)*	12 (30.77)	*8 (20.51)*	9 (23.08)	10 (25.64)	6 (15.38)	*11 (28.21)*	11 (28.21)			*7 (17.95)*	4 (10.26)
Making friends	14	*0 (0.00)*	0 (0.00)	*7 (50.00)*	0 (0.00)	*1 (7.14)*	3 (21.43)	*1 (7.14)*	5 (35.71)	*8 (57.14)*	2 (14.29)	*4 (28.57)*	6 (42.86)	*2 (14.29)*	9 (64.29)	*5 (35.71)*	7 (50.00)	*4 (28.57)*	3 (21.43)	*3 (21.43)*	6 (42.86)	6 (42.86)	2 (14.29)	*4 (28.57)*	3 (21.43)	*4 (28.57)*	4 (28.57)		

Legend: *Percentage: 20.00 > 30.00* | *Percentage: 30.00 > 40.00* | *Percentage: 40.00 > 60.00* | *Percentage: ≥ 60.00*

Table 7 - Co-occurring reported difficulties – teacher responses

Teacher responses ≥ Lot of difficulty	n	Co-occurrence with other module responses n (%) (*S: some difficulty*; L: ≥lot of difficulty; D: daily; *W: weekly*; M: more difficulty; LM: lot more difficulty).																									
		No other difficulty		Seeing		Hearing		Walking		Self-care		Speaking		Learning		Remembering		Anxiety		Depression		Behaviour		Focusing attention		Accepting changes		Making friends	
		S	L	*S*	L	*S*	L	*S*	L	*S*	L	*S*	L	*S*	L	*S*	L	*W*	D	*W*	D	M	LM	*S*	L	*S*	L	*S*	L
Seeing	15	*0 (0.00)*	4 (26.67)			*1 (6.67)*	1 (6.67)	*2 (13.33)*	4 (26.67)	*4 (26.67)*	2 (13.33)	*6 (40.00)*	4 (26.67)	*7 (46.67)*	6 (40.00)	*5 (33.33)*	3 (20.00)	*3 (20.00)*	5 (33.33)	*4 (26.67)*	2 (13.33)	2 (13.33)	2 (13.33)	*5 (33.33)*	6 (40.00)	*6 (40.00)*	1 (6.67)	*1 (6.67)*	2 (13.33)
Hearing	34	*2 (5.88)*	6 (17.65)	*3 (8.82)*	1 (2.94)			*11 (32.35)*	2 (5.88)	*3 (8.82)*	0 (0.00)	*6 (17.65)*	25 (73.53)	*18 (52.94)*	9 (26.47)	*22 (64.71)*	6 (17.65)	*4 (11.76)*	3 (8.82)	*4 (11.76)*	2 (5.88)	4 (11.76)	3 (8.82)	*12 (35.29)*	2 (5.88)	*13 (38.24)*	0 (0.00)	*8 (23.53)*	0 (0.00)
Walking	30	*1 (3.33)*	5 (16.67)	*4 (13.33)*	4 (13.33)	*3 (10.00)*	2 (6.67)			*9 (30.00)*	14 (46.67)	*10 (33.33)*	12 (40.00)	*11 (36.67)*	13 (43.33)	*13 (43.33)*	9 (30.00)	*7 (23.33)*	6 (20.00)	*10 (33.33)*	6 (20.00)	8 (26.67)	1 (3.33)	*13 (43.33)*	4 (13.33)	*13 (43.33)*	5 (16.67)	*9 (30.00)*	3 (10.00)
Self-care	24	*0 (0.00)*	0 (0.00)	*3 (12.50)*	2 (8.33)	*3 (12.50)*	0 (0.00)	*6 (25.00)*	14 (58.33)			*3 (12.50)*	17 (70.83)	*2 (8.33)*	21 (87.50)	*5 (20.83)*	17 (70.83)	*6 (25.00)*	5 (20.83)	*9 (37.50)*	2 (8.33)	8 (33.33)	6 (25.00)	*7 (29.17)*	12 (50.00)	*10 (41.67)*	7 (29.17)	*6 (25.00)*	8 (33.33)
Speaking	76	*0 (0.00)*	8 (10.53)	*6 (7.89)*	4 (5.26)	*8 (10.53)*	25 (32.89)	*19 (25.00)*	12 (15.79)	*19 (25.00)*	17 (22.37)			*24 (31.58)*	43 (56.58)	*35 (46.05)*	27 (35.53)	*19 (25.00)*	10 (13.16)	*18 (23.68)*	5 (6.58)	17 (22.37)	13 (17.11)	*27 (35.53)*	19 (25.00)	*33 (43.42)*	14 (18.42)	*22 (28.95)*	14 (18.42)
Learning	85	*1 (1.18)*	12 (14.12)	*15 (17.65)*	6 (7.06)	*8 (9.41)*	9 (10.59)	*18 (21.18)*	13 (15.29)	*24 (28.24)*	21 (24.71)	*27 (31.76)*	43 (50.59)			*27 (31.76)*	51 (60.00)	*24 (28.24)*	13 (15.29)	*19 (22.35)*	11 (12.94)	20 (23.53)	15 (17.65)	*39 (45.88)*	25 (29.41)	*43 (50.59)*	19 (22.35)	*23 (27.06)*	17 (20.00)
Remembering	56	*0 (0.00)*	0 (0.00)	*8 (14.29)*	3 (5.36)	*6 (10.71)*	6 (10.71)	*14 (25.00)*	9 (16.07)	*13 (23.21)*	17 (30.36)	*20 (35.71)*	27 (48.21)	*4 (7.14)*	51 (91.07)			*14 (25.00)*	12 (21.43)	*13 (23.21)*	11 (19.64)	15 (26.79)	13 (23.21)	*25 (44.64)*	21 (37.50)	*29 (51.79)*	13 (23.21)	*17 (30.36)*	14 (25.00)
Anxiety	51	*0 (0.00)*	9 (17.65)	*12 (23.53)*	5 (9.80)	*5 (9.80)*	3 (5.88)	*12 (23.53)*	6 (11.76)	*12 (23.53)*	5 (9.80)	*18 (35.29)*	10 (19.61)	*30 (58.82)*	13 (25.49)	*27 (52.94)*	12 (23.53)			*14 (27.45)*	26 (50.98)	15 (29.41)	9 (17.65)	*21 (41.18)*	12 (23.53)	*30 (58.82)*	9 (17.65)	*6 (11.76)*	7 (13.73)
Depression	35	*0 (0.00)*	2 (5.71)	*3 (8.57)*	2 (5.71)	*3 (8.57)*	2 (5.71)	*8 (22.86)*	6 (17.14)	*15 (42.86)*	2 (5.71)	*15 (42.86)*	5 (14.29)	*20 (57.14)*	11 (31.43)	*19 (54.29)*	11 (31.43)	*6 (17.14)*	26 (74.29)			6 (17.14)	8 (22.86)	*15 (42.86)*	10 (28.57)	*16 (45.71)*	8 (22.86)	*4 (11.43)*	7 (20.00)
Behaviour (≥More)	72	*0 (0.00)*	13 (18.06)	*16 (22.22)*	4 (5.56)	*13 (18.06)*	7 (9.72)	*14 (19.44)*	9 (12.50)	*21 (29.17)*	14 (19.44)	*21 (29.17)*	30 (41.67)	*33 (45.83)*	35 (48.61)	*33 (45.83)*	28 (38.89)	*13 (18.06)*	24 (33.33)	*19 (26.39)*	14 (19.44)			*30 (41.67)*	17 (23.61)	*37 (51.39)*	15 (20.83)	*19 (26.39)*	12 (16.67)
Focusing attention	33	*1 (3.03)*	2 (6.06)	*4 (12.12)*	6 (18.18)	*4 (12.12)*	2 (6.06)	*6 (18.18)*	4 (12.12)	*9 (27.27)*	12 (36.36)	*7 (21.21)*	19 (57.58)	*6 (18.18)*	25 (75.76)	*8 (24.24)*	21 (63.64)	*11 (33.33)*	12 (36.36)	*9 (27.27)*	10 (30.30)	7 (21.21)	10 (30.30)			*16 (48.48)*	12 (36.36)	*5 (15.15)*	15 (45.45)
Accepting changes	27	*0 (0.00)*	2 (7.41)	*2 (7.41)*	1 (3.70)	*2 (7.41)*	0 (0.00)	*6 (22.22)*	5 (18.52)	*15 (55.56)*	7 (25.93)	*8 (29.63)*	14 (51.85)	*6 (22.22)*	19 (70.37)	*11 (40.74)*	13 (48.15)	*10 (37.04)*	9 (33.33)	*11 (40.74)*	8 (29.63)	4 (14.81)	11 (40.74)	*12 (44.44)*	12 (44.44)			*7 (25.93)*	11 (40.74)
Making friends	21	*0 (0.00)*	0 (0.00)	*1 (4.76)*	2 (9.52)	*1 (4.76)*	0 (0.00)	*7 (33.33)*	3 (14.29)	*10 (47.62)*	8 (38.10)	*7 (33.33)*	14 (66.67)	*3 (14.29)*	17 (80.95)	*6 (28.57)*	14 (66.67)	*7 (33.33)*	7 (33.33)	*7 (33.33)*	7 (33.33)	4 (19.05)	8 (38.10)	*4 (19.05)*	15 (71.43)	*8 (38.10)*	11 (52.38)		

Legend: *Percentage: 20.00 > 30.00* | *Percentage: 30.00 > 40.00* | *Percentage: 40.00 > 60.00* | *Percentage: ≥ 60.00*

Table 8 summarises the most common co-occurring difficulties in Tables 6 and 7 (for which ≥ 40% of children were reported as having the co-occurring difficulty). Consistent with the correlation results, teachers identify more co-occurring difficulties than parents.

Table 8 - Most common co-occurring difficulties

Children with ≥ "a lot of difficulty":	Common co-occurring difficulties at the level of "a lot of difficulty" and *"some difficulty"*:	
	PARENT RESPONSES	**TEACHER RESPONSES**
Seeing	⇔ *learning, accepting changes, making friends*	⇔ learning, focusing attention, *being understood when speaking, accepting changes*
Hearing	⇔ being understood when speaking, *learning, accepting changes*	⇔ being understood when speaking, *learning, remembering*
Walking	⇔ *accepting changes, self-care*	⇔ self-care, learning, being understood when speaking, *remembering, focusing attention, accepting changes*
Self-care	⇔ walking, learning	⇔ learning, being understood when speaking, remembering, walking, focusing attention, *accepting changes*
Speaking	⇔ *accepting changes, learning, remembering*	⇔ learning, *remembering, accepting changes*
Learning	⇔ remembering, being understood when speaking, *accepting changes, self-care*	⇔ remembering, being understood when speaking, *accepting changes, focusing attention*
Remembering	⇔ learning, being understood when speaking, *accepting changes*	⇔ learning, being understood when speaking, *accepting changes, focusing attention*
Anxiety "daily"	⇔ depression, *learning*	⇔ depression, *learning, accepting changes, remembering, focusing attention*
Depressed "daily"	⇔ anxiety, *accepting changes, remembering, learning, being understood when speaking*	⇔ anxiety, *learning, remembering, accepting changes, self-care, being understood, focusing attention*
Controlling behaviour[1]	⇔ learning, *accepting changes, remembering, focusing attention, self-care*	⇔ Learning, being understood, *accepting changes, remembering, focusing attention*
Focusing attention	⇔ learning, remembering, accepting changes, being understood when speaking	⇔ learning, remembering, being understood when speaking, making friends, *accepting changes*
Accepting changes	⇔ *self-care, remembering*	⇔ learning, focusing attention, *being understood when speaking, accepting changes*
Making friends	⇔ learning, remembering, depression, being understood when speaking, *self-care, seeing, controlling their behaviour*	⇔ being understood when speaking, *learning, remembering*

Listing only the domains co-occurring amongst ≥ 40% of the sample simplifies reporting in Table 8, however, there are other significant findings at lower levels of co-occurrence which require closer examination (of Tables 6 and 7). For example, exploring co-occurrence at levels of ≥ 20% of the sample, difficulty walking can be seen to co-occur with difficulties in self-care, speaking, learning,

[1] "More" or "a lot more" difficulty

remembering, anxiety, depression, controlling behaviour, focusing attention, accepting changes to routine and making friends. This highlights the range of difficulties that children may be facing.

Several domains had sizeable proportions of children who only experience difficulty in that single domain, particularly amongst parent results; these included seeing (45.5%$_{P}$), walking (31.0%$_{P}$), anxiety (28.6%$_{P}$), controlling behaviour (23.9%$_{P}$), and accepting changes to routine (23.1%$_{P}$). Other domains had more moderate proportions of children only experiencing difficulty in that single domain, including speaking (20.0%$_{P}$), learning (18.6%$_{P}$), remembering (16.7%$_{P}$), depression (13.9%$_{P}$), focusing attention (7.4%$_{P}$), and hearing (5.3%$_{P}$). There were two domains - self-care and making friends - which occurred only in the presence of co-occurring difficulties; that is, these items do not identify any children who are not also identified within a different domain item.

Examination of patterns of difficulties usefully informs planning and budgeting for disability-inclusive education at the individual, school and national levels. To provide appropriate learning environments and supports and identify potential requirements for early intervention and referrals, it is useful for teachers and education policy makers to understand co-occurring difficulties (230). Whilst a child might be identified for her “main disability” (e.g. walking), the data clearly showed that difficulty walking as the sole limitation occurred in less than a third of children with difficulty walking; the majority of children experienced a range of co-occurring difficulties. In many EMISs in the Pacific (105) and globally (106) a common response category is “multiple disabilities”, which hides the types of impairment. It is useful to draw on this dataset to gain a picture of the types and patterns of co-occurring limitations that may be recorded as “multiple disabilities”.

6.7 *Combining child functioning data with learning and support needs data*

This section presents the results related to objective four – to determine whether combining CFM data with environmental data (learning and support needs) improves the accuracy of identifying different categories of functional difficulties among primary school aged Fijian children. The results are presented here in the form of a journal article, although this has not been submitted to a journal at the time of thesis submission. As outlined in the Preface, the co-author of this paper is M. Marella.

6.7.1 Title

Combining child functioning data with learning and support needs data to create disability identification algorithms in Fiji's Education Management Information System

6.7.2 Abstract

Purpose: Disability disaggregation of Fiji's Education Management Information System (FEMIS) is required to provide data to determine eligibility for disability inclusion grants. Data from the UNICEF/Washington Group Child Functioning Module (CFM) alone is not accurate enough to identify disabilities for this purpose. This study explores whether combining activity and participation data from the CFM with data on environmental factors more accurately identifies children with disabilities. *Methods:* a nested cross-sectional survey administered to teachers, using environmental factors questions related to children's learning and support needs (LSN) (personal assistance, adaptations to learning or assessment and assistive devices), within a broader diagnostic accuracy study. Frequencies, cross-tabulations and correlation coefficients were used to analyse relationships between environmental factors, impairments and functional difficulties. *Results*: CFM data is more useful than most LSN data in distinguishing between disability domains. However, LSN data is useful in strengthening accuracy of disability severity data and, crucially, in identifying which children have disability amongst those reported as having "some difficulty" on the CFM. *Conclusion:* combining activity and participation data from the CFM with environmental factors data through algorithms increases the accuracy of domain-specific disability identification. Amongst children reported as having a maximum of "some difficulty" on the CFM, those with disabilities are effectively identified through the addition of LSN data. Data on LSN additionally supports teachers to develop and monitor individual education plans for students with disability.

6.7.3 Introduction

To provide quality education for all, education systems in low- and middle-income countries (LMICs) are striving to transform to meet the diverse learning needs of all children. This requires approaches and policies that understand and value diversity in students' abilities, needs and individual characteristics. Whilst access to disability-inclusive education should ideally be accorded without requirements for eligibility, in reality providing special measures such as reasonable accommodation or individual supports means that definitions and parameters for eligibility must be determined (136).

Good evidence regarding the situation and needs of students with disabilities is a critical element in quality education for all. The central data mechanism within ministries of education that enables this evidence for policy development, planning and budgetary allocation is the Education Management Information System (EMIS). For this system to support disability-inclusive education student data must be disaggregated by disability. Methods of disaggregating EMISs by disability are evolving globally (105, 106) due partly to the increased demand for disability disaggregated data related to obligations within Article 31 of the Convention on the Rights of Persons with Disabilities (CRPD) (14) and to data required to report against the Sustainable Development Goals.

Fiji's Policy on Special and Inclusive Education (21) mandates that no child will be left behind. This policy is strongly supported by the government and is actively being rolled out through an implementation plan. The existence of Disability Inclusion Grants for schools based on enrolment of students with disabilities requires a rigorous process for determining eligibility for the grant. An important feature in the Fijian context is the relative lack of health, rehabilitation and diagnostic services for children with disabilities (68). The challenge in this context is to establish a system based on robust data which draws on the resources available in the Ministry of Education – fundamentally based on teacher observations. The choice of tool to collect data from teachers is critical.

A key tool being promoted for determining disability in children to measure the disability-inclusiveness of education programs in low and middle income countries is the UNICEF/Washington Group Child Functioning Module (CFM) (188). This includes 24 questions regarding difficulties across 13 activity and participation domains. The CFM was considered a strong candidate tool for disability disaggregation of Fiji's EMIS (FEMIS) due to several factors. It is relatively short and simple to administer without medical expertise, it identifies children with different functional difficulties and would enable comparison of school data to national data collections administered by the National Statistics Office (for which the CFM was designed). In addition the use of data on functioning to identify children with disabilities is a positive shift from the diagnostic or impairment data used previously in Fiji and commonly in other low and middle income country EMISs (105, 106).

