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Quality of Maternal and Newborn Care in Southeast Asian Contexts: Using Demographic and Health Surveys to Monitor and Explore Patterns of Care

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Abstract

Coverage of maternal and neonatal health services have increased substantially across the developing world, however concern is growing regarding the quality of this care. In the absence of comprehensive health information systems monitoring quality and identifying relative inequity in care is dependent on survey data which may be both limited in scope and too specialised to provide comparative assessments. This thesis explores the use of routinely collected Demographic and Health Survey (DHS) data to examine patterns of quality of routine maternal and neonatal care in three Southeast Asian countries that have experienced large increases in coverage in recent decades.

Using a range of indicators representative of good quality care, as well as weighting derived from Principal Component Analysis (PCA), data from the 2012 Indonesian DHS was used to create “Quality Indices” (QI) which were tested for their reliability and similarity with existing literature regarding quality differentials within the country. After determining the feasibility of the methods, further QI were constructed for the 2013 Philippines DHS and 2010 and 2014 Cambodian DHS. The QI were then used to examine patterns of quality in different population groups within countries and as well as identify general trends across countries.

The analysis demonstrated that while feasible, the use of DHS data for measuring quality was restricted by the number and nature of potential indicators available, as well as underlying limitations with regards to the nature of the survey. The country analyses revealed several important themes regarding the relationship between quality of care, wealth and health system reforms. Notably in all three countries the effect of geographic location on QI scores was substantial, reflecting the impact of the decentralisation of healthcare in these countries. While facility based delivery showed a substantial advantage over home based care in all countries, the effect of private vs. public or hospital vs. non-hospital care varied.

In the Philippines non-capital regions and non-hospital providers were associated with lower levels of care, while in Indonesia QI scores generally decreased with

distance from the Java/Bali island group and use of non-government facilities. Cambodia saw a remarkable transition with large overall increases in quality between the survey years, as well as substantial improvements in poor rural areas and in primary health facilities. Comparison of QI across countries showed that overall scores were much lower for Indonesia compared to the Philippines and Cambodia in 2010, with Cambodia 2014 performing the best.

These findings represent not only some of the most recent knowledge regarding quality of care, but also the first attempt at an equity based analysis of quality of care in these countries. They demonstrate not only the potential of DHS surveys in identifying patterns of quality care, but also the importance of health system factors in understanding and improving maternal and neonatal care in developing countries.

Declaration by author

This thesis is composed of my original work, and contains no material previously published or written by another person except where due reference has been made in the text. I have clearly stated the contribution by others to jointly-authored works that I have included in my thesis.

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Adaptation of early draft of Chapter 3

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Contributions by others to the thesis

In their roles as members of the supervisory team, Dr Eliana Jimenez Soto and Dr Andrew Hodge contributed to the conceptualisation and design of this thesis, and Dr Hebe Gouda provided advice regarding interpretation of the data.

Statement of parts of the thesis submitted to qualify for the award of another degree

None

Research Involving Human or Animal Subjects

No animal or human subjects were involved in this research

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List of Abbreviations

- ANC – Antenatal Care
- ARMM – Autonomous Region of Muslim Mindanao
- DHS – Demographic and Health Survey
- EMOC – Emergency Obstetric Care
- EW – Equal Weight
- FBD - Facility Based Delivery
- HIS - Health Information System
- IFA – Iron/Folic Acid
- IMPAC – Integrated Management of Pregnancy and Childbirth
- LBW – Low Birth Weight
- LGU – Local Government Unit
- LMIC – Lower and Middle Income Country
- MNCH – Maternal, Neonatal and Child Health
- NCR – National Capital Region
- OOP – Out of Pocket (Insurance)
- PCA - Principal Components Analysis
- PHC – Public Health Centre
- PMTCT- Prevention of Maternal To Child Transmission (of HIV)
- PNC – Postnatal Care
- QI – Quality Index
- SBA - Skilled Birth Attendant
- TT – Tetanus Toxoid (Immunisation)
- WHO – World Health Organization

1 Introduction and Overview of Thesis

As the world transitions from the era of the Millennium Development Goals and a focus on increasing coverage of key health services, to that of the Sustainable Development Goals which aim towards a more comprehensive goal of universal health coverage[1], the quality of health services has become a major focus of reforms aimed at achieving equitable outcomes across the whole population[2,3]. As access to healthcare increases in many Lower and Middle Income Countries (LMICs), systems for measuring and monitoring quality of care are necessary to ensure that improved access to health services is accompanied by quality care when these services are utilised[3-6]. Poor quality of care has, in particular, been raised as one of the greatest challenges currently facing Maternal, Neonatal and Child Health (MNCH)[7,8].