However, validation of the CFM has shown varying accuracy (a measure of sensitivity and specificity) from "excellent" to "poor" across disability domains and only "fair" accuracy of the Module as a whole (200, 229, 231, 232). The functional areas of seeing, hearing, walking and speaking appear to have the greatest accuracy, whilst cognitive domains such as learning, remembering and focusing attention have poorer accuracy. In addition, one of the response categories in the CFM ("some difficulty") captures many children with no disability as well as many children with moderate-severe impairments, meaning that children reported as "some difficulty" can neither be ignored nor be assumed to have disability. Verification of disability for grant eligibility requires face-to-face school visits; however, it would be inefficient to visit all children recorded as "some difficulty". These results highlight the need to explore the value of combining CFM data with additional information to enable a more accurate estimation of disability and reduce false positives on the list of children who need verification visits.

In the context of planning for disability-inclusive education, researchers and practitioners have long acknowledged the need to focus far more broadly than on impairments and health conditions of individual children. The focus must also be on functioning and participation considerations (163, 233) and changes required in the environment (136) or 'instructional context' (234). To establish eligibility for special supports, information is needed which defines whether a child has a disability as well as what the child's learning and support needs are to enable participation.

The International Classification of Functioning, Disability and Health (ICF) (30) defines disability as resulting from the interaction between health conditions and contextual factors (environmental and personal). Disability is conceptualised as impairments in body structure/function, activity limitations and/or participation restrictions. Of the constructs of the ICF, the CFM focuses on functioning and includes questions pertaining to **activity limitations** such as seeing, hearing, walking, and focusing attention, and **participation restrictions** such as accepting changes to routine, self-care or making friends. It does not collect information on environmental factors - the "physical, social, and attitudinal environment in which people live and conduct their lives" (30).

The ICF has been praised for its applicability within educational systems in classification and identifying and planning for children's support needs (120, 131, 134, 235). Aljunied and Frederickson (157) observe how well-matched the ICF's biopsychosocial model of disability is with interactional models of assessment and educational psychologists' ecological systems' practice frameworks. Despite this, there has been slow progress in taking on the ICF model in relation to children with special educational needs, perhaps due to challenges in operationalising it (156, 157, 161). Lebeer et al. (162) investigated special education needs assessment across seven European countries and found that the ICF model was used in only one country, Portugal. In other countries, static standardised psychometric testing was the prevailing method.

The CRPD is consistent with the ICF in its interactive conceptualisation of disability, considering the interrelationship between impairments and environmental factors:

> *"Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others".*

In ICF terms, **environmental factors** are facilitators or barriers influencing human functioning, which play a part in determining the extent to which health conditions lead to an experience of disability, and the extent to which children with disabilities access quality education. Environmental factors are categorised as: i) products and technology; ii) natural environment and human made changes to environment; iii) support and relationships; iv) attitudes; and v) services, systems and policies (30).

In her extensive examination of ICF literature (236), Madden highlighted significant challenges regarding how to consider the environment and its effect on an individual's functioning and how to establish "thresholds" categorizing different levels of functioning for population prevalence estimates and program eligibility. She noted how few existing measures encompass functioning and environmental factors and advocated for a measure that incorporated activities and participation as well as environmental factors and measures of "need for support or assistance" (p5827).

The complexity of coding environmental factors is acknowledged in the ICF Children and Youth manual, using the example of footpath curb cuts without textured paving being a barrier for a blind person but a facilitator for a wheelchair user (34). A student in one school who requires personal assistance for toileting may, in a different school with grab rails installed in the toilets, be independent in toileting. Another challenge relates to the *dependability* and *variability* of access to the resource, for example access to mobility aids in a context such as Fiji are variable; a child may have a wheelchair prior to a cyclone, but then this aid is destroyed during a disaster and replacement may not happen for several years, depending on donor priorities. This highlights the challenge in using environmental factors to code disability and the absolute centrality of context.

Klein & Kraus de Camargo (131) noted the lack of an exhaustive definition of "environment" and the subjectivity of a definition of "typical environment", proposing that environmental factors across different cultural and educational contexts may put different requirements on functional abilities and may therefore necessitate an adaptable definition. The ICF-based Documentation Tool (237) reflects the flexibility required for environment data by providing space for open-ended responses describing the facilitator/barrier. Regarding the environmental factor “Products and technology for education” (e130), the descriptor is “Equipment, products, processes, methods and technology used for acquisition of knowledge, expertise or skill, including those adapted or specially designed”. Similarly, the environmental factor “Special education and training services” (e5853), includes the descriptor “Services and programs concerned with special education in the acquisition, maintenance and improvement of knowledge, expertise and vocational or artistic skills, such as those provided for different levels of education, including those who provide these services”. The problem with a data collection tool such as this in Fiji is that most teachers would be unable to describe the facilitators/barriers that relate to these descriptors. Whereas by providing a list of contextually relevant and available products and services, for example “Braille machine” or “teacher aide”, teacher respondents are more likely to be able to complete the form. Benson highlighted how “the ICF’s complexity can be bothersome” (163)(p10) even in well-resourced settings where the person completing the ICF form may be an educational psychologist.

In Fiji, as in most settings, the picture related to environmental factors in the education context is complicated - a new inclusive education policy with a staged implementation plan (101), changing attitudes, varying access to assistive technologies, emergent and sporadic efforts towards school accessibility modifications and nascent availability of personal assistance in school settings are but some of the factors. To conceptualise environmental factors in a way that would be feasible to measure in the context of these dynamics and fit for purpose, we divided environmental factors into two levels: (i) the individual student, and (ii) the school and broader environment, with different measurement approaches for each.

School and broader environment factors have been documented extensively (103, 106, 132, 141) and include things such as built environment, transport, policies, flexibility of curricula, attitudes (parents, teachers, principal, peers, and community), pedagogy (teaching method and practice), teacher capacity, and economic costs. There is a degree of overlap for some of these factors between the two levels - individual student and school/broader environment - and we acknowledge that concepts such as ‘pedagogy’ have implications that relate to both levels. This paper focuses particularly on the first level – environmental factors specific to the individual, for which we use the term “learning and support needs” (LSN).

FEMIS has a “granular” design, based on individual student electronic files (105). The implication of this system design for disability disaggregation is that information defining disability can be based on a combination of constructs from different parts of the ICF. Combining variables occurs through algorithms, which are calculations within FEMIS. An important question was whether combinations of functioning data from the CFM and additional data on environmental factors could be used to increase the accuracy of identification of children with disabilities in Fijian schools.

6.7.4 Study objectives

The objectives of this paper were to:

1. Determine LSN of Fijian children with various functional difficulties and impairments; and

2. Determine whether combining CFM data with environmental data (learning and support needs) improves the accuracy of identifying different categories of functional difficulties among primary school aged Fijian children.

6.7.5 Methods

6.7.5.1 Study design and sampling

A nested cross-sectional survey within a larger diagnostic accuracy study (232, 238) undertaken from March-July 2015 in Fiji. Ethics approvals were obtained from the University of Melbourne's Human Research Ethics Committee and the Fiji Ministry of Education's ethics committee. All subjects had written consent. Sampling was purposive regarding school selection and student participation. Participants for the study were 5-15-year-old students recruited from ten special schools and five inclusive education (mainstream) schools from the four administrative divisions in Fiji. Children invited to participate included: all children in the special schools, and all children in the mainstream schools previously identified by the school to have disabilities, and selected controls matched by age, sex, ethnicity and location (section 6.5, appendix A, table A-1). Clinical assessments to determine impairment status are detailed elsewhere (200, 229)(section 5.3.4).

6.7.5.2 Participant demographics

The sample included 472 children with mean±SD age of 10.2±2.6 years (range: 5 to 15) in Classes 1 to 8, including approximately half from special and half from mainstream schools. Ninety-eight teachers participated. Distribution of impairments and functional difficulties have been reported elsewhere (232), but important to note for interpretation of the results is the fact that many children had multiple types of impairment, as determined by the clinical assessments.

6.7.5.3 Survey tool

This study used a draft of the CFM (5-17 years age group) current at February 2015, with permission from UNICEF and the Washington Group. Translation and pretesting processes are described in (105). The CFM includes 24 questions covering seeing, hearing, walking, self-care, speaking, learning, remembering, concentrating, behaviour, socialisation and mood (239). Scoring essentially uses a Likert scale of severity including "no difficulty", "some difficulty", "a lot of difficulty" and "cannot do at all". UNICEF/WG advise the cut-off for counting children at risk of disability as "a lot of difficulty" or "cannot do at all" to any item. The Module has two age group versions (2–4 and 5–17 years); the 5–17-year-old Module was used for this study to match the primary school age. The CFM was interviewer-administered with parents /caregivers. Teachers completed the questionnaire independently, which included the CFM plus additional questions on environmental factors, that is LSN, including personal assistance, adaptations to learning or assessment and assistive devices, as outlined below.

The LSN questions for our survey were devised based on a literature review and in collaboration with special and inclusive education experts from Fiji to ensure contextual relevance. The number of LSN questions was established to provide reasonable detail without being unwieldy, with questions worded with an average Fijian primary teacher in mind with no special education qualifications or training. The three LSN questions were:

1: "Compared with children of the same age, how much personal assistance at school does (child's name) require with any of the following tasks? (a) moving around the classroom, (b) moving around outside in the school grounds, (c) getting to and from school, (d) communication, (e) cognitive/learning activities, (f) self-care (eating, toileting), (g) socialising with other children, (h) managing own behaviour.” The response categories were (i) needs no extra assistance, (ii) needs a little more assistance than other children, (iii) needs much more assistance than other children.

2: “Are there any adaptations to learning or assessment that you currently make for (child’s name)? (a) Child sits close to the board or teacher, (b) printed materials are enlarged, (c) printed materials are provided in Braille, (d) physical education (sport) activities and games are modified, (e) modifying the lesson, or reducing the complexity of the lesson for the child, (f) sign language interpreters are available for learning and other school activities, (g) additional time provided for assessments, (h) personal assistance provided during assessments (e.g. note taker/writer, sign language interpreter, et cetera). Response categories were (i) yes, we do this, (ii) no need for this, (iii) not done, but there might be a need.

3: “Is (child’s name) currently using any of the following types of assistive devices? Tick all applicable options; referred to pictures of assistive devices: wheelchair, crutches, walking stick or walking frame, screen reading software, Braille machine, White cane, glasses, hearing aid, magnifier, orthotic devices, artificial limbs, modified furniture, communication boards, computer used specifically to overcome functional limitation/disability” (see Appendix 5 for pictures of assistive devices).

6.7.5.4 Data analysis

Impairment severity was determined based on clinical assessments of only vision, hearing, musculoskeletal impairment, speech and cognition and did not cover areas such as psychosocial function, behaviour or attention. The highest level of severity in any of the five clinical assessments was taken as impairment severity. Level of functional difficulty was established by taking the highest level of difficulty in any of the CFM domains (covering a more comprehensive range of disability domains than impairment severity).

Frequencies were used to analyse relationships between assistive technology, adaptations and assistance required and: (i) five impairments (vision, hearing, musculoskeletal, speech and cognitive), including children with only single impairment as well as any/multiple impairments; and (ii) difficulties in the functional domains not covered by the five clinical assessments (behaviour, socialisation, anxiety and depression). Spearman’s Rho correlation coefficient was used to test correlation between level of assistance needed and impairment severity and level of functional difficulty. Correlation coefficients were classified as very high (0.90–1.00), high (0.70<0.90), moderate (0.50<0.70), low (0.30<0.50) and negligible (0.00<0.30) (228). Level of assistance was cross-tabulated with impairment severity and level of functional difficulty.

6.7.6 Results

6.7.6.1 Relationship between impairments, assistive technology, adaptations and assistance required

This section outlines frequencies of (i) adaptations to learning and assessment (educational adjustments) (Table 1), (ii) personal assistance required (Table 1) and (iii) use of assistive technologies, for children with impairments (defined by the clinical assessments), and for children with difficulties in functional domains not covered by the clinical assessments (behaviour, socialisation, anxiety and depression). The number of children with speech impairments and no other types of disability was too small to analyse these results.

Table 9 - Learning and support needs as a percentage of children with disabilities, including any/multiple disability types and children with single disability categories

Learning and Support Need		Any / multiple disab. (n=245)	VI (n=20)	HI (n=38)	MSI (n=14)	CI (n=52)	Beh/Att/ Soc (n=23)
Educational Adjustments currently provided for learning and assessment							
Additional time provided for assessments	Y	78.8	70	71.1	50	75.5	91.3
	NbN	4.5	-	13.2	7.1	1.9	4.3
	Total	**83.3**	**70**	**84.3**	**57.1**	**77.4**	**95.6**
Student sits close to board or teacher	Y	63.3	45	73.7	50	57.7	78.3
	NbN	3.3	-	2.6	-	1.9	-
	Total	**66.6**	**45**	**76.3**	**50**	**59.6**	**78.3**
Lessons modified or reduced in complexity	Y	73.5	55	68.4	57.1	67.3	78.3
	NbN	2.4	-	5.3	-	3.8	4.3
	Total	**75.9**	**55**	**73.7**	**57.1**	**71.1**	**82.6**
Personal assistance provided during assessment	Y	62.9	40	76.3	35.7	50	69.6
	NbN	6.1	10	2.6	7.1	7.7	4.3
	Total	**69**	**50**	**78.9**	**42.8**	**57.7**	**73.9**
PE sessions are modified	Y	64.5	50	55.3	64.3	50	30.4
	NbN	4.5	-	5.3	7.1	1.9	-
	Total	**69**	**50**	**60.6**	**71.4**	**51.9**	**30.4**
Enlarged printed materials provided	Y	33.9	45	39.5	21.4	23.1	30.4
	NbN	4.5	-	2.6	-	5.8	-
	Total	**38.4**	**45**	**42.1**	**21.4**	**28.9**	**30.4**
Sign language interpreters used	Y	33.5	10	79	21.4	11.5	34.8
	NbN	5.7	-	5.3	7.1	1.9	8.7
	Total	**39.2**	**10**	**84.3**	**28.5**	**13.4**	**43.5**
Personal Assistance required for tasks							
Needs assistance with cognitive/learning activities	Little	43.3	20	65.8	28.6	50	34.8
	Much	28.2	5	5.3	14.3	21.2	56.5
	Total	**71.5**	**25**	**71.1**	**42.9**	**71.2**	**91.3**
Needs assistance with communication	Little	35.1	20	44.7	21.4	42.3	34.8
	Much	22.9	-	28.9	7.1	5.8	39.1
	Total	**58**	**20**	**73.6**	**28.5**	**48.1**	**73.9**
Needs assistance managing own behaviour	Little	35.5	5	26.3	21.4	42.3	47.8
	Much	17.1	5	-	7.1	3.8	39.1
	Total	**52.6**	**10**	**26.3**	**28.5**	**46.1**	**86.9**
Needs assistance getting to/ from school	Little	24.1	10	44.7	14.3	11.5	26.1
	Much	15.5	10	5.3	35.7	1.9	13
	Total	**39.6**	**20**	**50**	**50**	**13.4**	**39.1**
Needs assistance socialising with other children	Little	22	5	13.2	21.4	21.2	21.7
	Much	9	-	-	-	-	26.1
	Total	**31**	**5**	**13.2**	**21.4**	**21.2**	**47.8**
Needs assistance with self-care	Little	19.2	-	10.5	21.4	11.5	34.8
	Much	12.7	-	-	21.4	3.8	13
	Total	**31.9**	**0**	**10.5**	**42.8**	**15.3**	**47.8**
Needs assistance moving around in classroom	Little	9	10	10.5	21.4	3.8	4.3
	Much	7.3	5	-	21.4	-	-
	Total	**16.3**	**15**	**10.5**	**42.8**	**3.8**	**4.3**
Needs assistance moving around outside	Little	9.4	5	5.3	21.4	3.8	8.7
	Much	9.4	10	2.6	28.6	-	-
	Total	**18.8**	**15**	**7.9**	**50**	**3.8**	**8.7**

Y= "Yes, we do this"; NbN= "No, but there might be a need"; "Little"=child needs a little more assistance than other children; "Much"=child needs much more assistance than other children. **Classified by clinical assessments**: VI=vision impairment (visual acuity < 6/18) (200); HI=hearing impairment (≥41dBA) (200); MSI=musculoskeletal impairment (classified as moderate-severe musculoskeletal impairment on the Rapid Assessment of Musculoskeletal Impairment) (200); CI=cognitive impairment (231). **Classified by teacher CFM score** of ≥"A lot of difficulty" on one or more of the respective questions: Behaviour/Attention/Socialisation.

As shown in Table 9, the most common **educational adjustment** being provided is “additional time for assessments”, provided to 91.3% of children with difficulties with behaviour/attention/socialisation and between 70.0-78.8% of children with other disability types, except children with only musculoskeletal impairment (MSI) of whom only 50.0% received this accommodation. The next most common LSN provided is “modifying or reducing the complexity of lessons”, followed by “student sits close to board or teacher”, “personal assistance provided during assessment”, and then “modifying PE sessions” which was done or needed for 71.4% of children with MSI but only for 30.4% of children with difficulties with behaviour/attention/socialisation. Whilst “enlarged printed materials” were unsurprisingly provided to 45% of children with vision impairment, they were reportedly also used or needed for 28.9% of children with cognitive impairment (CI), 42.1% of children with hearing impairment (HI), 30.4% of children with difficulties with behaviour/attention/socialisation, and 38.4% of children with any/multiple disability types. Similarly, whilst “sign language interpreters” were unsurprisingly provided or needed mostly for children with HI (84.3%), they were also provided for 34.8% of children with difficulties in behaviour/attention/socialisation and 33.5% of children with any/multiple disability types.