Issues around the provision of good quality care have been particularly noticeable in Southeast Asia, where many countries have seen large increases in access to MNCH services, but have not yet seen commensurate improvements in health outcomes[9,10]. Notably, programs targeted towards poor and disadvantaged sections of the population, such as the social insurance programs in Indonesia and the Philippines[2 11] have found that despite marked increases in service coverage, key outcome measures, such as maternal and neonatal mortality rates, have not substantially improved - potentially due to a substandard quality of care[12]. At the same time, as the recent Lancet series on Maternal Health notes, there is also a global trend towards increasing overuse of unnecessary and inappropriate interventions during facility based deliveries, particularly within the private sector[3], suggesting that it is not only traditionally disadvantaged populations that experience poor quality care in these contexts.

One of the greatest obstacles facing efforts to address quality of care in LMICs is the current lack of data relating to quality indicators[6,13]. In the absence of fully functional Health Information Systems (HIS), and a tendency for existing systems and surveys to focus on coverage[14], evidence on quality of care is scarce and often only available when specialised studies are conducted[15]. In addition, there is no single definition of quality of care, and no standard set of indicators through which to measure it, leading to a lack of comparability between studies even when they are conducted in similar contexts. As a result, it is difficult to monitor changes in quality of care within a population, making the evaluation of quality improvement strategies exceedingly difficult.

With regards to maternal and neonatal health, existing measures of quality are typically focused on high level, facility based care. Commonly reported indicators of the quality of maternal care include caesarean and episiotomy rates[16], maternal near misses[17], and maternal mortality – all measures that are not appropriate at lower levels of care. Even fewer measures of quality of care exist for neonates, and the few that are commonly reported also emphasise tertiary level care. Consequently these measures tend to exclude women who deliver at home or in smaller clinics, which in many developing contexts can represent the majority of the population. The situation is compounded by the existence of largely unregulated private sectors that may provide a high proportion of maternal and neonatal health services in urban areas[18-21] but are often not covered by existing reporting schemes. It is thus extremely difficult to determine how major health policies affect quality of care across the entire health system, and in particular judge how equitably good quality care is distributed.

One potential method to collect information on the experiences of women regardless of where they deliver is to employ population surveys. Specially constructed surveys in small populations[22-25] have been used to collect detailed data relating to quality, however the wide scale implementation of such surveys are constrained by cost and lengthy timeframes. At the same time there has historically been a limited availability of quality related measures in large scale population surveys. Attempts to use such surveys to report population level indicators of quality have been typically based on the coverage of antenatal care as reported by country level Demographic and Health Surveys (DHS)[26-28]. Following recent increases in the number of quality related indicators being collected through these surveys[29,30] it may be feasible to construct a more comprehensive picture of quality over the entire continuum of care, however no studies have as of yet attempted to do so.

This thesis will address these gaps in the literature by attempting to address two major objectives:

1) The development of a summary measure of the quality of maternal and neonatal care using DHS data

    a. This will involve the formulation of an appropriate methodology based on existing literature regarding the construction of composite indices and relevant evidence regarding quality within maternal and neonatal health
    b. The methodology will be piloted using a single DHS dataset, the resulting measure tested with regards to its reliability and validity, and a decision made regarding its feasibility as a tool to measure quality of care.
2) To assess the distribution of quality of maternal and neonatal care within Southeast Asian contexts in terms of known equity and health system factors
    a. If the measure described in 1) is shown to be capable of representing quality of care, then an equity based analysis will be undertaken examining how scores vary between different population subgroups and between different types of providers.
    b. This will be done using both comparison of mean values as well as basic regression techniques
    c. The analysis will be carried out individually for Southeast Asian countries for which an appropriate DHS dataset is available. Additional analysis will also, if feasible, be conducted on a pooled dataset included in order to directly compare countries and identify potential regional patterns of quality of care.

This study thus represents not only the first time the DHS data will be used to measure quality of maternal and neonatal care along the continuum of care, but also one of the few attempts to provide an equity based analysis of quality of care at a country level. These findings, particularly as they relate to recent health system reforms, may not only provide an overview of where current policies are failing to reach those in need, but also provide insight into how future efforts might be better targeted to improve maternal and neonatal outcomes in Southeast Asia.

2 Background – What is quality of care and how is it measured?

The first step in creating and using a measure of quality of care is determining what exactly "quality" encompasses. This chapter will explore the literature pertaining to key concepts surrounding quality of care in maternal and neonatal health, with a particular emphasis on existing definitions and methodologies for exploring deficiencies in quality of care.

2.1 What is quality of care?

Despite its acknowledged importance, quality of care is a difficult concept to define[8,13,19,31,32] and therefore measure. At its heart, it may be considered as a series of value judgements applied to various dimensions of health care[31]; the earliest attempts to define quality of care consisted of 'articles of faith' reflecting the desired attributes and goals of medical care. As such, definitions of quality can vary substantially between contexts – the relevant dimensions of care and values used to define quality are largely dependent on the underlying goals and setting of the health service being examined.

The nebulous nature of quality has led to a multitude of different conceptual frameworks through which it can be examined. Perhaps the most famous of these is the Donabedian model[31,33], wherein information regarding quality of care can be classified into three categories: structure, process and outcome. Structural elements include all the factors affecting the context in which care is delivered, including physical infrastructure, availability of drugs and equipment, availability of staff and organisational characteristics such as staff training and payment methods. These elements do not function well as sole measures of quality, as the relationship between structure and process, and structure and outcomes can be quite complex.

Process elements include all the actions that make up health care, from diagnosis to treatment, and also includes preventative actions of health care such as patient education, counselling and community based outreach. Processes can further be classed as technical processes (representing how care is delivered) and interpersonal processes (representing the manner in which care is delivered). Donabedian considered this category to be the strongest measure of true quality of care, as it encompassed all actions taken as part of the care process.

Finally, outcome elements include all the effects of healthcare on the population, whether it be changes in mortality and morbidity rates, patient satisfaction or quality of life, or changes in health related knowledge and behaviours. Like structural indicators, outcome indicators have limitations with regards to causality, as many external factors other than medical care may influence outcomes. A comprehensive understanding of quality of care thus requires elements from all three categories to be included in the analysis.

Generally, the three categories are represented in a linear fashion[32], with structural elements influencing process elements which in turn affect outcomes. In any given context, indicators within each category might be tailored to represent what are considered to be the core goals and values for that setting. The Donabedian framework was originally designed to explore quality of care within clinical practice, but due to this versatility it has been applied to many health related fields.

The modification of more generalised quality frameworks to specifically address MNCH care is relatively recent. A 2011 review by Raven *et al*[15] noted that there were surprisingly few definitions and frameworks described in the global literature but identified three general types of frameworks for understanding quality in MNCH: *perspectives based* models which focus on how quality of care is understood by different stakeholders[34]; *characteristics based* models in which quality of care is seen as comprising particular characteristics, which may vary between settings; and *systems based* models, where quality of care is related to dimensions of the health system. Perspectives based models tend to be used to explore individual experiences with health care, while characteristics and systems based models are more often used to examine the general functioning of MNCH services. The difficulty in functionally capturing information relating to all of these aspects of quality care has however hindered the implementation of a holistic model such as the one suggested by the authors.

Table 2.1.1 Standards of Care and Examples of Quality Statements from the WHO Standards for Improving Quality of Maternal and Newborn Care in Health Facilities

Standard of Care	**Quality Statement Example**
Standard 1: Every woman and newborn receives routine, evidence-based care and management of complications during labour, childbirth and the early postnatal period, according to WHO guidelines.	*1.8 All women and newborns receive care according to standard precautions for preventing hospital acquired infections*
Standard 2: The health information system enables use of data to ensure early, appropriate action to improve the care of every woman and newborn.	*2.1: Every woman and newborn has a complete, accurate, standardized medical record during labour, childbirth and the early postnatal period.*
Standard 3: Every woman and newborn with condition(s) that cannot be dealt with effectively with the available resources is appropriately referred.	*3.2: For every woman and newborn who requires referral, the referral follows a pre-established plan that can be implemented without delay at any time.*
Standard 4: Communication with women and their families is effective and responds to their needs and preferences.	*4.1: All women and their families receive information about the care and have effective interactions with staff.*
Standard 5: Women and newborns receive care with respect and preservation of their dignity.	*5.2: No woman or newborn is subjected to mistreatment, such as physical, sexual or verbal abuse, discrimination, neglect, detainment, extortion or denial of services.*
Standard 6: Every woman and her family are provided with emotional support that is sensitive to their needs and strengthens the woman's capability.	*6.1: Every woman is offered the option to experience labour and childbirth with the companion of her choice.*
Standard 7: For every woman and newborn, competent, motivated staff are consistently available to provide routine care and manage complications.	*7.2: The skilled birth attendants and support staff have appropriate competence and skills mix to meet the requirements of labour, childbirth and the early postnatal period.*
Standard 8: The health facility has an appropriate physical environment, with adequate water, sanitation and energy supplies, medicines, supplies and equipment for routine maternal and newborn care and management of complications.	*8.3: An adequate stock of medicines, supplies and equipment is available for routine care and management of complications.*

An important framework for considering quality is one developed by the World Health Organisation (WHO)[35,36], initially as part of their attempt to create a method in which to rank and compare health systems in the World Health Report 2000, and later refined to provide a toolkit to assist policymakers in designing strategies to improve quality. The framework identifies six dimensions of quality that a health system should seek to make improvements to, and frames these as health system goals to be worked towards.