Of the LSN that require **personal assistance**, “assistance with cognitive/learning activities” was the most commonly reported. 56.5% of children with difficulties in behaviour/attention/socialisation required “much more” assistance than other children (and 34.8% required “a little more”), compared to only 5% and 20% of children with vision impairment needing these respective levels of assistance. 65.8% of children with HI required “a little more” assistance and only 5.3% “much more”. The next most common need for personal assistance was “assistance with communication”; once again, children with difficulties in behaviour/attention/socialisation had greater levels of need (73.9%), followed by children with HI (73.6%) and then CI (48.1%). The third most common need was for “assistance managing own behaviour”, for which 86.9% of children with difficulties in behaviour/attention/socialisation required either much more or a little more assistance than other children, compared to 46.1% of children with CI, and less for children with MSI (28.5%), HI (26.3%) and VI (10.0%). 35.7% of children with MSI need “much more” “assistance getting to/from school” and 20-30% with self-care and moving around in and outside the classroom.

Regarding use of **assistive technologies**, of the children with vision impairment and no other difficulty (n=20), 32.1% have printed materials provided in Braille. All 6 of the children who use Braille machines were blind; all 4 of the children who use white canes were blind; 8/12 of the children who use screen reading software had vision impairment (moderate-blind); 10/16 of the children who use glasses had mild to severe vision impairment. All 28 of the children who use hearing aids had HI. All 14 of the children who use wheelchairs had MSI; all 7 of the children with crutches/walking frame had MSI; and all 4 of the children with orthotic devices had MSI. None of the sample used prosthetics. Five of the 23 children with difficulties only in behaviour/ attention/ socialisation used a communication board; and 3 used a computer to support functional limitations. Of the 19 children with modified furniture, 6 had MSI, 4 were blind and 8 had CI.

The number of children who appeared **anxious** or **depressed** “daily” were too few (n=10 and n=5 respectively) to report frequencies usefully. However, to establish whether LSN data usefully differentiates disability domains (discussed later in relation to algorithms), it is pertinent to provide an overview of the results. None of these children had assistive technology needs. Most children with anxiety had modified lessons, additional time for assessments and sat near the teacher or board, and small numbers needed assistance with learning and assessments, communication, behaviour management and modifying PE activities. There were no distinct patterns of LSN for children who appeared depressed “daily”. LSN varied across the children and included assistance with learning, communication, assistance socialising, managing behaviour; and modified lessons, additional time and personal assistance for assessments, sitting close to the board or teacher and modified PE activities.

6.7.6.2 Correlation and cross-tabulation between LSN, impairment severity and CFM responses

Overall, there was a significant and ‘‘moderate’’ (r=0.519; n=390; p<.000) correlation between the level of assistance needed and impairment severity (based on five impairment types). There was a significant and “moderate” (almost “high”) correlation (r=0.681; n=390; p<0.000) between the level of assistance needed and level of functional difficulty (based on teacher responses to all CFM questions).

The left-hand side of table 10 presents the spread of ‘level of assistance required’ across the levels of functional difficulty reported in the CFM. As expected, the level of assistance required increases proportionally with the level of functional difficulty. Of children with the level of functional difficulty “a lot of difficulty” and “cannot do at all”, 44.2% and 76.1% respectively needed much more assistance than other children. Of the children with “some difficulty” functioning, 38.5% needed no assistance and 45.3% needed only a little more assistance than other children; and of the children with “no difficulty” functioning, 89.6% required no assistance.

Of the 16.2% of children reported as having only “some difficulty” and yet who needed much more assistance than other children (n=19), 84.2% had impairments; 14 severe and 2 moderate. Of the children with “some difficulty” functioning who needed “a little more assistance” (n=53), 47.2% had impairments; 14 severe, 10 moderate and 1 mild. Of those with “some difficulty” yet requiring “no assistance” (n=45), only 22.2% had impairments; 3 severe, 6 moderate and 1 mild.

The right-hand side of table 10 presents the spread of ‘level of assistance required’ across the impairment severities. Children with severe impairments have the highest assistance needs, with 62.5% requiring much more assistance and 46.0% requiring a little more assistance than other children. 85.7% of children with no impairments required either no assistance (58.3%) or only a little more assistance (27.4%) than other children. As mentioned in Data Analysis, the impairment severity only considers assessments of vision, hearing, musculoskeletal, speech and cognition. The raw data was reviewed to explore factors that may explain the 24 children who appear to have “no impairment” but require “much more assistance” than other children; all 24 children fit into one or more of the following categories: anxious “daily”, depressed “daily”, have more or a lot more difficulty controlling their behaviour, have a lot of difficulty accepting changes to their routine, have a lot of difficulty making friends, or are reported as having particular learning difficulties such as dyscalculia.

Table 10 - Cross-tabulations between level of assistance required and: highest level of functional difficulty (CFM response) and impairment severity

Level of assistance required	Highest level of functional difficulty				Impairment Severity			
	No difficulty	Some difficulty	A lot of difficulty	Cannot do at all	None	Mild	Moderate	Severe
No assistance needed	69	45	9	2	98	6	14	7
	55.2%	36.0%	7.2%	1.6%	78.4%	4.8%	11.2%	5.6%
	89.6%	*38.5%*	*7.0%*	*3.0%*	*58.3%*	*35.3%*	*25.5%*	*4.7%*
Needs a little more assistance than other children	7	53	63	14	46	5	23	63
	5.1%	38.7%	46.0%	10.2%	33.6%	3.6%	16.8%	46.0%
	9.1%	*45.3%*	*48.8%*	*20.9%*	*27.4%*	*29.4%*	*41.8%*	*42.0%*
Needs much more assistance than other children	1	19	57	51	24	6	18	80
	0.8%	14.8%	44.5%	39.8%	18.8%	4.7%	14.1%	62.5%
	1.3%	*16.2%*	*44.2%*	*76.1%*	*14.3%*	*35.3%*	*32.7%*	*53.3%*
Total	77	117	129	67	168	17	55	150
	19.7%	30.0%	33.1%	17.2%	43.1%	4.4%	14.1%	38.5%

Italicized percentages indicate column percentages; non-italicized percentages indicate row percentages.

6.7.7 Discussion

FEMIS requires a higher degree of accuracy than most EMISs in low and middle-income countries because it is the basis of funding eligibility decisions at an individual student level. Within an overarching goal of developing a valid and feasible approach for disability disaggregation of FEMIS, previous work (232) has established that functioning data from the CFM is not accurate enough to identify disability for this purpose. In addition, as FEMIS is also used to document required educational accommodations for individual children including exam/ assessment accommodations, functioning data does not provide this information. Due to the granular nature of FEMIS's architecture, multiple variables can be combined within algorithms (calculations) in FEMIS to define disability types and levels. This study explored LSN of Fijian children with different types of functional difficulties and impairments and explored combinations of functioning and LSN data that may distinguish between disability types amongst children in Fiji.

In Fiji disability-inclusive education is a relatively emergent approach. It is early days in building teacher skills in differentiating teaching for children, discerning different LSN and awareness of options for reasonable accommodations. In addition, resources to thoroughly regulate the new Special and Inclusive Education Policy are not available currently. In this context, it is likely that using LSN data as the *primary* means of determining eligibility for disability funding would have lower validity and reliability than observations of functioning.

As outlined earlier, classification merely by diagnosis does not adequately inform supports needed for individual children (131) and diagnosis has been shown to be a weak predictor of participation compared with environmental factors (132, 240). Especially evident in diagnoses such as autism spectrum disorder, learning disorders or cerebral palsy, there is enormous variation in functional abilities within and across these diagnoses. Ruppar et al. (234) argue that assigning resources in education systems should not happen on the basis of disability labels, but instead by careful consideration of LSN.

In line with these positions, the first objective of our study was to explore LSN of Fijian children. The most common LSN identified in our study were requirements for additional time and personal assistance during assessments, modifying or reducing the complexity of lessons, providing personal assistance with cognitive/learning activities, and sitting close to the board or teacher; these were mutual to children with all types of impairments or functional difficulties. The widespread use of these cost-free and allowable modifications by teachers in the study sample is a positive indication of knowledge and application of educational accommodations for students with disabilities in the inclusive education demonstration schools and special schools included in the sample. Assistance with communication and managing behaviour were also commonly required, which highlights the need for teachers to have skills in positive behaviour management and methods for building communication skills in children.

A small number of LSN were specific to impairment groups, for example providing materials in Braille was only relevant for children with vision impairment, and assistance moving around the classroom or outside was mainly relevant for children with mobility impairment. Other LSN were predominant amongst certain types of impairments or functional difficulties but were required across a wide range of children, for example modifying PE activities and enlarging printed materials. Sign language interpreters were used mostly for children with HI, but also for children with speech and cognitive impairments. Basic sign language skills are common amongst teachers in special schools in Fiji and amongst teacher aides in the inclusive education demonstration schools included in the sample for this study. This may explain why sign language is available and used so widely.

Results regarding the need for personal assistance are interesting in relation to human resource planning for disability-inclusive education. Children with difficulties with behaviour/attention/socialisation needed high levels of personal assistance across a range of tasks. On the other hand, children with vision impairment required the least personal assistance, although the sample are almost entirely from a specialist school for children with vision impairment. It is possible that in a well-adapted environment, where educational accommodations are in place, students with vision impairment are relatively independent of additional personal supports.

The second objective of this study was to determine whether combining CFM data with environmental data on LSN improves the accuracy of identifying different categories of functional difficulties, as required by the MoE. The purpose of this enquiry was related to previous findings showing limitations in solely using CFM data for identifying children with disabilities in Fiji (200, 229, 231, 232). The sensitivity of the CFM response category “a lot of difficulty” was too low and the sensitivity of the response category “some difficulty” was high but the specificity was very low. This implies that many children on the MoE’s list for conducting disability verification visits to schools (based on the response option “some difficulty”) would be found not to have disability, wasting resources for unnecessary visits.

Our correlation and cross-tabulation results clearly showed that the LSN data effectively distinguishes between children with and without disabilities and increases proportionately along a gradient of increasing severity of impairment and functional difficulty. Amongst children reported as having “some difficulty”, the gradient of impairments directly relates to the reported levels of assistance required and therefore provides evidence of the usefulness of LSN data in increasing the accuracy of identifying children with disabilities amongst those reported as having only “some difficulty” on the CFM. This was demonstrated by the high levels of clinical impairments amongst children reported as “some difficulty” on the CFM, but who need “much more” assistance than other children. The implication of this is that combining functioning data from the CFM with LSN data increases accuracy in identifying children with disabilities amongst those identified as only having “some difficulty” on the CFM.

The results showed that some assistive technologies are useful for distinguishing between disability types and can be useful for this purpose in algorithms combining CFM data with LSN; these include hearing aids, Braille machine, white cane, wheelchair, orthotic devices and prosthetics. On the other hand, four assistive technologies were used by children across a range of disability types and were therefore unable to be used within algorithms in the same way. These include: modified furniture, screen reading software, communication board and computer used to support functional limitation. Collecting information on these assistive technologies may be useful to determine the LSN of an individual child, but as elements in algorithms designed to delineate disability types, they are confounding variables.

The intersection between students’ capacities and environmental factors, or LSN, is arguably the basis to defining supports and services needed for successful educational outcomes of students with disabilities (241). Various researchers have underscored the value of the ICF for considering and documenting the role of the environment as a barrier or facilitator of child functioning, including accommodations and pedagogical modifications (120, 233), although widespread uptake of the ICF for this purpose has been limited (131). A common tool for disability-inclusive education in many countries, facilitating communication and cohesive approaches between teachers, families and others involved in the education of children with disabilities is the Individualised Education Plan (IEP). Central to the development of the IEP is identifying a child’s LSN and establishing an agreed process of meeting these (242). Whilst the exhaustiveness of the ICF-CY coding has been criticised as being unwieldy (163), Kostanjsek et al. (243) envisaged the possibility of developing a list of generic environmental factors relevant across health conditions that could be implemented alongside functioning questions. This is the approach taken within Fiji.

Based on the study results, Fiji developed an assessment tool called the Student Learning Profile. This incorporates functioning data based on the CFM, a generic list of questions on environmental factors/LSN including assistive technology, and student strengths and interests. The Student Learning Profile is the basis of algorithms in FEMIS which combine functioning and LSN data to define disability and distinguish between disability types. It is also the basis of the discussions at the school level to develop a student’s IEP. Sanches-Ferreira et al. (233) emphasised the importance of *severity* of functional difficulty as a key factor in determining eligibility and planning for appropriate supports, and in line with this, the Student Learning Profile includes four CFM response categories to inform this.

The CFM data is the most useful element in distinguishing between disability types within the algorithms, whereas most LSN questions do not help in distinguishing between disability types because they are applicable across a wide variety of children. However, when used in combination with CFM functioning data, the LSN are very helpful in distinguishing between children with and without disabilities, which is vital for increasing the accuracy of disability identification amongst children who are reported as having "some difficulty" on the CFM.

Mont points out that environmental factors such as educational accommodations vary across contexts and over time and are heavily dependent on policies and resourcing, and that therefore in establishing an internationally comparable method for disaggregating EMISs, using learning supports to categorise disability is inappropriate; in contrast, functioning data is more suited for this purpose (244). Hollenweger (136) agrees that environmental factors vary greatly across contexts, but argues that "ultimately the policy context, financial resources and available services define which eligibility criteria are applied and how they are applied" (p4) and that it is therefore doubtful that a uniform disability definition that does not take contextual influences into account would result in equitable supports for inclusive education. In terms of FEMIS, using functioning and environmental factors data to categorise disability for disaggregating FEMIS enables the provision of equitable supports, and where needed (for internationally comparable data) the functioning data could be extracted from the system separately from the LSN data.

Lebeer et al. (162) outline important limitations of static, standardised psychometric tests of children's functioning which are commonly deficiency-orientated. In their research looking at assessment methods of children with developmental difficulties across Europe, they found that most children's learning problems were seen to be a problem in the child's functioning rather than due to the interaction between the child's impairment and barriers within the educational context. They advocate for dynamic and functional assessment methods, which support better understanding of the child's needs in learning and development and provide recommendations on how to work with the child. There are three elements of Fiji's approach to disability disaggregation of FEMIS which respond to Lebeer's recommendations:

(i) Defining whether a child has disability using algorithms that combine functioning and LSN data within FEMIS. This acknowledges the dynamic nature of disability and enables a child to move in and out of the definition of "disabled", based on changes in environmental factors and/or functional capacity;
(ii) The Student Learning Profile includes questions on capabilities and LSN which facilitate decision-making using individualised approaches for improving learning and development; and
(iii) The real-time nature of FEMIS, whereby data can be uploaded at any time in the school year, facilitates dynamic assessment.

6.7.8 Conclusion

The method of disaggregating FEMIS by disability requires more accuracy than most EMISs in low and middle-income countries because it is the basis of funding eligibility decisions at an individual student level. We have shown that combining activity and participation data from the CFM with data on environmental factors (i.e. learning and support needs) through algorithms increases accuracy in identifying children with disabilities amongst those identified as only having "some difficulty" on the CFM and enables domain-specific disability identification for the purpose of disability disaggregating FEMIS. Certain LSN are common to children with various disability types and, whilst useful in identifying which children have disability amongst those reported as having "some difficulty" on the CFM, these LSN items are not useful in distinguishing between disability domains. CFM data is more important in distinguishing between disability domains. Additionally, data on LSN supports the development and monitoring of IEP for students with disability.

A limitation of this study is the inability for the findings to be transferred to many other low and middle-income contexts - at this point. As highlighted earlier, the granular nature of FEMIS enables disability determination based on combinations of functioning and LSN data using algorithms. This is not possible in countries using a manual census-based EMIS. However, an increasing number of EMISs globally are transitioning to granular forms (105), including notably UNESCO's OpenEMIS which is currently being trialled in 10 countries.

A further limitation relates to the lack of attention paid in this paper to environmental factors at the 'school and broader environment level'. Factors such as accessible buildings and assessment policies play a central role in the degree to which a child with a health condition is disabled. Whilst the categorisation of disability for the purpose of disaggregating FEMIS is based on 'individual student level' factors identified in the Student Learning Profile, data on 'school and broader environment level' factors is collected within FEMIS using a School Accessibility and Inclusion Form (245). Data from this form is entered on each the school's page within FEMIS (as opposed to the individual student pages). This enables analyses such as correlations between individual student learning outcomes with 'school and broader environment level' factors.

Schools included in this study were special schools and inclusive education demonstration schools, which possibly led to a greater level of teacher awareness of children's learning and support needs. Further research is needed to understand how this tool works in schools with less awareness of disability-inclusive education.

7. Overarching thesis discussion and implications

Demand for disability disaggregated EMIS data has grown around the world, particularly in response to SDG reporting requirements for Goal 4 – to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. Prior to this study, Fiji's Ministry of Education was grappling with flawed disability data that was inadequate for the purposes of planning and monitoring its policy objectives of disability-inclusive education and reporting against related national and international commitments. Evidence from the literature showed that no EMIS in the Pacific was based on a validated means of identifying disability (105), which largely mirrored the situation in other LMICs around the world (106). A recent tool for identifying disability in children, the UNICEF/Washington Group Child Functioning Module (239), has been recommended by multiple United Nations and peak disability stakeholder groups as the tool for disability disaggregating the SDG indicators related to children (35, 36, 115). The CFM was developed with parents/primary caregivers as the proxy respondent and prior to this study had not been tested in the context of an educational setting with teachers as the proxy respondents.