The framework frames quality as health care that is safe (delivering care which minimises risk to patients), effective (delivering evidence based care that results in improved health outcomes), timely (delivering appropriate, geographically reasonable care with minimal delay), efficient (delivering care in a manner that best uses available resources), equitable (delivering care that does not vary in quality because of patient characteristics) and patient centred (delivering culturally appropriate care taking into account individual preferences)[37]. An analysis of where deficiencies in each of these dimensions are occurring can then be used to set health goals. These health goals then define the actions to be taken, which may occur as interventions targeting leadership, information, patient and population engagement, regulations and standards, organisation capacity and models of care.

While this framework is designed to provide a very broad lens through which to create quality improvement[38] it can be adapted to specific areas of interest. As part of a series on improving maternal and newborn quality of care, a modified Donabedian model was used in which the WHO defined characteristics of efficacy, efficiency, timeliness, patient centeredness, equity, and safety formed the basis of the process component. More recently, this framework has been expanded to formulate a series of standards designed to promote improvements in the quality of maternal and neonatal care in health facilities[39] [37]. The framework involves eight standards of care (see Table 2.1.1) each with several associated quality statements outlining specific elements to drive improved quality of care relating to that standard. While comprehensive, and addressing many key areas of facility based care, the WHO standards have been criticised for limited focus on preventative care and actions taken early in the continuum of care[40], and are thus considered to still be a work in progress.

2.2 How is quality of care measured?

Measuring quality of care is dependent not only on the definition of quality used, but also the way in which data regarding quality dimensions is collected[19,31]. Different measures often require different collection techniques, each of which will have both advantages and limitations.

The predominant method for collecting data on quality of care is through the use of *facility based records*[31]. These can include annual reports, the organisational and accounting records for a facility – from which structural indicators such as staff and equipment availability may be drawn, as well as individual patient records – from which process indicators such as diagnosis and prescribed treatment may be drawn as well as aggregate output indicators such as case fatality rates[41]. Data can also be indirectly drawn from facility records through standard reporting systems – many developed countries have systems whereby health providers report on a number of selected indicators to some form of regulatory authority. The included indicators may vary substantially, and can lead to vigorous academic debate[42,43].

Facility based records have the advantage of being present in some form or another in most healthcare settings[32]. The use of facility based records to obtain structural indicators – typically presence or absence of drugs combined with the availability of medical equipment – has historically been a common method of estimating quality in data poor settings[19]. This proxy indicator is however of limited usefulness – as an example Das *et al*[19] note that stockouts of drugs could potentially be correlated with either good or poor quality care; drug stocks may be depleted either due to an increase in attendance by those needing and receiving the drug in questions, or by inappropriate use of a drug in those who do not need it. For this reason process indicators are necessary, which in turn requires some form of clinical records to be available in the facility. However, clinical records are not perfect; even in developed countries it can be difficult to obtain such records from small private practices, and the quality of the records themselves may be quite poor[31]. This has generally limited the detailed use of clinical records to studies involving either hospital level care or large publically funded programs. Completeness of information is an issue for all facility records in general, and thus has in itself been considered as a method to assess quality of care – if records are incomplete there is potential for inappropriate care based on lack of communication between health providers.

Another method of collecting data on quality of care in contexts where good quality records are not available is through *direct observation*[31,44]. Here, interviewers shadow a particular health provider, taking a note of physical surroundings and sitting in on patient-provider consultations and recording the actions the provider takes. Occasionally these sessions may be teamed with exit interviews for the patient in order to obtain additional data on patient views and characteristics. More generally, structured and semi-structured interviews may be used to provide information regarding the beliefs, opinions and understanding both patients and providers have with regard to particular aspects of healthcare. On their own interviews can be used to identify differences in perspectives between patients and providers as well as between different types of providers[41]. When conducted in association with other methods of data collection they can provide essential context for understanding why particular actions were taken.

Direct observation when combined with provider and patient interviews can thus provide a great deal of in-depth information regarding many process and structural indicators, as well as immediate patient satisfaction[41], but has more difficulty in measuring indicators of clinical outcomes (once a patient leaves the facility their health status remains unknown unless they return at a later date)[19]. Due to the time-consuming nature of direct observation data collection often occurs in a cross sectional manner, making analysis of trends difficult. Additionally, data can only be collected with regards to more common conditions, as these make up the bulk of a provider’s cases. However the largest problem with direct observation as a method for collecting data is observation bias[31]. There is some evidence that providers will change their behaviours while in the presence of the interviewer even when they are unaware of the exact elements the interviewer is observing[19,32]. As such, direct observation may produce overestimates of quality.

Lack of blinding similarly affects the use of *vignettes*; hypothetical cases in which providers are presented with a set of symptoms for a theoretical patient[19,32]. Their mode of inquiry, diagnosis and proposed treatment are then assessed by an interviewer. Because the provider knows the case is theoretical, they are more likely to respond based on what they “should” do rather than what they actually would do. As a result, vignettes are limited in their ability to measure provider behaviours[32]. They are however a good method of testing provider knowledge and competence, particularly when combined with other interview based techniques[19].

A more sophisticated version of the vignette is the *standardised patients* method[19]. This approach involves the use of members from local community who have extensively trained in acting to present the same case to multiple providers. While the use of standardised patients overcomes many of the limitations of direct observation, its use is limited by the need for the conditions being assessed to have no obvious physiological symptoms and not require invasive exams for diagnosis. It is also not an acceptable method for studying childhood conditions. Combined with vignettes however they can provide a surprising amount of information regarding the 'know-do' gap. Das *et al* in particular note that in their studies of provider behaviours in India, the gap between provider knowledge as assessed by vignettes and provider action as measured by direct observation and standardised patients (see below) actually increases with provider knowledge[19]. In essence, the greater the provider's theoretical competence, the greater likelihood that they are not fully utilising their knowledge in practice.

The final method of collecting data on quality of care is through the use of *surveys* – particularly household surveys[41]. Surveys can be highly versatile, collecting information on client perspectives, information about their experience of care and reasons for health related decision making. Community surveys can also be used to indirectly obtain information that is difficult to collect directly from providers – caesarean rates for example are often not reported by all providers, but with a sufficient sample it may be possible to calculate based on women's reports[41] Additionally the ability of surveys to collect additional background information about the attributes of the respondent allows for greater discrimination between groups than facility based records and thus greater potential for the analysis of equity differentials. Survey based data is however prone to both recall and sampling bias[45,46] as respondents may not remember in detail actions which took place some time ago, and patients who had particularly severe conditions leading to either severe morbidity or death are unlikely to be accounted for within the sample.

2.3 What, specifically, does Maternal and Neonatal Quality of Care entail?

Conceptualisations of what defines quality of care, and the criteria used to determine the presence and absence of quality can, as noted in the previous section, vary considerably. Generalised quality frameworks such as the WHO quality standards[37,39] can be applied within the context of maternal and neonatal health, however there is still a need to not only understand, but also appropriately measure elements specific to these forms of care. The following sections provide examples of methodologies involving the conceptualisation and measurement of maternal and neonatal quality of care within LMIC settings.

2.3.1 Maternal Quality of Care

Historically efforts to improve maternal quality of care in LMICs have largely involved increasing access to emergency obstetric services. Two good examples of this focus are the PMM (Preventing Maternal Mortality)[47-49] and AMDD (Averting Maternal Death and Disability)[50-52] projects: PMM focused on referral hospitals in Africa during the 1990s while the AMDD projects took a district based approach in a diverse range of sites a decade later. As implied by the project names, the key quality related measure in these studies was maternal mortality. Unfortunately while general observations suggested that the study facilities did appear to be of higher quality (structural quality, while a key part of the strategy, was not directly measured), mortality did not uniformly improve[13]. Here the difficulty with relying upon only structural and outcome measures of quality becomes apparent – without measuring process indicators it is impossible to determine if the reason for the lack of impact on outcomes was due to poor technical competence leading to inappropriate care or poor patient satisfaction leading to lower use of facilities.

Criterion based clinical audits are a frequently used tool for improving the quality of obstetric care that require the measurement of process based indicators of quality[53,54]. Typically the criterion used to assess quality are based upon a set standard of care – an initial investigation is then undertaken to assess how many criteria are currently being met, strategies are designed to address the identified problems and after a period of implementation the criteria are re-measured. Quality is thus measured by compliance with criteria. A 2011 review by Pirkle *et al*[54] found while the number and quality of studies was somewhat limited, most reported significant improvements in compliance with criteria but there was little effect on maternal mortality, however this may have been an effect of small sample sizes. No studies compared criterion based audit against other methods of measuring quality of care, nor did any asses wider patient outcomes.

The emphasis on life-threatening conditions and Emergency Obstetric Care (EMOC) in such trials is also problematic, as the majority of women served by a facility will not experience pregnancy complications, and thus the overall quality of care provided by the facility to non-complicated cases remains unassessed.

One proposed methodology for assessing routine maternal care is the Skilled Birth Attendance Index (SBAI) proposed by Hussein and colleagues[55]. The SBAI, like criterion based audit, assesses the number of indicators of good delivery care each patient receives, however, the measurement method involves analysing facility based medical records. As a result many of the indicators reflect the presence or absence of particular information in the record itself and few direct process indicators are available. Those that are available, e.g. "routine oxytocic administered" or "blood pressure measured at start of labour" are clinically oriented, and omit many elements associated with patient satisfaction and acceptability of care.

As a more comprehensive example of a framework for examining maternal care, Hulton *et al*[41] defined quality as "the degree to which maternal health services for individuals and populations increase the likelihood of timely and appropriate treatment for the purpose of achieving desired outcomes that are both consistent with current professional knowledge and uphold basic reproductive rights".