The aim of this study was to identify a valid, reliable and feasible method for Fiji to identify children with disabilities in schools and disaggregate Fiji's EMIS by disability. To achieve this aim, a cross-sectional diagnostic accuracy study investigating the sensitivity and specificity of the CFM was undertaken, comparing parent responses and teacher responses to reference standard (clinical) assessments. A key analytic method was the use of ROC curves to depict the trade-off between sensitivity and specificity and arrive at an overall measure of diagnostic accuracy, indicating how well the index test (CFM) classified the student in comparison to the reference standard (clinical) tests. Additionally, a nested cross-sectional survey was self-administered by teachers as they completed the CFM on each student participant. This survey included questions on environmental factors related to learning and support needs, including personal assistance, adaptations to learning or assessment and assistive devices.

The data produced a series of novel findings indicating that the CFM is a useful core aspect of data required for disability disaggregation of Fiji's EMIS and that teachers are adequately accurate proxy respondents to the CFM. However, the mixture of severity of impairments reported across CFM response categories and ambiguity in the choice of cut-off level, in both parent and teacher results, are limitations of the CFM and indicate that the CFM may not be accurate enough to be used as the sole method for identifying children with disabilities. Findings from the nested survey showed that combining activity and participation data from the CFM with data on environmental factors (i.e. learning and support needs) increased the accuracy of overall and domain-specific disability identification. As FEMIS is an online system, it was possible to readily build algorithms combining these data to enable accurate and valid disability disaggregation.

The five results chapters in this thesis focused on different aspects of the CFM validation. This discussion chapter synthesises the principal findings from the results to emphasise the main ideas that emerged and to discuss key insights that contribute to the literature. The question of feasibility of implementation for the system is then considered, drawing on an excerpt from a book chapter (to be published in May 2019) which used the system developed in Fiji through this research as a case study to illustrate good practice in disability disaggregation of EMISs. Implications of the findings for disability disaggregation of EMISs both in Fiji and elsewhere are then highlighted, the limitations of the study addressed, followed by areas for future research and the overall conclusions.

7.1 Synthesis of principal findings

7.1.1 The CFM is useful but not accurate enough as the sole data for identifying children with disabilities for Fiji's EMIS

Using the function-based CFM response categories is an improvement on impairment-based disability categorisation in EMISs, which has been the most common approach in EMISs globally (106), in the Pacific (105) and in Fiji (128). This provides a solution to problems highlighted by various researchers of impairment-based disability categorisation in education, such as inconsistency in use and interpretation of terminology (134, 242), obscuring the nature and severity of children's problems (129, 133) and poor prediction of participation (132).

As with most EMISs, Fiji's EMIS is inherently limited by its focus on enrolled children, whereas countless children with disabilities are out-of-school in Fiji (92) and across the Pacific (82). Measuring enrolment ratios - the proportion of in-school children with disabilities out of all children with disabilities in the population - is an important means of assessing how well policies are reaching very marginalised children with disabilities. Disability-disaggregated enrolment ratios are required to report on indicators for the CRPD and other international frameworks. As the CFM is being rolled out within national statistics offices as a module to attach to censuses and surveys, function-based population data on children with disabilities will be available. Using the CFM in EMISs enables comparability with that population data, in line with recommendations by the World Report on Disability (2).

A further advantage of the CFM is the existence of four levels of response category, which enables a distinction to be made between severities of disability. Fiji's previous disability categorisation used simple yes/no classifications with no teacher training provided and diagnoses rarely available to assist in selecting categories. As highlighted by Croft (10), knowing the level of disability is critical for planning educational interventions; this enables distinction between children with high support needs and those with mild functioning difficulties. However, whilst the presence of scaled response options is a critical improvement, the results from this study showed variable performance across the different response levels.

Contrary to the recommended interpretation of the response categories by UNICEF/WG (183, 184) and USAID (188), this research did not show a consistent and predictable set of CFM responses in comparison to the children's level of impairment. This study identified that the three CFM response categories - "some difficulty", "a lot of difficulty" and "cannot do at all" - do not relate to the same levels of severity across different functioning domains. Whilst most moderate impairments are reported as "some difficulty", children with severe impairments appear across the three response categories.

The Fiji data showed that, based on combined results from the seven domains that had a reference standard (clinical) assessments - seeing, hearing, walking, speaking, learning, remembering and focusing attention - the diagnostic accuracy of the CFM was just "fair" (209). That is, an area under the ROC curve of 0.763 for parent responses and 0.786 for teacher responses (Se = 0.55 and Sp = 0.80 at the level "a lot of difficulty"; Se = 0.98 and Sp = 0.33 at the level "some difficulty"). The only other research to publish overall diagnostic accuracy of the CFM was the study amongst 2-4 year olds in South Africa, which showed comparable sensitivity (0.60) and specificity (0.84) at the level “a lot of difficulty”. However, this comparison should be taken with caution as Visser’s study only had five children with disabilities and used a different age-group version of the CFM. Ultimately, the Fiji data showed that the sensitivity of the CFM response category “a lot of difficulty” was too low, missing many children with disabilities, and that the sensitivity of the response category “some difficulty” was high but the specificity was very low. This implies that many children on the MoE’s list for conducting disability verification visits to schools (which is based on the response option “some difficulty” so children are not missed), would be found not to have disability.

The main functions for the data in Fiji are to disaggregate the EMIS for budgeting, policy tracking and reporting; alert teachers to individual children’s potential learning and support needs; and inform eligibility for services and assessment accommodations. The CFM is not accurate enough, as a tool used by itself, to fulfil these purposes.

7.1.2 A different CFM cut-off level is required for use in EMISs compared to censuses and surveys

The CFM was designed to disaggregate censuses and household surveys, for which the data aims to show differences in equality of opportunities between disabled and non-disabled populations (36). For this purpose, it is important to minimise the false positives amongst the population counted as having disabilities (175). The trade-off is the increased likelihood of a bias towards people with more severe disabilities and an increase in false negatives, which mean that some children with disabilities would be missed. In contrast, Fiji’s policy commitments require a disability identification approach that captures all children with disabilities so no children slip through the net. Identifying children with mild and moderate disabilities enables early interventions and educational adjustments. As Madans et al. emphasise, “disability is not a singular static state, there is no simple, singular way to collect disability data” (36)(p1165) and therefore the purpose for the data must be identified to ensure appropriate data collection (168).

UNICEF/WG emphasise the usefulness of the CFM’s different severity levels for different data purposes, and recommend using the response category “a lot of difficulty” as the cut-off for determining disability in censuses and surveys for the purpose of disaggregating outcome indicators (183, 184). This was informed by field testing in Samoa, Mexico and Serbia which showed that the “some difficulty” cut-off estimates an unreasonably high prevalence compared to “a lot of difficulty” cut-off (175). The Fiji data provide evidence that, for both parent$_{(P)}$ and teacher$_{(T)}$ responses, 39.7%$_P$ / 32.7%$_T$ of children with moderate clinical impairments and 27.5%$_P$/ 20.5%$_T$ of children with severe impairments are identified by parents or teachers as having just “some difficulty” and would miss out on services if the cut-off were “a lot of difficulty”. This is consistent with findings from research in Cameroon, India and Guatemala (194, 195, 197, 198) which highlighted the large numbers of children with disabilities who are categorised as having just “some difficulty”.

Mactaggart’s doctoral thesis (197) provides the only comparable research which reports sensitivity/specificity of CFM domains. The difference in sensitivity/specificity between “some difficulty” and “a lot of difficulty” shows strong similarities to the Fiji results. For example, in vision impairment results from Cameroon, sensitivity/specificity = 0.79/0.80 (“some difficulty”) compared to 0.31/0.99 (“lot of difficulty”); and India, sensitivity/specificity = 0.84/0.78 (“some difficulty”) compared to 0.39/0.99 (“lot of difficulty”). Comparable figures from the Fiji data showed sensitivity/specificity = 0.80/0.89 ("some difficulty") compared to 0.14/0.99 ("lot of difficulty") for parent respondents and 0.71/0.90 ("some difficulty") compared to 0.36/0.99 ("lot of difficulty") for teacher respondents. Essentially, the "lot of difficulty" clearly has an impressive specificity in all three countries, but the "some difficulty" cut-off has better overall diagnostic accuracy (balance between sensitivity and specificity). This mirrors the Fijian data that looked at the whole CFM: at "some difficulty" sensitivity was excellent for both parents and teachers (0.98_P/ 0.96_T) but specificity was very poor (0.33_P/ 0.42_T). At the cut-off "a lot of difficulty" specificity was much better (0.80_P/0.82_T) but sensitivity dropped significantly (0.55_P/0.57_T). These results further highlight an important shortcoming in diagnostic accuracy of the CFM-7 – the recommended response category "a lot of difficulty" misses many children, but the next lower category "some difficulty" includes too many false positives. These limitations are clearly stated in the literature published by the CFM developers.

Massey (191) described how CFM cognitive testing indicated greater divergence within and across countries related to respondents' interpretation of the "some difficulty" category, and field testing bolstered the cognitive testing findings by showing that this cut-off results in greatest variation in prevalence across countries (175). However, the CFM is not the only disability tool to face challenges with poor accuracy of moderate response categories. In their analysis of the World Health Survey, Mitra et al. had to select the cut-off "severe difficulty" because the mild and moderate difficulty categories had not performed well in cognitive testing (6). Schneider (246) speculates that variation in access to health care across countries influences the degree to which difficulties are reported, particularly mild and moderate difficulties. She posits that where access to health care is low, recognition and diagnosis of problems is low.

In response to this key limitation of the CFM, Mactaggart recommended that children identified having "some difficulty" should be clinically assessed in the same domain of functioning to identify a higher proportion of children with disabilities. Whilst including a clinical second phase may be possible within survey processes, this is not a feasible process for Fiji's schools, given the limited access to medical services in many places. With the large numbers of children identified as having "some difficulty" who do not have disabilities, it would be cost and time inefficient for families and the state to undertake second phase assessments with all those children. The Fiji study explored an additional type of data to increase the accuracy of identifying children likely to have disability amongst the long list of children from the CFM response category "some difficulty" (discussed in 7.1.5).

A second difference in the recommendations arising from this study compared to Mactaggart's is that Mactaggart recommended subsequent clinical assessments in the same domain of functioning identified as "some difficulty" on the CFM. The Fiji data indicate that clinical assessment needs to be wide ranging enough to pick up unidentified and unexpected impairments. For example, some children reported to have difficulty walking were subsequently recognised through clinical assessments to have vision impairment and not mobility impairment. These would not be picked up if secondary assessment only reviewed musculoskeletal function.

These findings mean that children reported as having "some difficulty" can neither be ignored nor be assumed to have disability. Mitra suggested using a "trichotomy" (severe, moderate and no difficulty), in which classification of people with moderate functional difficulty was based on "some difficulty" in at least one domain with no higher levels of difficulty recorded (247). This is consistent with our finding that the cut-off "some difficulty" included most of our children with moderate impairments, however the challenge remains that 47.8%$_P$ / 39.1%$_T$ of children with no clinical impairment are reported as having “some difficulty” (i.e. would be false positives at the cut-off “some difficulty”).

The choice of cut-off is different for a Ministry of Education than for a Bureau of Statistics. The more severe cut-off at “a lot of difficulty” would result in an unacceptable number of children with disabilities missing out on relevant education services, yet the “some difficulty” cut-off brings more false positives, thereby increasing costs of follow up assessments. For Fiji’s Ministry of Education, prioritising sensitivity and accepting a lower specificity is important to give children with disabilities the greatest chance of being recognised by the screening tool. The question remained about whether additional data could reduce the number of false positives (see 7.1.5).

7.1.3 Teachers are adequately accurate respondents to the CFM

Fiji’s former policy on special and inclusive education, current at the time of this research, mandated that a medical diagnosis must be provided for a child to be recognised as having a disability (128), which was a limiting factor in the MoE’s ability to count children with disabilities given the absence of clinical diagnostic services in many places. In Fiji, teachers are primarily responsible for the student data within EMISs and are reliant on their own observations and knowledge to determine disability categories as required by FEMIS data entry formats.

This study provides evidence that teacher responses to the CFM are reasonably accurate compared to parent/caregiver responses, for whom the CFM was designed and tested. Whilst parent responses are more accurate in the domains of seeing, walking and speaking (ranging from 0.848 to 0.975), teacher accuracy is very acceptable (ranging from 0.823 to 0.909). Conversely, teacher responses are substantially more accurate in the domains of learning, remembering and focusing attention. For hearing, the accuracy is very similar between respondent types.

Teacher results showed higher correlations for domains which might be expected to correlate (anxiety and depression; learning and remembering; changes to routine and focusing attention). This indicated that teachers might be observing these functional domains more consistently than parents and may be more accurate. The results also highlighted a potentially important role for teachers in Fiji in identifying children at risk of psychosocial distress. These issues both point to important areas for future research.

The study results showed “excellent” inter-rater reliability between parents and teachers for the questions on hearing, walking, speaking; “good” IRR for self-care, seeing and learning; “fair” for remembering and making friends; and “poor” for controlling behaviour, sadness, focusing attention, anxiety and accepting changes to routine. These findings differed from those of McLeod et al. (248) who found that parents’ and educators’ responses to the *Parents’ Evaluation of Developmental Status* (PEDS) were significantly correlated in all areas except gross motor. This may imply that the PEDS functions better than the CFM, however there are too many potential confounding factors that make it difficult to interpret this difference. These relate to differences between LMIC versus high income country settings and varying education and health knowledge levels of teachers and parents in the two settings, which hark back to the cross-country variations in disability reporting that Schneider described (246). The IRR results from the Fiji study need to be considered in relation to accuracy; if both respondents are equally “wrong” on a CFM question this may result in a high IRR but not mean the tool is useful. For example, given the poor accuracy of parent and teacher CFM responses to the focusing attention question and the poor accuracy of the remembering question for parents, it is not surprising that the IRR for these domains is mixed. A limitation of the study is the lack of reference standard (clinical) assessments of many of the domains that resulted in low IRR, so it is difficult to interpret the factors influencing the poor IRR.

This study provides evidence supporting the conclusion that teachers can measure functional difficulties using the CFM with an adequate degree of accuracy. This aligns with the World Report on Disability recommendations to use a 'difficulties in functioning approach' instead of an 'impairment approach' to better capture the extent of disability (2). However, given the better accuracy of parents in some domains, a system designed to incorporate both the teacher and the parent observations of the child may increase the accuracy of disability identification even further. This would inherently support other beneficial processes in disability-inclusive education such as communication and relationship between teachers and parents.

7.1.4 Disability domain-specific findings and interplay between CFM items

Whilst it is essential to understand the overall properties of the CFM for disability identification as outlined in 7.1.1, there are vast differences between different disability types and their implication for planning and resourcing. Examining the properties of the disability domain-specific questions of the CFM and the interplay between them contributes important information to the literature and influences how the resulting system in Fiji is developed.

The study revealed that certain individual domain-specific questions showed much higher accuracy: speaking (0.975_P / 0.909_T), walking (0.889_P / 0.869_T), seeing (0.848_P / 0.823_T) and hearing (0.847_P / 0.846_T) (200, 229), which are perhaps more observable functions (chapters 6.2 and 6.3). In the cognitive domains, the accuracy of parent responses was worse, rating "fair" to "poor" in learning (0.774_P), remembering (0.663_P) and focusing attention (0.623_P). For these domains, teacher accuracy was higher: learning was "good" (0.822_T), remembering was "fair" (0.781_T) and focusing attention was "poor" (0.686_T) (chapter 6.4). Importantly, the Youden Index related to these accuracy figures indicated that the most accurate response category for all of the individual domain analyses was "some difficulty".

There were some notable findings particular to certain disability domains. The CFM includes two questions related to difficulty being understood when speaking; one is by people inside the house, and the other is by people outside the house. The data show a high correlation between the two, and a higher accuracy for the "outside" question at all cut-off levels (chapter 6.3). This observation is consistent with the recently published CFM field tests from Samoa, Serbia and Mexico, which showed that 0.0% of all children with functional difficulties in any country only had difficulty being understood by people inside the household, compared to 0.6-1.5% by people outside the household (175). Additionally, the data analysis syntax recommended by UNICEF for analysis of the CFM questions (184) combines these two questions and takes the most severe level of difficulty from either question as the level of difficulty being understood when speaking. The implication both for EMISs and national surveys and censuses is that the "inside" question may be redundant, which is a useful finding as cost per question is an imperative in national data collections.

The second potentially redundant functioning question in the CFM relates to self-care. Both correlation and co-occurrence results (section 6.6) indicate that this question may be redundant as a separate domain. It provides very useful information school support needs and potentially as an indication of severity of disability. However, similar to Cappa et al.'s data in Samoa and Serbia (175), the self-care question did not identify any new children with disabilities who were not identified by other questions on the CFM. In the context of censuses and surveys where there is pressure to reduce the number of questions, this question could be deleted. The Fiji MoE does not recognise "self-care" as a disability category, however it represents an important area of potential assistance requirements, such as the need for teacher aides. Therefore this question should be included in data collection on learning and support needs.

The six CFM domains without a clinical reference standard in this study – self-care, anxiety, depression, controlling behaviour, accepting changes, and making friends - indicated an excessively high proportion of children having "some difficulty" (or seeming anxious or depressed "weekly"), implying that this cut-off was not accurate for these domains. The "a lot of difficulty" (or "daily") cut-off appears to represent more reasonable numbers of children with functional difficulties in these domains. Consistent with these findings, field testing of the CFM (175) also resulted in the recommendation to use "daily" as the cut-off for anxiety and depression. Regarding the controlling behaviour question, field testing showed unexpectedly high numbers of children with difficulty controlling behaviour, which precipitated the CFM authors changing the response categories (175).