As such, the criteria used to measure quality within this framework were comprehensive and fell into 10 elements separated into two categories: "provision of care" and "experience of care". "Provision of care" involved five subcategories; human and physical resources (relating to their functionality), referral systems, maternity information systems, use of appropriate technologies, internationally recognised good practice and management of emergencies. Experience of care included four domains; human and physical resources (relating to their acceptability), cognition, respect dignity and equity, and emotional support (see Table 2.3.1 for examples of specific criteria in each element). The list of indicators to be monitored was somewhat exhaustive, covering a wide range of structural, process and outcome elements, and requires multiple sources of information including facility records, provider interviews and direct observation.

When this framework was applied in urban India[56] the analysis was somewhat simplified (management of emergencies was not examined), however it provided a wealth of information regarding the services delivered in the study area. The authors found that quality was suboptimal across all 10 elements in both public and private facilities. In particular, they identified a lack of essential drugs, overuse of inappropriate procedures, users being left unsupported, evidence of physical and verbal abuse, and births occurring in hospitals without a health professional in attendance. They also noted equity issues, with religion, wealth and literacy all potentially appearing to influence the experience of care.

In an update to the framework[13] the authors recognised that the shifting understanding of what constitutes quality of care necessitated a regrouping of elements to better support quality improvement efforts: the increasing importance of accountability and dissemination of information to the community necessitated an additional element in the framework and several of the elements considered to be in the domain of provision of care were found to overlap with experience of care. The revised framework maintains the categories of “provision of care” and “experience of care”, however each category contains seven elements: human resources, infrastructure, equipment supplies and medicine, clinical practice (for “provision of care”) / respect cognition and equity (for “experience of care”), evidence and information, referral and networks of care. This updated framework was used to create an assessment tool for use in northern Nigeria, which found suboptimal levels of quality, particularly with regards to physical infrastructure. The authors also noted the difficulty in obtaining information on quality of care for even the tracer indicators used to construct the tool.

Table 2.3.1 Examples of Quality Criteria for Maternal Care Proposed by Hulton et al 2000

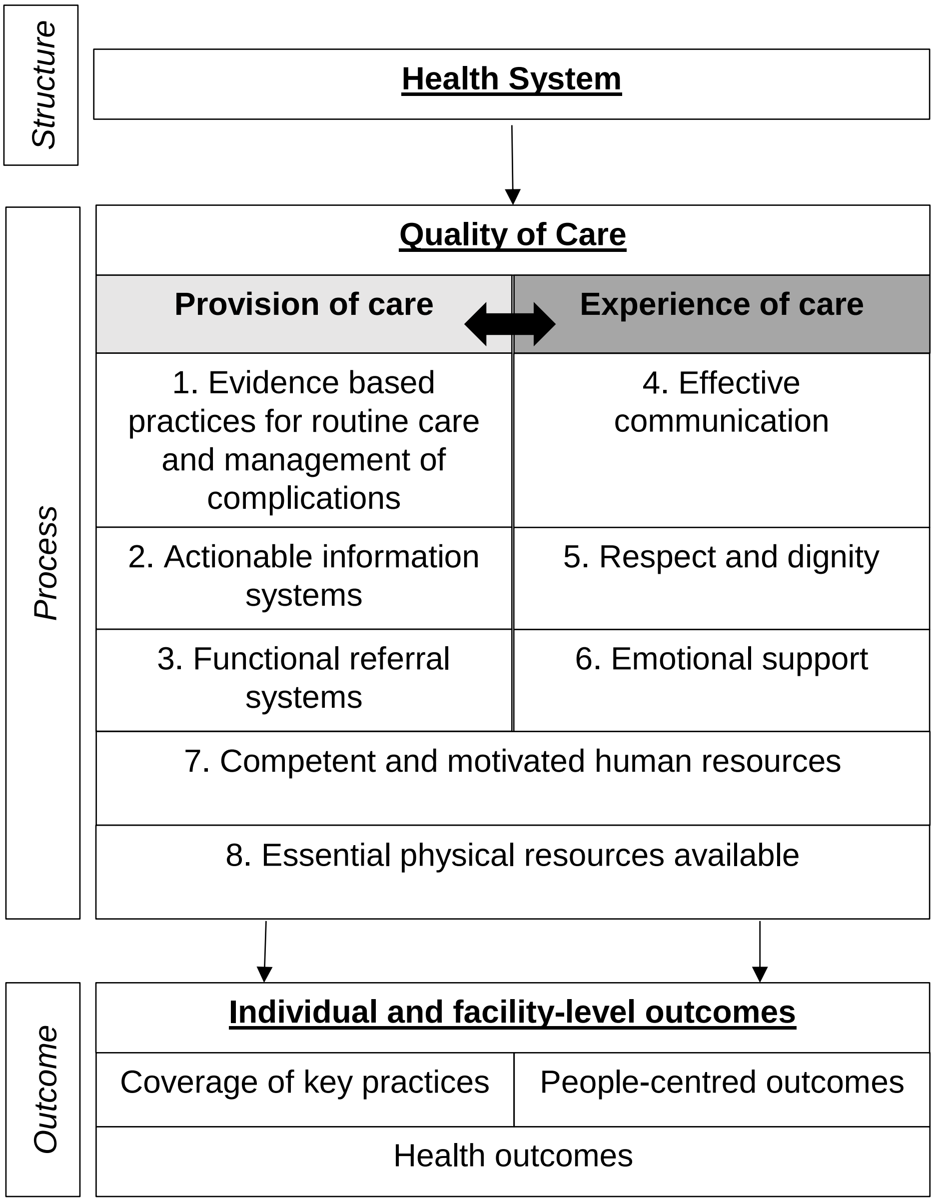
<u>Provision of Care</u>	
Human and Physical Resources • Skill mix is appropriate to cope with patient flow and the case mix of deliveries at the facility • General infrastructure of the facility is of sufficient size and state to cope with demand, and essential support services are reliable • Organisational and management structure of the labour, delivery and postpartum suite ensures most efficient use of resources • Staff always adequately protected from risks associated with their work	Management of Emergencies • Health workers of an appropriate level are trained in clinical skills to manage ante and postpartum haemorrhage, and oxytocics and IV fluids are available at all facilities, and blood transfusion services are available on a 24hr basis at comprehensive emergency obstetric care units • All women and birth attendants are aware of requirements for clean delivery, and health staff are able to recognise puerperal sepsis and manage it appropriately or refer. All facilities are able to provide necessary treatment for sepsis.
Use of Appropriate Technologies • The use of vaginal examination to assess the progress of labour is kept to the minimum necessary • Intramuscular oxytocin is not used to speed up labour • Use of Caesarean Section falls within reasonable limits • Effective pain relieve is always provided for operative procedures	Maternity Information Systems • Basic registers in facilities are designed to record data that is sufficient to monitor and evaluate activities effectively • Current procedures for recording information result in complete and accurate data entry • A review process is in place to ensure data is comprehensive and used effectively to improve patient management and service delivery
Referral Systems • Admissions procedure ensures timely examination and referral of a woman presenting with a complication • Reliable transport is available on a 24hr basis • Functional and reliable communication system enables staff to communicate with referral hospital of first choice to ensure that essential staff and equipment are available • A qualified member of staff is on call to accompany complicated cases to the referral hospital when necessary	Internationally Recognised Good Practice • Magnesium Sulphate is the drug of first choice to the treatment of eclampsia • Women are actively considered for vaginal delivery after one caesarean section • Women can adopt whatever position they choose for non-complicated deliveries • Women are always allowed the social support of their choice during labour and birth • A woman’s physical wellbeing is regularly assessed throughout labour