A unique contribution of this study to the literature is analysis of the inter-item correlation coefficients and co-occurrence of CFM functioning domains (section 6.6). The patterns of functional limitations are important for teachers and policy makers to understand co-occurring difficulties to identify potential requirements for early intervention and referrals and to provide appropriate learning environments and supports. Most children in the study experienced multiple difficulties, at varying levels of difficulty. Many EMISs in the Pacific (105) and globally (106) include a response category "multiple disabilities". The Fiji study validates the need for EMISs to collect data on children with difficulties in multiple functional domains and provides a picture of the types and patterns of co-occurring limitations that may be recorded as "multiple disabilities". Finally, and uniquely to this study, was the importance of the patterns of functional limitations in informing the development of algorithms for coding disability into types and levels of severity within FEMIS, which are discussed in the next section.

7.1.5 Combining CFM data with environmental factors data may increase the accuracy of disability identification

Fiji's method of disaggregating its EMIS by disability requires more accuracy than many EMISs in LMICs because it is the basis of funding eligibility decisions at an individual student level. Central to this research was the question of which elements of the ICF would be most relevant to disaggregate FEMIS and inform disability-inclusive education. The findings showed that combining activity and participation data from the CFM with data on environmental factors (i.e. learning and support needs) through algorithms enables domain-specific disability identification for that purpose.

As explored in section 4.1, it is clear that simple disability classification does not adequately inform supports needed for individual children (131) and thorough consideration of LSN is required to allocate disability-related resources in education systems (234). This study contributes to the literature by documenting LSN of Fijian children matched with functional difficulties and clinical impairments. The study identified: common LSN such as requirements for additional time and personal assistance during assessments; LSN specific to impairment groups such as Braille materials for children with vision impairments; and LSN that were principally used by children with certain types of impairments or functional difficulties but required across a wide range of children.

A strong contribution of this study were the results that clearly showed that LSN data successfully discriminates between children with and without disabilities. LSN were found to increase uniformly along a gradient of increasing levels of impairment and functional difficulty, particularly amongst children recorded as having "some difficulty" on the CFM. This suggests that combining CFM functioning data with LSN data may helpfully increase accuracy in identifying children with disabilities amongst the most challenging group - those identified on the CFM as having "some difficulty".

Some assistive technologies proved useful for distinguishing between disability types including hearing aids, Braille machine, white cane, wheelchair, orthotic devices and prosthetics. This capacity to distinguish between disability types makes items on these technologies useful for including in algorithms. Other assistive technologies including modified furniture and screen reading software were used by children across multiple disability types, which makes information on these technologies useful to determine the LSN of an individual child, but potentially confounding variables within algorithms designed to delineate disability types.

Most LSN are applicable across a wide variety of children so do not help distinguish between disability types but do distinguish between children with and without disabilities. Within the algorithms, data from the CFM is the most useful element in distinguishing between disability types. In combination, CFM data and LSN data provide a sophisticated and effective means of disability identification, capable of distinguishing between disability types and levels of severity whilst providing data that informs the supports required to benefit each child. This key finding from the study makes an original contribution to addressing the challenges outlined in the literature related to (i) identifying and measuring disability in children and (ii) understanding which ICF elements or combination of elements are feasible and effective to apply in education settings in LMICs. The discussion thus far has examined the findings to address the question of effectiveness. Now we turn to the issue of feasibility.

7.2 *Paper Four: The Fiji case study - demonstrating feasible implementation for disability-disaggregation within an EMIS*

The following case study is an excerpt from a chapter the candidate co-authored with Daniel Mont, to be published in 2019 within the SAGE Handbook on Inclusion and Diversity in Education (205). The purpose of including this excerpt is to introduce the system which was implemented as a result of the research. Following the case study, various elements of the system are discussed in relation to a schema put forward by Florian and Rouse (118), categorising the four types of challenges to address in progressing education data systems to improve disability-inclusive education.

Case Study: Disability Disaggregation of Fiji's Education Management Information System

As part of a six-year education sector strengthening program in Fiji, the Ministry of Education and the Access to Quality Education Program, funded by the Australian Department of Foreign Affairs and Trade, researched and implemented a method for validly and reliably disaggregating Fiji's EMIS by disability. The UNICEF/Washington Group Child Functioning Module (CFM) was used as the tool for collecting functioning data within a **Student Learning Profile** form which also collects information on assistive technology, learning and support needs, capabilities and access to referral services. A second form called the **School Accessibility and Inclusion Form** was developed to collect information on school infrastructure, transport and efforts towards inclusion.

Research

A cross-sectional diagnostic accuracy study was undertaken, including 472 children with and without disability. Parents (or primary caregivers) completed the CFM through an interviewer, and teachers self-completed the CFM along with a range of questions on assistive devices and learning support needs of each child. Each child was assessed for vision, hearing, musculoskeletal impairment, speech and cognition (200, 231, 249). Parent and teacher responses were compared to the clinical assessments and diagnostic accuracy was calculated using the clinical assessment as the reference standard test.

In summary, results showed that the CFM can be used well by teachers. The accuracy of teacher responses was better than parents on the cognitive functioning questions, and parent results were slightly better on vision, hearing, walking and speech. Diagnostic accuracy (the balance between sensitivity and specificity) was highest at the cut-off level "some difficulty" however children categorised as having "some difficulty" included those with a wide range of functioning including those with no impairment to those with profound impairments. Despite this, given the policy context and commitment to fulfil the obligations of the newly ratified CRPD, the Ministry of Education felt that using the cut-off "a lot of difficulty" would miss too many children with disabilities and chose to use the cut-off "some difficulty". To overcome the problem of false positives, various actions were taken:

1. The wording of this category was changed from "some difficulty" to "a little difficulty" to increase the distance between this category and "a lot of difficulty".
2. A Student Learning Profile Guidance Matrix was developed to provide teachers clear guidance on how to choose the level of difficulty that matches their students' functioning.

3. A national training program was rolled out for schools, including a training film.
4. Analysis was undertaken to identify algorithms combining CFM (functioning) responses with data on learning and support needs and assistive devices. These algorithms are the basis of how the FEMIS identifies disability.
5. A system for verification of disability was established.

The verification visit by a designated officer from the Ministry of Education is of particular importance in Fiji because of the new policy whereby schools receive a disability inclusion grant based on children with disabilities enrolled. Funding would not be allocated based on self-report methods. Using the algorithms, automated reports indicate which children should receive a verification visit by the Ministry of Education.

Implementation

Following the research, the system was developed, tested in schools, improved through workshops with the Ministry of Education and disability stakeholders, and re-tested in schools. The FEMIS Disability Disaggregation Package was developed and provided to all schools in late 2016. The system is being taken up by schools, evidenced by the more than 500 students with disabilities recorded on the system in 2016 and over 1,000 in 2017. In the national Special and Inclusive Education implementation plan, one of the indicators is “Number and proportion of schools which have entered disability data within FEMIS.”

The student level data is collected in the online **Student Learning Profile** form which can be entered directly where desirable, or alternatively in a paper format which is later used for data entry onto the online form. The Student Learning Profile form uses a simplified version of the CFM questions because a matrix for these functioning responses is more compact on a form and simpler to use rather than the full wording of each question. It also includes questions on fine motor difficulties and distinguishes between general learning difficulties and specific learning disabilities (e.g. dyslexia). Forms are completed for children with difficulties in any of the following areas: seeing, hearing, moving (gross and fine motor), speaking, learning, behaviour /socialisation, or emotions; and children who consistently perform very poorly in assessments and class activities. Schools are encouraged to refer to the **Student Learning Profile Guidance Matrix** when completing the form to increase the consistency of category selection.

Most schools print the form to complete during a meeting between the parent(s), teacher and where possible, other relevant people such as teacher aide, the previous year’s teacher, School Inclusion Coordinator, or kindergarten teacher if the child is joining class one. If a child is being transferred from a special school to a mainstream school the teacher from the referring special school should join the meeting. It may be appropriate to have the child in the meeting as well. The meeting enables discussion about the child’s functioning, clinical assessment and treatment history, referrals to services that may be useful, and options for enabling the fullest potential for learning and other outcomes.

The system records clinical information in the Student Learning Profile. One of the reasons for this is to strengthen linkages between education and health services and to provide a location for clinical information to be stored. This is beneficial for some families who, through floods or cyclones or for other reasons, may lose clinical paperwork. The clinical information section records services that have been accessed as well as services from which the child would benefit. Referrals for new services are revisited periodically to ensure services have begun and to evaluate results. This enables the system to track changes in access to health and other specialist services and overcomes a problem that many EMISs have, which is the inability to distinguish between children who have outstanding support needs compared to those for whom the support needs have already been met.

The Student Learning Profile should ideally be entered into the FEMIS system by the end of term one of each school year to enable Ministry planning and budgeting. However, some areas of difficulty will not be immediately recognised and therefore it is possible to complete or amend the Student Learning Profile form at any time during the year through the online portal.

The **School Accessibility and Inclusion Form** collects information at the school level in line with UNICEF guidelines on disability disaggregation of EMISs (106). The form should be completed by the school management committee with the head teacher and where possible with the involvement of students with disabilities, their parents and local Disabled Persons Organisations. Information is provided in the Disability Disaggregation Package about conducting access audits. The form records accessibility regarding a range of elements such as toilets, assembly area and emergency response plans. Importantly, for any element that is inaccessible, it requires the school to record plans to increase accessibility. This encourages school awareness and conversation about accessibility and provides a tool which supports planning and budgeting for improvements. It also acts as a tool for baseline information and monitoring accessibility changes. The form has a section on special materials or equipment such as Braille machines and computer screen readers and on availability and frequency of visiting specialist staff. This raises schools' awareness of these options and the information enables reporting against indicators within Sustainable Development Goal (SDG) 4. Finally, the form records information related to activities that the school undertakes to include children with disabilities, such as vision and hearing screening programs, disability awareness activities, availability of specialist staff, use of Individual Education Plans, and activities to identify and include children with disabilities who are out of school.

The third area in the system is information about **qualifications and professional development of school staff** related to disability-inclusive education. The purpose of recording this information is to be able to track progress towards a workforce with inclusive education capacity and to cross-match student needs with staffing data. Incorporating this data into the human resources database in Fiji is a work in progress as each staff person needs relevant qualifications and training data-entered on their file. Completion of the mid-point review for the Special and Inclusive Education Policy Implementation Plan is an indicator for the Ministry of Education, for which data on professional development of the workforce will be critical.

An important feature of Fiji's EMIS is that it is **granular**. In other words, a separate record is maintained for each child, unlike systems where only aggregate data is collected. This facilitates the matching of disability data to variables such as attendance, learning outcomes, family-level socioeconomic data, geographic location, and school factors. This enables a range of analysis to inform and report against policies, legislation, the CRPD and the SDGs. Following on from the positive uptake of the system, work in the near future aims to maximise the potential of a granular system; using the system itself to facilitate inclusion. For example with careful computer programming, reports can be automated to cover functions such as reminding schools in the lead up to exams which children may be eligible for reasonable accommodations; or sending automated emails to schools tailored to the child's functioning and other data providing information about nearby health services; flagging human resource issues for schools where children have sign language requirements but where no sign language interpreters are on staff; or referring teachers to relevant sections of a key resource used by the Ministry, the Disability-Inclusive Education Handbook for Teachers.

The resources mentioned in this case study are available at http://www.education.gov.fj/index.php/school/special-inclusive-education-resources.

Against a backdrop in Fiji of poor access to education for children with disabilities (92, 96) and inadequate access to disability and rehabilitation skills in the health system, especially in areas outside of the capital (29, 68, 102, 103), the Ministry of Education required an approach for identifying disability that would work without clinical diagnoses. An important principle in the development of the system had to be feasibility, considering staff workloads and teacher skills and knowledge (103).

The system implemented based on the research, outlined in the case study, is feasible essentially for three reasons: (i) the research showed that teachers can identify disability in the absence of clinical diagnosis services, through observations of student function (CFM) combined with information about LSN; (ii) the system was designed to operate in the technical context of Fiji's EMIS, which is granular and online; and (iii) the system was developed with a firm eye on the policy and resourcing context, for example, living up to the policy commitment to "leave no child behind" whilst ensuring a cost-effective approach to verification to enable the rollout of the Disability Inclusion Grant. Section 7.3 discusses these and other issues arising from the Case Study along with implications of other aspects of the study results.

7.3 Implications for progressing education data systems for disability-inclusive education

Part of the ambiguity about how to successfully implement disability-inclusive education and measure its effectiveness in LMICs (10, 11, 24-26, 77, 116, 117) stems from challenges in validly, reliably and feasibly identifying disability amongst children and disability-disaggregating EMISs. As outlined in the literature review, the international directive to strengthen disability data for this purpose is wide-ranging, from the CRPD (14), the Secretariat of the Conference of States Parties to the CRPD (122), the General Assembly (123), high-level groups working on the SDGs (124, 250), and the UN Economic and Social Council (125) to UNESCO and world education leaders (41, 111, 113, 126), researchers (11, 43, 55, 108, 251), and from across the Pacific region (37, 87).

Florian and Rouse (118) suggested four categories of challenges that need addressing to progress education data systems for disability-inclusive education. These form a useful structure to considering the implications from this research and issues related to feasibility of the resulting system developed in Fiji. The categories include: (i) *conceptual issues* pertaining to classification of disability, means of assessment and reliability and validity of data; (ii) *technical issues* pertaining to data collection, entry, analysis and information technology system capacity and compatibility; (iii) *ethical/legal issues* pertaining to privacy, access and ways by which collecting data may interfere with educational judgements; and (iv) *economic issues* relating to cost-benefit of data systems.

7.3.1 Conceptual issues related to disability classification, validity and reliability

Perhaps the most obvious implication of the study is the need to incorporate relevant aspects of the ICF within school data collection formats to enable disability identification as well as individualised planning. As described in the case study (section 7.2), the central form developed in Fiji following the research was the *Student Learning Profile*. The main elements of this profile include:

- functioning data based on the CFM (with response categories enabling severity data);
- a generic list of learning and support needs questions relevant across health conditions, including assistive technologies, personal assistance and educational adaptations (generic simplifies the ICF coding on environmental factors (163);
- an optional section on clinical, diagnostic and treatment information, to record any available information on existing diagnoses or treatments, and to prompt discussion between the teacher and family regarding referrals that might be necessary for screening or services; and,
- student strengths and interests, which are important to highlight children's potential and design individualised educational or therapeutic intervention plans (162).

The poor performance of the CFM response category "some difficulty" in the research had important implications for the development of the approach to disability disaggregation of Fiji's EMIS. Given the large numbers and varied functional range of children categorised in the "some difficulty" response category, this had serious cost implications for the MoE in considering how to identify the children with disabilities from this large group. Analysis was undertaken into combinations of functioning (CFM) data and LSN data that increased accuracy of disability identification, which was used as the basis of algorithms built into FEMIS. Additionally, the response category was rephrased to "a little difficulty" to encourage respondents to preference the more severe category as relevant. The importance of training teachers was recognised and built into training budgets and schedules, including the development of a training film. The *Student Learning Profile Guidance Matrix*, which exemplifies response categories, was developed and incorporated in trainings to further increase accuracy and reliability of categorisation. Examples of descriptors in the *Guidance Matrix* under the domain Learning are:

- A little difficulty: "Needs some assistance but can work independently".
- A lot of difficulty: "Has a lot of difficulty with learning academic skills and concepts; or, with learning to do practical tasks such as unpacking schoolbag, putting books and pencils in desk, doing jobs or duties, home responsibilities, including self-care (toileting, dressing, eating)".

The use of training and provision of the guidance matrix is consistent with Ogonowski's findings (252) demonstrating improved inter-rater reliability in identifying children's disabilities following training and use of guidance tools. Fiji's teachers are a long-term workforce who will fill in forms many times over many years; training and guiding documents may be a beneficial investment resulting in continued classification accuracy improvement.

A system for verifying the presence of disability was included in the *FEMIS Disability Disaggregation Package,* which is used throughout schools in Fiji. The purpose of the verification system was additionally to address the risk of over-identification of disabilities due to the incentive of securing funding. Self-report tools such as the CFM and the Student Learning Profile have inherent risks of over or under-reporting depending on perceived benefits or disadvantages. Travelling to remote areas to assess children simply based on a self-reported "some difficulty" response would be cost-prohibitive and an inefficient use of already stretched MoE staff time. Boesen aptly highlighted that the more accurate the low cost screening stage is (i.e. data entered in the Student Learning Profile), the higher the efficiency of the more expensive secondary testing (i.e. verification visits)(146). The combined LSN data in the algorithm reduces false positives, identifying a more accurate group of children for verification visits. Additionally, a further layer of accountability was built in to discourage false reporting. Once a child's data is entered, the system prompts the Head Teacher to review and authorise the veracity of the data. In places where there are no factors likely to result in over-reporting (such as a financial incentive which may increase teacher ratings of student functioning difficulty), it is probably adequate to use the data without undertaking a verification visit.

The data showing better response accuracy in some of the disability domains by parents, and other domains by teachers, prompted the decision to encourage combined parent-teacher discussions for completing the Student Learning Profile. This has the advantages of building teacher-parent relationships for ongoing communication to support children's development. Given the risk of under-reporting of children with disabilities due to stigma or a perceived lack of benefit to identifying a child as having disability (113), the term "disability" is avoided and schools are instructed to complete the Profile for all children with *difficulties* in areas such as seeing, hearing, walking, et cetera, as well as all children who consistently perform very poorly in assessments and class activities.

Whilst this research focused on individual student level environmental factors such as assistive devices and learning supports, factors at the "school and broader environment level" play a central role in enabling disability-inclusive education. Measurement of these factors is also important, to monitor progress in accessibility and to enable analyses such as correlations between individual student attendance or learning outcomes with "school and broader environment level" factors. In Fiji, this data is collected in the School Accessibility and Inclusion Form (245).

7.3.2 Technical issues pertaining to data collection, entry, analysis and information technology system capacity and compatibility

Madden stressed that measurement must be not only fit for purpose, but also "fit for process". She highlighted how measurement processes should blend in with and enhance the routine dealings of services and administration and be worthwhile to people sharing and documenting the information (236). This principle is central to building disability into Fiji's EMIS. Processes for data collection, entry and analysis of disability data needed to consider the requirements and circumstances of all parties from children, families, teachers and school administrative staff through to information technology staff and ministry officers responsible for policy monitoring and implementation.

The dominant feature of the EMIS in Fiji is its online, granular operation. This was pivotal in solving the challenge arising from the tension between sensitivity and specificity of the different cut-off levels on the CFM. The increasing availability of granular, computer-based systems globally enables a solution to the complexity of disability measurement. Through algorithms, various elements of the ICF can be combined to identify disability more accurately and record contextual data that will benefit children on an individualised level by supporting appropriate educational accommodations. An added benefit of being online is the ability to upload data at any time in the school year, unlike annual census survey styles of EMIS. Teachers in Fiji may not identify functional difficulties or learning and support needs immediately but after some months with the child may decide to complete the Student Learning Profile. This approach facilitates dynamic assessment as recommended by Lebeer et al. (162), enabling children to move in and out of the definition of "disabled".

One of the most impressive features of granular EMISs is the capacity they support for analysis between disability and multiple other variables. Disability intersects with other causes of inequality, such as gender, ethnicity, geography and socioeconomic status (10). It is important to monitor which children, with which disabilities, under which circumstances, are included or excluded. This enables use of data to increase accountability in how resources are distributed to schools, groups and individuals (253). Several Pacific countries are moving from census-based to granular EMISs, which will enable similar approaches to, and benefits from, disability disaggregation. This will enable reporting on participation or learning outcomes by disability type, gender, class, age, and any other variables prioritised for analysis.

The evidence demonstrating the validity of teacher responses to the functional CFM questions enabled the subsequent development of data collection formats devised for teachers in classroom settings. The 24 questions in the CFM, with frequent skip patterns, were designed for interviewer administered survey settings. These would be unwieldy and overwhelming on a form that teachers use repeatedly. Following this study, the CFM questions were re-structured into a matrix in the Student Learning Profile in a user-friendly format that has proven to be understandable without training and a reasonable request of teachers' time. Formats must be efficient and useful for teachers and, in the case of granular EMISs, work both as a paper form and as an online form.

The contextual requirements had some specific implications for data collection. The CFM 5-17-year-old version does not include a fine motor question, which is a gap in education settings. This was added to the Student Learning Profile. Additionally, a number of CFM questions were combined into overarching categories to match the level of detail needed for the MoE. For example, anxiety and depression were combined into a single question "How often does the child seem: very sad and depressed, and/or very worried and anxious?". Questions on behaviour, attention and socialisation were also combined, as were the learning and remembering questions.

If schools undertake a sizeable effort to gather and input disability data, and they do not receive information back demonstrating that the data is being analysed and utilised, this risks completion rates and quality dropping. This has implications for the validity of the disability data if teachers and head teachers do not attach importance to it and hurry their responses. Designing data feedback loops into Fiji's EMIS whereby the data proves immediately useful to the teacher and head teacher, and where they can see data informing decisions, funding or policy, is an important element of creating a successful and valid system.

7.3.3 Ethical/legal issues pertaining to privacy, access and ways by which collecting data may interfere with educational judgements

Both internationally (120) and in Fiji (103), the classification of disabilities bring concerns related to risks of labelling students, reduced expectations, reinforcing separation rather than inclusion within education systems, stigma, peer rejection and lowered self-esteem by children with disabilities. Earlier research by the candidate in Fiji (103) indicated awareness of the tension between these risks and the benefits to be had through disability identification, such as improved access to services and educational supports, which have been shown to have lifelong positive benefits (143). Rieser (139) argues that generalised approaches to inclusion are not sufficient and that teachers need to be able to meet impairment-specific needs, which requires appropriate identification of those needs.

Of course, with identification comes responsibility. The ethical responsibility is to ensure that identification through a screening process such as the Student Learning Profile does not contribute to exclusion from education or other discrimination faced by children with disabilities (143, 254). The screening should lead to appropriate referrals if risks are identified and the design of appropriate education intervention plans (255). WHO and UNICEF suggest that the decision to undertake screening must consider the availability and effectiveness of services to support children with disabilities or resources to provide interventions. They also recommended instituting monitoring and follow-up systems to guarantee that children identified through screening consequently obtain assessments and services. In response to these ethical implications, referral information was included in the guidance documents and the online system enables automated referral tracking and links to relevant sections in the *Disability-Inclusive Education Handbook for Teachers*, a resource developed by the candidate distributed by the Ministry to all schools in Fiji.

The Global Program on Education (66) noted the common disconnection between efforts for children with disabilities made within health, social services, education and civil society. They insisted that achieving disability-inclusive education required a concerted effort to deliver holistic services to children with disabilities. One of the anticipated advantages of Fiji's identification system is the collation of data relevant to other ministries and the promotion of intersectoral coordination on issues related to children with disabilities. Whilst the health information systems in Fiji are not yet capable of tracking access to relevant services by children with disabilities, such as community-based rehabilitation, physiotherapy, vision and hearing services and assistive technologies, the education system is an important platform for childhood data which, over time, may provide valuable opportunities for analysing health service access. Additionally, FEMIS includes data on transport, bus subsidies, birth certificates and family socioeconomic circumstances. With concerted analysis, equalisation of opportunities for children with disabilities against a range of social variables may be monitored.

Whilst this research has focused on the ICF elements of activity limitation, participation restriction, impairments and environmental factors, the development of the final system in Fiji did incorporate a means of collecting information on "health condition". This happened for two main reasons:

(i) clinical, diagnostic, treatment and referral information are an important part of obtaining appropriates services for children with, or "at risk of" disabilities; many children can benefit from available health services, such as glasses or removing impacted wax from ear canals, which can prevent some difficulties becoming disabilities and mitigate the extent of impact in others. Additionally, the collection of data on services within FEMIS enables distinction between children who may need services, and those who have already received the services. The lack of this data is a common drawback of most EMISs (105), which limits the data's usefulness for planning and budgeting.

(ii) Offering the choice to families in Fiji to have clinical information stored on FEMIS provides a back-up for families who, through humidity, relocation, natural disasters or other circumstances, have limited means of retaining hard copies of personal information.

Clinical information is not part of FEMIS's algorithm for determining disability, and providing the clinical information is optional for families.

Despite the advantages of the disability identification system resulting from the research, it is still possible that a teacher inaccurately assumes a child has learning difficulties, whereas the student may simply not be coping with the teaching style. Disability labels can be long lasting and have damaging effects on the child. As stated in the *FEMIS disability disaggregation package - guidelines and forms*, the system identifies children "at risk of disability" and for whom additional learning supports and/or referrals to health services are required. The system does not generate a diagnosis of disability; teachers and parents are merely recording their observations of the child's level of function in different activities (245).

The final ethical issue to discuss is the imperative to retain a focus on the (literally) countless children with disabilities who are out of school. Along with others around the world (113), Fijians have voiced strong concerns about the urgent necessity of identifying and addressing the needs of out-of-school children with disabilities (103). This thesis has focused entirely on validating a system that enables identification of disability amongst enrolled students, which may turn out to be the minority of children with disabilities. However, by validating and incorporating the CFM, which is designed to be used in population-based surveys, Fiji's EMIS data will be comparable with its future estimates of total numbers of children with disabilities. This will provide Fiji with a means of tracking changes in the percentage enrolled and attending school out of the total children with disabilities in the population, even when the EMIS itself cannot perform that function. Whilst the EMIS counts disabilities using the CFM cut-off "some difficulty" in combination with LSN data, it does have the capacity to use exactly the same measure of disability as the Fiji Bureau of Statistics definition, which is likely to use "a lot of difficulty" as the cut-off, based on recommendations enabling international comparability.

7.3.4 Economic issues relating to cost-benefit of data systems

The personnel costs of collecting and entering data in every school is considerable and instituting a new system disability identification brings a responsibility to minimise time required and maximise usefulness of the data. Robertson (202) proposed criteria for screening tools for identifying children with intellectual disabilities in LMICs, which is useful more generally. She recommended that tools be affordable, quick, acceptable in context, easy to use by community level workers (in this case, teachers), and have high specificity and sensitivity to balance the risks of cost-burden with false positives and adverse impacts on children's lives with false negatives.

In terms of affordability, the costs of teachers and parents completing a form are minimal compared to the costs implicit under the former policy (128), which required students to have medical diagnoses. These required families to bear the costs of taking days or weeks to travel, in many cases by boat, to the capital city for assessments. Benefits of parents and teachers completing the form together include increased communication about the child's learning and support needs and making and supporting referrals to services. Regarding time - the form takes considerably more time (approximately 20 minutes) than a teacher ticking a box based on a list of impairment categories; however the data, once entered online, remains active until changed and teachers are freed of the burden of manually calculating totals to insert in matrices on annual education census surveys. By field-testing the Student Learning Profile and broader disaggregation system in schools and through consultation workshops with the Ministry of Education, the acceptability and ease of use was proven. Which leaves Robertson's last criteria – the requirement for high specificity and sensitivity. This is undoubtedly the most important criteria, which has been at the heart of this research, with the challenges and responses discussed at length throughout the results papers and earlier in this discussion chapter. The research identified shortcomings of the CFM related to sensitivity and specificity and identified a means of managing these, by incorporating learning and support needs data with CFM data within algorithms in the online system.

In relation to the cost-benefit of the changes required to EMISs to enable disability-disaggregated data, it is helpful to reflect on the incredible efforts undertaken over decades to improve education for children with disabilities around the world, with very little evidence to show for it. It is worth reiterating Bakshi's conclusion from her 2013 systematic review of disability-inclusive education, which exposed that it was impossible to draw any firm conclusions about the effectiveness of approaches to increase accessibility of education for children with disabilities (116). So we need to compare the costs of building valid disability data into EMISs against the unknown (and potentially large) costs of implementing policies and programs, often funded by donor agencies, that do not have any conclusive measures of their effectiveness. The cost-benefit of countries investing in building disability disaggregation into their education data systems is unquestionable.

7.4 Limitations of the research

There were several limitations to the study that need to be acknowledged.

7.4.1 Limitations of the diagnostic accuracy study design

For the purpose of assessing diagnostic accuracy of the CFM, this study used impairment-based assessments as the reference standards (i.e. "gold standards") to identify disability cases and controls. This effectively defined disability as clinically assessed impairment of a moderate or more severe level. As discussed in section 5.3.6, the CFM measures different aspects of the ICF - activity limitations and participation restrictions – and so one may query whether impairment-based reference standards should be used to assess diagnostic accuracy of the CFM. However both Visser (196) and Mactaggart (197) used impairment-based assessments to explore the properties of the CFM and the impairment-based assessments provided validated, objective and replicable approaches to assessment which was critical to ensuring consistency over the period of data collection. So for the purposes of this study, they were accepted as the best available reference standard.

An important limitation is common to all diagnostic accuracy studies – the assumption that the clinical assessment standards are 100% sensitive and specific themselves. That is, that the tests for vision, hearing, musculoskeletal impairment, speech and cognition are indeed 'gold standards' against which the CFM can be measured. To address this limitation, the assessment team consisted of three experienced screeners whose full-time job is school-based vision and hearing screening in Fiji, plus three physiotherapists, an occupational therapist, and a local researcher who was highly trained in administration of the computer-based Cambridge Neuropsychological Test Automated Battery (CANTAB). The methods were based on internationally accepted standards, outlined in sections 6.2, 6.3 and 6.4. The only issue to note is that hearing loss of 41-60 dBA was the lowest level of hearing loss accepted as cases. Greater than 30 or 31dBA is more commonly used as a criterion for hearing impairment in children (218, 219), however >40 dBA was used in this study to identify children with clinically relevant hearing impairment due to the ambient noise levels in the assessment rooms in the schools. This is consistent with the extensive prior experience of the hearing assessors in Fiji and with other studies in LMICs (220, 221).

There were some limitations in applying the Rapid Assessment of Musculoskeletal Impairment as the reference standard to judge the CFM walking questions. Firstly, the Rapid Assessment of Musculoskeletal Impairment uses physiotherapist's opinion to classify severity of musculoskeletal impairment and a variation across the three therapists in this study may be possible. Secondly it assesses musculoskeletal impairment and does not identify other health conditions that could result in difficulty walking such as heart disease, asthma and vision impairment, which would have increased numbers of false positives and reduced the specificity. However, a recognised bias in two-gate diagnostic accuracy studies is "limited challenge" through which excluding participants with alternative diagnoses can lead to reduced false-positive rates and higher specificity (206). The representative sampling approach sought to overcome any risk of this bias and contribute to more cautious estimates of sensitivity/specificity.

The main limitation related to the reference standard used for speech – the Intelligibility in Context Scale (ICS) – was that it was a proxy tool for speech sound disorder. At the time of the study there were no speech pathologists in Fiji and it would have been cost prohibitive to bring a specialist in to travel with the team for several months. The ICS has been validated in Fiji, measures very comparable constructs as that measured in the CFM, and has been shown to perform well in Fiji (229, 256). Analysis of the results led to uncertainty about whether to regard children with scores in the middle range (2.5-3.86) as a case or a control. This uncertainty resulted in excluding 134 children with those scores. Cook (207) would argue that this use of a third category of "indeterminate scores" in a diagnostic accuracy study overcomes a common limitation, which is lack of this third category. However only 71 cases and 257 controls remained, and analysis was certainly therefore based on cases with higher levels of impairment. This increased the risk of "spectrum effect", a sampling bias that can produce higher estimates of sensitivity and specificity (Rutjes, 2005). For future application of the Intelligibility in Context Scale as a reference test in LMICs, a subsequent speech assessment for children scoring between 2.5-3.86 is recommended, enabling all participants to be included, thus mitigating "spectrum effect", whilst circumventing the costs of full speech assessments on the whole sample.

A final limitation in relation to the speech assessment is that the study did not endeavour to test the sensitivity and specificity of the CFM in relation to a diagnosable speech disorder, nor did it exclude children with concurrent conditions. Future research should compare the CFM to a comprehensive speech-language assessment to understand the types of communication disorders that are picked up by the CFM.

The reference standard test for the three cognitive questions – learning, remembering and focusing attention – was the CANTAB (217). The principal limitation is the necessary assumption that the selected sub-tests of CANTAB provide a reference standard against which to test these three CFM questions. It is difficult to assess the degree to which the cognitive processes measured by the CANTAB tests overlay with the constructs measured by the three CFM questions. CANTAB provided a consistent reference standard assessment against which to compare diagnostic accuracy of teachers contrasted with parents, however if comparing diagnostic accuracy of the CFM to other studies which may use different reference standard tools, the Fiji results should be interpreted cautiously. Further diagnostic accuracy research using standardised educational psychology child assessments that cover intellectual and learning disabilities as the reference standards would be highly valuable.

Both parents and teachers had poor accuracy on the 'focusing attention' question which prompted investigation into whether the CANTAB Overall Impairment Score was adequate for measuring the construct of attention/concentration. The sub-test Reaction Time (RTI) was analysed, which showed a lack of correlation with the CFM's responses, implying that the attention/ concentration construct being measured by CANTAB may indeed be divergent from that in the CFM, which is clearly a limitation of this study. However, poor inter-rater reliability between teacher and parent for the 'focusing attention' question infers that parents and teachers are interpreting the construct differently from each other, which underlines the necessity for further research into what the CFM's 'focusing attention' question is actually measuring.

Another limitation of this study is that the five clinical assessments did not cover all the functioning constructs that are covered by the CFM, specifically self-care, anxiety/worry, depression/ sadness, behaviour and socialisation. The study attempted to overcome this limitation by making interpretations based on inter-rater reliability and simple proportions reported in different severity levels of the CFM. However, an outstanding recommendation for further research is for a diagnostic accuracy study which adequately covers these constructs.

7.4.2 Sample limitations

A notable limitation in the sample was the relatively high proportion of cases who were from special schools (76.2%) due to the limited numbers of children with disabilities in mainstream schools. To achieve the required sample size across all five impairment groups, recruitment had to allow for this imbalance. Despite this, the sample of cases for vision impairment (n=35) and musculoskeletal impairment (n=42) fell short of the target of 52. The implications of the sampling bias include possible variations in responses related to different levels of disability experience and awareness amongst teachers and parents, and is potentially related to different perceived incentives in responding differently. Future research should aim to rectify this sampling disparity and shortfall. Larger sample sizes would have enabled more sub-group analyses, such as comparisons between special and mainstream schools, age groups, geographic locations and sex.

An important limitation relates to generalizing the findings to other populations. Of the parents/caregivers of the cases, 42% had attained a tertiary education, which is substantially higher than the national average (257). The level amongst controls was 15%, which is closer to average. This highlights potential differences related to parents of children in special schools, but importantly raises the question of difference between parents of children with disabilities in school compared to those who are out of school. Future research should include out-of-school children with disabilities, whose parents may respond differently to the CFM questions.

Another sampling limitation is that 62.8% of cases were male compared to 49.0% of controls and the mean age of cases was 10.15 years compared to 9.71 years amongst controls. This limitation was partially addressed by examining correlations between age, sex and the CFM questions, and there appears to be negligible impact of these variations. Age had significant but negligible correlation with the domains learning (0.164), remembering (0.118) and depression (0.097). Sex had significant but negligible correlation with the domains speaking (0.092), learning (0.144), controlling behaviour (0.156), focusing attention (0.096) and making friends (0.097).