Table 2.3.1 Cont.

Experience of Care	
Human and Physical Resources • Physical infrastructure and overall environment of maternity ward is acceptable to all/most women • Contact time with qualified staff is sufficient • Staff are competent to provide appropriate care	Cognition • Necessary information is conveyed effectively in a language that is understandable to all women • All women are fully prepared for treatment and understand their options. Where possible they experience real informed choice
Respect, Dignity and Equity • All facilities have an individual responsible for assessing socioeconomic and cultural context of the catchment area and an effective mechanism for feeding relevant recommendations to providers • Cultural Practices that do not interfere with high quality care are respected • All women are treated with the same standard of care regardless of education, class, caste and age • Services are appropriately priced for the catchment	Emotional Support • Except in exceptional circumstances women are able to freely choose the social support they receive during labour and delivery • All women are treated with honesty, kindness and understanding • In the event of death or disability appropriate levels of professional and emotional care are made available to women and their families • All staff are aware of their supportive role in the provision of care

Most recently, this work has formed the basis of the WHO framework for improving Quality of Care for pregnant women and newborns[37], in which several of the elements within "Provision of Care" and "Experience of Care" have been restructured and placed within the Donabedian "Structure, Process, Outcome" model (see Figure 2.3.2). The WHO envisions this framework as becoming the shared understanding underlying future quality improvement initiatives targeting preventable mortality and morbidity in MNCH.

Figure 2.3.2 WHO Quality of Care Framework for Maternal and Newborn Health



While comprehensive, frameworks such as these tend predominantly focus on facility based deliveries, particularly at higher levels of care. Pitroff *et al* [57] make a point that in many countries it is impossible (and also not desirable) for all women to deliver in large hospitals, and that while the presence of a functional referral system is an integral part in delivery of quality maternal care, providing higher level care should not interfere with the delivery of “minimum care” at lower levels. As such quality of maternal care should also include indicators related to antenatal care (ANC), postnatal care (PNC) or care provided outside the hospital setting.