7.4.3 Analysis of the CFM item on difficulty controlling behaviour

In the version of the CFM used in this study, the response categories for the question on difficulty controlling behaviour were: "No difficulty", "The same or less" (than other children), "More difficulty", and "A lot more difficulty". Analysis for this study used the response "more difficulty" as the cut-off to determine disability. A recent publication by UNICEF and the Washington Group analysing CFM data from Samoa, Serbia and Mexico (175), reported problems with the response categories for this behaviour question which led them to change the response categories in the final version of the CFM to reduce numbers of children recorded as having difficulty controlling behaviour.

7.5 Future research recommendations

This study has highlighted some further areas of inquiry related to childhood disability measurement, raised some important questions that would benefit from implementation research and built a platform to enable a range of research related to disability-inclusive education.

7.5.1 Further research related to childhood disability measurement

As the UNICEF/WG CFM looks likely to be used widely, it would be important to continue exploring its psychometric properties. As described in the limitations (section 7.4.1), the five clinical assessments in this study did not cover all the functioning constructs included in the CFM, specifically self-care, anxiety/worry, depression/sadness, controlling behaviour, accepting changes to routine and making friends. Comparison of parent and teacher responses to these questions with validated educational psychology and child development assessments would further add to our knowledge of how well the CFM questions are identifying related disabilities and whether there are implications for education systems. As mentioned, the recent publication by UNICEF and the WG of the field testing raised important doubts about the response categories for the controlling behaviour question (175), which highlighted how substantive the implications are on overall prevalence estimates.

As highlighted in the limitations, the sample in this study drew heavily on recruitment of children enrolled in special schools. It would be valuable to undertake additional research which targeted more children with disabilities from mainstream schools as well as those who are out of school.

The CFM was developed with parents as proxy respondents for child functioning, and this study tested the accuracy of teachers as proxy respondents. Future research should test the proxy responses against children's own self reports of function.

The lower accuracy results of the questions on learning, remembering and focusing attention in this study highlight a need for deeper investigation. The CANTAB computer-based assessment system enabled large numbers of consistent assessments over multiple sites in a cost-effective way, which made it possible to include these domains in Fiji. However these functioning domains are very important to understand and further efforts, perhaps by specialists in educational- and neuro-psychology, may enable a deeper investigation into the properties of the CFM cognitive questions.

7.5.2 Implementation research into disability disaggregation within Fiji's EMIS

Since the research, the Fijian government with support from the Australian government has taken steps to roll out the process of disability disaggregation of Fiji's EMIS to schools around Fiji. It would be timely to investigate the completeness and accuracy of disability data on FEMIS, factors affecting data collection processes and quality of data, the usefulness or limitations of the training and the guidance documents, means of improving response accuracy, how well the algorithms are functioning, variation between data entered and results of verification visits, cognitive testing to explore commonalities amongst teachers who incorrectly categorise, the degree to which data collected has been used to inform decision making at schools and district and central system levels, factors affecting this usage, and to explore further areas of data analysis that are not currently being undertaken.

A specific question that would benefit from future research relates to a finer-grained exploration of learning and support needs to determine differential support levels; specifically, how the levels relate to funding needs. The MoE is reviewing its formula for school funding and has requested assistance in determining funding based on levels of disability-related need. This is a complex question with which many countries regularly grapple. An attitude often promoted within the field of disability-inclusive education is that, by adopting an inclusive attitude and using approaches such as curriculum differentiation, peer support, positive behaviour management and cooperative learning, teachers should be able to provide disability-inclusive education for all children. This establishes a complex context for funding and planning for disability-inclusive education. For example, if the system has invested in training teachers well enough to implement these approaches, then potentially a teacher aide may not be required to support a child with intellectual disability or a child with autism in a regular class. But, is it in the interest of that teacher to work hard to implement these approaches and entirely manage his or her own classroom? Or would s/he prefer to have funding for a teacher aide? And how would this impact the way learning and support needs are reported and funded? Given the imperative for thorough consideration and good evidence to support funding decisions, there is a great need to explore how learning and support needs relate to funding requirements.

A priority within Fiji's MoE is on identifying children with specific learning disabilities such as dyslexia. It has been common practice within schools to label large numbers of children as "non-readers" and categorise this as disability, despite other factors that affect children's reading, for example teaching in languages which are not mother tongue for the child, poor access to books or poor teaching practices. Some schools were encouraging "non-readers" to drop out of regular schools and enrol in special schools. Correct identification would enable appropriate responses for children who do have specific learning disabilities, as distinct from children who may benefit from other types of educational or social interventions. The academic field of Specific Learning Disability diagnosis is intricate and involved. This study did not focus on this area, however in the current data format (Student Learning Profile) being rolled out in Fiji, a second learning question has been included focusing teachers' responses on specific learning areas within literacy or numeracy, and an algorithm has been developed. This question aims to prompt teachers to undertake a further, more detailed assessment. Research into the validity and usefulness of the new question and algorithm is required.

7.5.3 Disability-inclusive education research

The presence of a validated system for disability disaggregation of Fiji's sophisticated EMIS supports new research which can answer previously unanswerable questions. Fundamentally, the questions are about how to effectively fulfil the rights of children with disabilities to access quality, inclusive education, responding to the large gaps in evidence in this sector (116). Naturally the specific research questions should be driven by local priorities, including those of the MoE, disability stakeholder groups, teacher training institutions, schools, et cetera. The following list provides a selection of the research that would be possible:

- Quantitative analysis of differences in enrolment, attendance and learning outcomes, by disability type, geography, gender, and household income status. The geospatial school data in FEMIS would enable production of maps to illustrate the findings, which would be a useful research tool within subsequent qualitative research to provoke discussions about underlying factors for the quantitative findings. Discussion-based research in Fiji and other Pacific island countries matches cultural norms and is a valued approach (258, 259)
- Time series analysis to investigate a range of variables over time - attendance, transition to higher grades or to/from special schools, changes in functional status related to access to assistive devices or other services
- Factors affecting participation in literacy and numeracy assessments; linked to learning methodologies, reasonable accommodations, teacher qualifications and training, et cetera.
- Analysis of relationship between "school and broader environment level" factors and individual student attendance and learning outcome data.
- Mapping what learning and support needs are required versus those being met, and identifying whether these vary between disability types, geographic location, school type, gender; and whether provision of these learning and support needs results in better learning outcomes.
- Analysis of health system referrals required and implemented, by geographic location; this could be matched with data from the School Accessibility and Inclusion Form to explore the reach and gaps of disability-related in-school screening programs (vision, hearing, etc).
- Specific analysis related to disability types, for example, how are deaf and hard of hearing students faring in the system and what is the best way of supporting their needs?
- Where children with disabilities have been to kindergarten and/or early intervention, does that improve their learning outcomes and transition through to secondary/tertiary education?
- Correlations between transport subsidy, disability and attendance.

7.6 Conclusion

In spite of promises, policies and programmes on disability-inclusive education globally over many years, there is little evidence regarding the effectiveness of these. A primary weakness underlying the lack of evidence has been the inability to disaggregate education management information systems by disability, leaving governments and donor agencies without critical data to inform investments and report on commitments.

Over a number of years, but particularly in the lead up to the SDG era, world education leaders have pledged to improve national monitoring and evaluation systems to produce accurate evidence for policy formulation, education system management and accountability. Specific commitments have been made to strengthen government systems' capacity to disaggregate data by disability, with an emphasis on internationally comparable data and statistics disaggregated by disability. Pacific Island education leaders have made similar commitments to strengthening EMISs across the region to enable disability disaggregation, however prior to this study none of the Pacific EMISs had identified and validated a feasible method of disaggregation by disability. Fiji's Ministry of Education sought better data to plan, monitor and report against commitments within its disability-inclusive education policy, the recently-ratified CRPD and other international frameworks.

The aim of this study was to identify a valid, reliable and feasible method for Fiji to identify children with disabilities in schools and disaggregate Fiji's EMIS by disability. A challenge and opportunity was presented related to the specific design of FEMIS, which is an online granular system with individual student data. This presented potential for multiple applications of disability data, which meant that the purpose was three-fold. The method of disability identification needed to be: feasible and valid for the primary purpose of data disaggregation, accurate enough to provide verifiable information to inform individual eligibility for a disability inclusion grant, and comprehensive and detailed enough to inform provision of individualised supports.

Marguerite Schneider perfectly captured the intricate challenge at the heart of this thesis:

> A very real tension in disability measurement … is to keep measures simple and easy to administer in a standard manner, while recognizing and incorporating the complexity and preventing the statistics from being interpreted as reductionist versions of the phenomenon. The ideal of accurate and simple measures to represent a complex phenomenon is no simple task: the two could be construed as inherently contradictory. Reconciling this contradiction entails not only ensuring that the measures used are accurate, but also that those who use these measures and related statistics understand what is being measured and how to use and interpret the data. (260)

In their seminal work on the role of datasets for education of children with disabilities nearly fifteen years ago, Robson and Evans recommended that EMISs use "a simple tool, such as the Ten Questions tool". Since then researchers identified irreconcilable problems with the Ten Questions Screening Instrument and a major body of work was undertaken by UNICEF and the Washington Group on Disability Statistics to develop an important new instrument, the Child Functioning Module. The CFM has been accepted by peak representative bodies from United Nations agencies, national statistical agencies, disabled persons organisations and by many key donor agencies as the preferred tool for disability disaggregating SDG indicators. The CFM was designed to disaggregate population survey data and can be administered cost-effectively, without difficult-to-acquire expertise, providing results that are accurate enough to establish trends in prevalence and compare SDG or other indicators between populations. However, the CFM was designed and tested with parents as the primary respondent whereas teacher-based data is used in education management information systems. The lack of validation of the CFM with teachers as respondents was a critical gap in the literature.

This research indicates that the CFM is a useful core aspect of data required for disability disaggregation of Fiji's EMIS and that teachers are adequately accurate proxy respondents to the CFM. However, the mixture of severity of impairments reported across CFM response categories and ambiguity in the choice of cut-off level, in both parent and teacher results, are limitations of the CFM and indicate that the CFM may not be accurate enough to be used as the sole method for identifying children with disabilities. Combining activity and participation data from the CFM with data on environmental factors (i.e. learning and support needs) increased the accuracy of overall and domain-specific disability identification.

Based on this research, the Fijian Ministry of Education, in partnership with the Australian government project Access to Quality Education Program, implemented a system for disability disaggregation of

Fiji's EMIS. Whilst implementation is nascent and there are undoubtedly problems to be uncovered, there is now a feasible and useable system underway that is collecting valid data. In 2007 Fiji's Permanent Secretary for Education declared that Fiji was ready to progress disability-inclusive education (99). Perhaps now Fiji can progress this agenda more effectively, using valid data to inform its approaches to disability-inclusive education and strengthen policy and resourcing accordingly.

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Appendices

Appendix 1: Questionnaire – parents

Child functioning and disability study – Parent questionnaire

i. Identification

Name of child	First name: Surname:		
Name of School			
Child's class			
Date of interview	_____ / _____ / 2015		
Name of interviewer			
Details of parent / primary care-giver completing assessment *(only complete one option)*		Age	Highest level of education: (1=primary, 2= secondary, 3= higher education)
	❒ Mother		
	❒ Father		
	❒ Other (describe, eg. grandmother): ________________________		

Demographics

Q1.01 Current place of residence of the child:

.... ***(Village or town)***

Q1.01a Is that urban, peri-urban, rural or remote?

1. ❒ Urban
2. ❒ Peri-urban
3. ❒ Rural
4. ❒ Remote

Q1.02 Child's Date of birth: .... ***Age (in years):*** ....

Q1.03 Child's Gender:

1. ❒ Male
2. ❒ Female

Q1.04 Child's Ethnicity:

1. ❒ iTaukei (Fijian)
2. ❒ Indo-Fijian
3. ❒ Other (Please specify)

WG/UNICEF module – interviewer administered with parent/primary caregiver

CHILD FUNCTIONING AND DISABILITY (AGE 5-17)		CFD
CFD1. I WOULD LIKE TO ASK YOU SOME QUESTIONS ABOUT DIFFICULTIES YOUR CHILD MAY HAVE. DOES (*name*) WEAR GLASSES?	Yes ... 1 No ... 2	2⇨CFD3
CFD2. WHEN WEARING HIS/HER GLASSES, DOES (*name*) HAVE DIFFICULTY SEEING? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty ... 1 Some difficulty ... 2 A lot of difficulty ... 3 Cannot do at all ... 4	1⇨CFD4 2⇨CFD4 3⇨CFD4 4⇨CFD4
CFD3. DOES (*name*) HAVE DIFFICULTY SEEING? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty ... 1 Some difficulty ... 2 A lot of difficulty ... 3 Cannot do at all ... 4	
CFD4. DOES (*name*) USE A HEARING AID?	Yes ... 1 No ... 2	2⇨CFD6
CFD5. WHEN USING HIS/HER HEARING AID(S), DOES (*name*) HAVE DIFFICULTY HEARING SOUNDS LIKE PEOPLES' VOICES OR MUSIC? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty ... 1 Some difficulty ... 2 A lot of difficulty ... 3 Cannot do at all ... 4	1⇨CFD7 2⇨CFD7 3⇨CFD7 4⇨CFD7
CFD6. DOES (*name*) HAVE DIFFICULTY HEARING SOUNDS LIKE PEOPLES' VOICES OR MUSIC? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty ... 1 Some difficulty ... 2 A lot of difficulty ... 3 Cannot do at all ... 4	
CFD7. DOES (*name*) USE ANY EQUIPMENT OR RECEIVE ASSISTANCE FOR WALKING?	Yes ... 1 No ... 2	2⇨CFD12
CFD8. WITHOUT USING HIS/HER EQUIPMENT OR ASSISTANCE, DOES (*name*) HAVE DIFFICULTY WALKING 100 METERS ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 1 FOOTBALL FIELD. WOULD YOU SAY (*name*) HAS: SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	Some difficulty ... 1 A lot of difficulty ... 2 Cannot do at all ... 3	 2⇨CFD10 3⇨CFD10

CFD9. WITHOUT USING HIS/HER EQUIPMENT OR ASSISTANCE, DOES (*name*) HAVE DIFFICULTY WALKING 500 METERS ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 5 FOOTBALL FIELDS. WOULD YOU SAY (*name*) HAS: SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	Some difficulty .... 1 A lot of difficulty .... 2 Cannot do at all 3	
CFD10. WHEN USING HIS/HER EQUIPMENT OR ASSISTANCE, DOES (*name*) HAVE DIFFICULTY WALKING 100 METERS ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 1 FOOTBALL FIELD. WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	3⇨CFD14 4⇨CFD14
CFD11. WHEN USING HIS/HER EQUIPMENT OR ASSISTANCE, DOES (*name*) HAVE DIFFICULTY WALKING 500 METERS ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 5 FOOTBALL FIELDS. WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	1⇨CFD14
CFD12. COMPARED WITH CHILDREN OF THE SAME AGE, DOES (*name*) HAVE DIFFICULTY WALKING 100 METERS ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 1 FOOTBALL FIELD. WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	3⇨CFD14 4⇨CFD14
CFD13. COMPARED WITH CHILDREN OF THE SAME AGE, DOES (*name*) HAVE DIFFICULTY WALKING 500 METERS ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 5 FOOTBALL FIELDS, OR GOING FROM HOME TO CHURCH. WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	1⇨CFD14
CFD14. DOES (*name*) HAVE DIFFICULTY WITH SELF-CARE SUCH AS FEEDING OR DRESSING HIM/HERSELF?		

WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty........1 Some difficulty........2 A lot of difficulty........3 Cannot do at all........4	1⇨CFD15
CFD15. WHEN (*name*) SPEAKS, DOES HE/SHE HAVE DIFFICULTY BEING UNDERSTOOD BY PEOPLE <u>INSIDE</u> OF THIS HOUSEHOLD? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty........1 Some difficulty........2 A lot of difficulty........3 Cannot do at all........4	
CFD16. WHEN (*name*) SPEAKS, DOES HE/SHE HAVE DIFFICULTY BEING UNDERSTOOD BY PEOPLE <u>OUTSIDE</u> OF THIS HOUSEHOLD? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty........1 Some difficulty........2 A lot of difficulty........3 Cannot do at all........4	
CFD17. COMPARED WITH CHILDREN OF THE SAME AGE, DOES (NAME) HAVE DIFFICULTY LEARNING THINGS? WOULD YOU SAY (NAME) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty........1 Some difficulty........2 A lot of difficulty........3 Cannot do at all........4	1⇨CFD18
CFD18. COMPARED WITH CHILDREN OF THE SAME AGE, DOES (NAME) HAVE DIFFICULTY REMEMBERING THINGS? WOULD YOU SAY (NAME) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty........1 Some difficulty........2 A lot of difficulty........3 Cannot do at all........4	1⇨CFD19
CFD19. HOW OFTEN DOES (NAME) SEEM ANXIOUS, NERVOUS OR WORRIED? WOULD YOU SAY: DAILY, WEEKLY, MONTHLY, A FEW TIMES A YEAR OR NEVER?	Daily........1 Weekly........2 Monthly........3 A few times a year........4 Never........5	
CFD20. HOW OFTEN DOES (NAME) SEEM SAD OR DEPRESSED? WOULD YOU SAY: DAILY, WEEKLY, MONTHLY, A FEW TIMES A YEAR OR NEVER?	Daily........1 Weekly........2 Monthly........3 A few times a year........4 Never........5	

CFD21. COMPARED WITH CHILDREN OF THE SAME AGE, HOW MUCH DIFFICULTY DOES (NAME) HAVE CONTROLLING HIS/HER BEHAVIOUR? WOULD YOU SAY: NO DIFFICULTY, THE SAME OR LESS, MORE OR A LOT MORE?	No difficulty.........1 The same or less.........2 More.........3 A lot more.........4	1⇨CFD22 2⇨CFD22
CFD22. DOES (NAME) HAVE DIFFICULTY FOCUSING ON AN ACTIVITY THAT HE/SHE ENJOYS DOING? WOULD YOU SAY (NAME) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty.........1 Some difficulty.........2 A lot of difficulty.........3 Cannot do at all.........4	
CFD23. DOES (NAME) HAVE DIFFICULTY ACCEPTING CHANGES IN HIS/HER ROUTINE? WOULD YOU SAY (NAME) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty.........1 Some difficulty.........2 A lot of difficulty.........3 Cannot do at all.........4	1⇨CFD24
CFD24. DOES (NAME) HAVE DIFFICULTY MAKING FRIENDS? WOULD YOU SAY (NAME) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty.........1 Some difficulty.........2 A lot of difficulty.........3 Cannot do at all.........4	

End of the assessment   Thankyou!

Appendix 2: Questionnaire – teachers

Fiji Ministry
of Education,
National Heritage
and Arts

Access to Quality Education Program (AQEP)

GRM INTERNATIONAL

Child functioning and disability study – Teacher questionnaire

i. Identification

Name of child	First name:	Surname:
Name of School		
Child's class		
Date questionnaire completed	**_____ / _____ / 2015**	
Teacher Name & TPF	Name:	TPF:

WG/UNICEF module – child's classroom teacher to complete independently

Instruction: Please circle relevant response number in middle column; then follow arrow prompts in right column. If there is no arrow prompt, please go on to very next question.

WASHINGTON GROUP/UNICEF MODULE (AGE 5-17)		CFD
CFD1. I WOULD LIKE TO ASK YOU SOME QUESTIONS ABOUT DIFFICULTIES (*name*) MAY HAVE. DOES (*name*) WEAR GLASSES?	Yes ..... 1 No 2	 2⇨CFD3
CFD2. WHEN WEARING HIS/HER GLASSES, DOES (*name*) HAVE DIFFICULTY SEEING? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty ..... 1 Some difficulty ..... 2 A lot of difficulty ..... 3 Cannot do at all 4	1⇨CFD4 2⇨CFD4 3⇨CFD4 4⇨CFD4
CFD3. DOES (*name*) HAVE DIFFICULTY SEEING? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty ..... 1 Some difficulty ..... 2 A lot of difficulty ..... 3 Cannot do at all 4	
CFD4. DOES (*name*) USE A HEARING AID?	Yes ..... 1 No 2	 2⇨CFD6
CFD5. WHEN USING HIS/HER HEARING AID(S), DOES (*name*) HAVE DIFFICULTY HEARING SOUNDS LIKE PEOPLES' VOICES OR MUSIC? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty ..... 1 Some difficulty ..... 2 A lot of difficulty ..... 3 Cannot do at all 4	1⇨CFD7 2⇨CFD7 3⇨CFD7 4⇨CFD7

CFD6. DOES (*name*) HAVE DIFFICULTY HEARING SOUNDS LIKE PEOPLES' VOICES OR MUSIC? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	
CFD7. DOES (*name*) USE ANY EQUIPMENT OR RECEIVE ASSISTANCE FOR WALKING?	Yes .... 1 No 2	2⇨CFD12
CFD8. WITHOUT USING HIS/HER EQUIPMENT OR ASSISTANCE, DOES (*name*) HAVE DIFFICULTY WALKING 100 METERS ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 1 FOOTBALL FIELD. WOULD YOU SAY (*name*) HAS: SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	Some difficulty .... 1 A lot of difficulty .... 2 Cannot do at all 3	2⇨CFD10 3⇨CFD10
CFD9. WITHOUT USING HIS/HER EQUIPMENT OR ASSISTANCE, DOES (*name*) HAVE DIFFICULTY WALKING 500 METERS ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 5 FOOTBALL FIELDS. WOULD YOU SAY (*name*) HAS: SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	Some difficulty .... 1 A lot of difficulty .... 2 Cannot do at all 3	
CFD9A. WHAT TYPE OF DIFFICULTY DOES (*name*) HAVE WITH WALKING 500 METRES?	Willingness to walk .... 1 Physical ability to walk .... 2 Other 3	
CFD9B. HOW MUCH CONCERN DO YOU HAVE ABOUT THIS DIFFICULTY?	No concern at all .... 1 A little concern .... 2 A lot of concern .... 3 Somewhere between a little and a lot 4	
CFD10. WHEN USING HIS/HER EQUIPMENT OR ASSISTANCE, DOES (*name*) HAVE DIFFICULTY WALKING 100 METRES ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 1 FOOTBALL FIELD. WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	3⇨CFD14 4⇨CFD14
CFD11. WHEN USING HIS/HER EQUIPMENT OR ASSISTANCE, DOES (*name*) HAVE DIFFICULTY WALKING 500 METRES ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 5 FOOTBALL FIELDS. WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty 3	1⇨CFD14

	Cannot do at all 4	
CFD12. COMPARED WITH CHILDREN OF THE SAME AGE, DOES (*name*) HAVE DIFFICULTY WALKING 100 METRES ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 1 FOOTBALL FIELD. WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	 3⇨CFD14 4⇨CFD14
CFD13. COMPARED WITH CHILDREN OF THE SAME AGE, DOES (*name*) HAVE DIFFICULTY WALKING 500 METERS ON LEVEL GROUND? THAT WOULD BE ABOUT THE LENGTH OF 5 FOOTBALL FIELDS, OR GOING FROM HOME TO CHURCH.. WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	1⇨CFD14
CFD14. DOES (*name*) HAVE DIFFICULTY WITH SELF-CARE SUCH AS FEEDING OR DRESSING HIM/HERSELF? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	1⇨CFD15
CFD15. WHEN (*name*) SPEAKS, DOES HE/SHE HAVE DIFFICULTY BEING UNDERSTOOD BY PEOPLE <u>INSIDE</u> OF HIS/HER MAIN CLASSROOM? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	1⇨CFD16
CFD16. WHEN (*name*) SPEAKS, DOES HE/SHE HAVE DIFFICULTY BEING UNDERSTOOD BY PEOPLE <u>OUTSIDE</u> OF HIS/HER MAIN CLASSROOM? WOULD YOU SAY (*name*) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	1⇨CFD17

CFD17. COMPARED WITH CHILDREN OF THE SAME AGE, DOES (NAME) HAVE DIFFICULTY LEARNING THINGS? WOULD YOU SAY (NAME) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty....1 Some difficulty....2 A lot of difficulty....3 Cannot do at all....4	1⇨CFD18
CFD18. COMPARED WITH CHILDREN OF THE SAME AGE, DOES (NAME) HAVE DIFFICULTY REMEMBERING THINGS? WOULD YOU SAY (NAME) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty....1 Some difficulty....2 A lot of difficulty....3 Cannot do at all....4	1⇨CFD19
CFD19. HOW OFTEN DOES (NAME) SEEM ANXIOUS, NERVOUS OR WORRIED? WOULD YOU SAY: DAILY, WEEKLY, MONTHLY, A FEW TIMES A YEAR OR NEVER?	Daily....1 Weekly....2 Monthly....3 A few times a year....4 Never....5	
CFD20. HOW OFTEN DOES (NAME) SEEM SAD OR DEPRESSED? WOULD YOU SAY: DAILY, WEEKLY, MONTHLY, A FEW TIMES A YEAR OR NEVER?	Daily....1 Weekly....2 Monthly....3 A few times a year....4 Never....5	
CFD21. COMPARED WITH CHILDREN OF THE SAME AGE, HOW MUCH DIFFICULTY DOES (NAME) HAVE CONTROLLING HIS/HER BEHAVIOUR? WOULD YOU SAY: NO DIFFICULTY, THE SAME OR LESS, MORE OR A LOT MORE?	No difficulty....1 The same or less....2 More....3 A lot more....4	1⇨CFD22 2⇨CFD22

CFD22. DOES (NAME) HAVE DIFFICULTY FOCUSING ON AN ACTIVITY THAT HE/SHE ENJOYS DOING? WOULD YOU SAY (NAME) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty....1 Some difficulty....2 A lot of difficulty....3 Cannot do at all....4	

CFD23. DOES (NAME) HAVE DIFFICULTY ACCEPTING CHANGES IN HIS/HER ROUTINE? WOULD YOU SAY (NAME) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	1⇨CFD24
CFD24. DOES (NAME) HAVE DIFFICULTY MAKING FRIENDS? WOULD YOU SAY (NAME) HAS: NO DIFFICULTY, SOME DIFFICULTY, A LOT OF DIFFICULTY OR CANNOT DO AT ALL?	No difficulty .... 1 Some difficulty .... 2 A lot of difficulty .... 3 Cannot do at all 4	

Learning support needs

Q1) How long in total have you taught (child) (including previous years you have taught him/her)?

________years _________months

Q2) Is (child) currently using any of the following types of assistive device(s)? *(Tick all applicable options; refer to the pictures of assistive devices)*

1. ❒ Wheelchair
2. ❒ Crutches
3. ❒ Walking stick or walking frame
4. ❒ Screen reading software (computer program reads the text out loud, eg. JAWS)
5. ❒ Braille machine (child reads through touching the bumps on the machine or page)
6. ❒ White cane
7. ❒ Glasses
8. ❒ Hearing aid
9. ❒ Magnifier
10. ❒ Orthotic devices (to support legs, arms or spine)
11. ❒ Artificial limbs (prosthetics)
12. ❒ Modified furniture (eg. special chair or desk)
13. ❒ Communication boards (e.g. a board with pictures children point to and express themselves)
14. ❒ Computer used specifically to overcome a functional limitation/disability (Please specify what and how this is used to support learning)
    ………………………………………..……………………………….
15. ❒ Other (Please specify) ....
16. ❒ No Assistive Device used

Q3) **a) Is there a teacher aide in this child's classroom? Yes / No** (please circle)

b) Is there any other support staff or volunteers who work with this child regularly (ie. At least monthly) Yes / No (please circle)

Please provide details: ____

Q4) Compared with children the same age, how much personal assistance at school does (child) require with any of the following tasks? *(answer all rows; for each row tick one column only. This question relates to assistance from a human, not due to assistive devices).*

	Needs no extra assistance	Needs a little more assistance than other children	Needs much more assistance than other children
4a. Moving around the classroom			
4b. Moving around outside in the school grounds			
4c. Getting to and from school			
4d. Communication			
4e. Cognitive / learning activities			
4f. Self-care (eating, toileting)			
4g. Socialising with other children			
4h. Managing own behaviour			

Q5) Are there any adaptations to learning or assessment that you currently make for (child)? Tick a column for every question. We would be VERY GRATEFUL if you could please describe as many other types of assistance that you provide, using the blank rows.

	Yes, we do this	No need for this	Not done, but there might be a need
5a. Child sits close to the board or teacher			
5b. Printed materials are enlarged			
5c. Printed materials are provided in Braille			
5d. Physical education (sport) activities and games are modified			
5e. Modifying the lesson, or reducing the complexity of the lesson for the child			
5f. Sign language interpreters are available for learning and other school activities			
5g. Additional time provided for assessments			
5h. Personal assistance provided during assessments (eg. note taker/writer, sign language interpreter, etc)			
Other:			
Other:			
Other:			

End of the assessment Thankyou!

Appendix 3: Ethical clearance

17 March 2015

THE UNIVERSITY OF MELBOURNE

Dr M Marella
Melbourne School of Population and Global Health
The University of Melbourne

Dear Dr Marella

I am pleased to advise that the Health Sciences Human Ethics Sub-Committee approved the following Project:

Project title:	**Validating a tool for schools to identify children with disabilities in Fiji**
Researchers:	**Dr M Marella, Prof B I Mcpake, Mrs E Sprunt**
Ethics ID:	**1543942**

The Project has been approved for the period: **17-Mar-2015 to 31-Dec-2015**

It is your responsibility to ensure that all people associated with the Project are made aware of what has actually been approved.

Research projects are normally approved to 31 December of the year of approval. Projects may be renewed yearly for up to a total of five years upon receipt of a satisfactory annual report. If a project is to continue beyond five years a new application will normally need to be submitted.

Please note that the following conditions apply to your approval. Failure to abide by these conditions may result in suspension or discontinuation of approval and/or disciplinary action.

(a) **Limit of Approval:** Approval is limited strictly to the research as submitted in your Project application.

(b) **Variation to Project:** Any subsequent variations or modifications you might wish to make to the Project must be notified formally to the Human Ethics Sub-Committee for further consideration and approval. If the Sub-Committee considers that the proposed changes are significant, you may be required to submit a new application for approval of the revised Project.

(c) **Incidents or adverse effects:** Researchers must report immediately to the Sub-Committee anything which might affect the ethical acceptance of the protocol including adverse effects on participants or unforeseen events that might affect continued ethical acceptability of the Project. Failure to do so may result in suspension or cancellation of approval.

(d) **Monitoring:** All projects are subject to monitoring at any time by the Human Research Ethics Committee.

(e) **Annual Report:** Please be aware that the Human Research Ethics Committee requires that researchers submit an annual report on each of their projects at the end of the year, or at the conclusion of a project if it continues for less than this time. Failure to submit an annual report will mean that ethics approval will lapse.

(f) **Auditing:** All projects may be subject to audit by members of the Sub-Committee.

If you have any queries on these matters, or require additional information, please contact me using the details below.

Please quote the ethics registration number and the title of the Project in any future correspondence.

On behalf of the Sub-Committee I wish you well in your research.

Yours sincerely

Ms Jennifer Hassell - Secretary
Health Sciences HESC
Phone: 90353341, Email: hassell@unimelb.edu.au

MINISTRY OF EDUCATION, NATIONAL HERITAGE, CULTURE & ARTS

Quality Education for Change, Peace and Progress

Resident Address: Marela House, 19 Thurston Street, Suva, Fiji. Ph: (679) 3314477
Postal Address: Private Mail Bag, Government Buildings, Suva, Fiji. Fax: (679) 3303511

Our Reference: RA 09/15 *Date:* 5th March 2015

Ms Beth Sprunt
University of Melbourne
Australia.

Re: **Official Approval to Conduct Research in Fiji**

Dear Ms Sprunt

We are pleased to inform you that the approval for the request to conduct research in Fiji has been granted on the topic: "**Development and validation of a method for disaggregating the Fiji Education Management Information System by disability.**"

The approval is granted from March – May 2015 as specified in your request.

It is also noted that in this research, you will be working with the Access to Quality Education Program (AQEP) and the Ministry of Education who would be assisting you with facilitating your research. Please liaise with the relevant personnel and organizations with regards to the logistics and the conduct of your research and be further advised that the Government of Fiji's legislations, procedures, policies and protocols must be unreservedly adhered to.

As a condition for the research approval, a copy of the final research report must be submitted to the Ministry of Education (MoE) through this office upon completion, before the commencement of any publication. Only after the MoE Research & Ethics Council has endorsed the report, shall you be allowed to do any publication of the report. The report will be reserved in the MoE Research Library and will be availed for reference by Senior Ministry and Government officials.

Moreover, it is important to note that the Ministry of Education reserves a right to publish the final report or an edited summary of it.

Please liaise with the Immigration Department in regards to the issuance of your Research Permit.

We further wish you success in your research project.

……………………………………………
Parmeshwar Mohan (Mr)
for **Permanent Secretary for Education, National Heritage, Culture & Arts**.

cc. MoE Research File

Appendix 4: Information and consent form

Consent Form – Parents/Primary caregiver

Research to assess child functioning and disability in Fijian primary school children

Parents name: ________________________________
School name: ________________________________

Name of child for whom consent is given:

1. ______________________________ Class: ______ Date of Birth: _______________________

		Tick to indicate information has been communicated
The Access to Quality Education Program (AQEP), together with the Ministry of Education and staff from the Ministry of Health are doing some research to work out what special supports children might need at school. This study is funded by the Australian government and is conducted in partnership with the University of Melbourne, Monash University, the Pacific Islands Forum Secretariat and the Pacific Disability Forum.		☐
We are inviting you to take part through answering a short questionnaire.		☐
The study involves assessing your child at the school for vision, hearing, movement and cognitive abilities. The assessment will take about 75 minutes.		☐
The findings from this study will be included in an overall report, but no-one will be able to identify information about you or your child. Any information you give us will be confidential.		☐
Your participation is completely voluntary. You can stop at any time during the questionnaire. So if you would prefer not to, please let us know and we will not disturb you any further. You or your family members will not be disadvantaged in anyway if you choose not to participate in the study.		☐
Are you willing to participate in the questionnaire?	YES	☐
(IF YOU ARE NOT WILLING TO ATTEND FOR THE QUESTIONNAIRE, YOUR CHILD WILL NOT BE IN THE STUDY)	NO	☐
Are you willing for your child to participate in the study?	YES	☐
	NO	☐

Signature of parent/guardian: _ Date: _ _ _ _ _ _ _ _ _ _ _ _

Fiji Ministry
of Education,
National Heritage
and Arts

Access to Quality
Education
Program (AQEP)

Appendix 5: Pictures of assistive devices available during questionnaire completion

			
Wheelchair	Crutches	Walking frame	White cane
			
Braille machine	Screen reading software	Magnifier and glasses	Hearing aid
			
Orthotic device	Prosthetic limb	Modified furniture	Communication board