Table 2.3.3 Quality indicators used by Doubova et al 2014

Indicators of Quality of ANC	
Initiation and number of antenatal visits • Percentage of pregnant women who began ANC during the first trimester of gestation • Percentage of women with low risk pregnancy who at the end of the pregnancy had at least four ANC visits	Health education • Percentage of pregnant women who had documented educational activities provided by the maternity nurse or social worker • Percentage of overweight/obese pregnant women who had documented nutritional counselling provided by the nutrition service
Screening • Percentage of pregnant women who were referred to or had documented Rh and blood group test • Percentage of pregnant women who were referred to haemoglobin test during the first two ANC visits • Percentage of pregnant women who were referred to fasting plasma glucose test during the first two ANC visits and between weeks 24 and 28 of gestation • Percentage of pregnant women who were referred to obstetric ultrasound between weeks 18 and 22 of gestation • Percentage of pregnant women who were referred to VDRL test(syphilis screening) during the first two ANC visits	Treatment and referrals to the obstetrician-gynaecologist • Percentage of pregnant women diagnosed with bacterial vaginosis or trichomoniasis, who had vaginal metronidazol prescription in adequate doses and duration • Percentage of pregnant women with systolic blood pressure ≥ 140 mmHg, or diastolic blood pressure ≥ 90 mmHg who were referred to the second or third level of care • Percentage of pregnant women with pre-existing degenerative chronic disease (diabetes, hypertension, lupus, heart disease) who were referred to the second or third level of care • Percentage of pregnant women between 20–32 weeks with symphysis-fundal height 4 cm less than indicated by their gestational age, who were referred to ultrasound or another level of care
Nutritional supplementation • Percentage of pregnant women who had prescription of folic acid during the first trimester of gestation	

Doubova *et al*[57] investigated the possibility of using the electronic health records of family medicine clinics in Mexico City to evaluate the quality of antenatal care. The chosen indicators of quality were based on locally appropriate processes of care (see Table 1.3.2). It should be noted that while the included indicators strongly align with global standards or care. A number of indicators were excluded from the analysis due to either lack of local relevance (e.g. measles screening) or lack of available data (e.g. smoking cessation counselling). The study found that on average women only received 1/3 of the indicators of recommended care. Coverage of four or more ANC visits was the most prevalent indicator, and was much higher than many of the other indicators of quality. This is somewhat unsurprising as while number of ANC visits has been used as a measure of quality in other survey based studies[25,26,58], concerns have been raised about the potential lack of content within each visit.

2.3.2 Neonatal quality of care

Neonatal quality of care is rarely measured on its own; due to its close association with maternal delivery services, it is usually incorporated into studies that also examine maternal health services, in particular postnatal care. There is however a dearth of studies examining PNC in developing countries and the lack of evidence relating to newborn health is the subject of several recent calls to action[7,30,38,58].

In particular, Bhutta and colleagues[59,60] note that while interventions that result in improved neonatal outcomes are well known and present in the literature[61], far less is known about their prevalence and implementation in developing countries. As part of a series examining approaches to improving the quality of maternal and newborn care, a Donabedian based framework incorporating the WHO framework goals was used to examine at three levels of the health system: community, facility and district[38]. They note that the while there are many potentially beneficial strategies, standardised measures of quality are necessary to properly evaluate quality improvement efforts[59].

In regards to different health system levels there was little literature related to district and facility based strategies in LMICs[19,62]. In contrast studies of community based interventions related to strategies such as home visitation, community mobilisation and training of community based health workers showed improvements in neonatal outcomes [60]. Much of this evidence is however reliant upon outcome based measures of quality; the lack of process and structural indicators is one of the limitations mentioned by the authors.

Some structural indicators are however examined in the comprehensive needs assessment for newborn care published by Duysburgh *et al*[63]. Here the authors analysed newborn health policies, services and care in three countries (Indonesia, Laos and the Philippines) in order to explore options to improve newborn survival. They found that despite the presence of comprehensive newborn policies in all three countries, the quality of care provided at primary and referral level health services was poor. In particular they noted that many providers interviewed could not correctly provide information on essential newborn care and some facilities lacked necessary equipment for newborn resuscitation. While the study identified several other needs related to equity and accessibility, the need for better quality care was emphasised as a necessary step in decreasing neonatal mortality in these countries.

2.4 What are the gaps in the literature?

While there are a number of comprehensive frameworks and methods for assessing quality of care in MNCH, they generally rely upon the facility based records for data collection and focus on higher level care that may not be representative of community and primary level health services[19,59]. The need for information on quality of care at multiple levels of the health system[64], as well as the need to measure quality of care among disadvantaged groups[65] has been identified as a key impediment to quality improvement efforts in LMICs.

Another concern is that many existing techniques fall back on the use of structural and outcome based measures of quality, omitting process based measures which are not only necessary to examine how health system elements interact[65] but also important to how quality of care is perceived by patients[66].

This study will investigate the use of Demographic and Health Surveys to provide a primarily process indicator based measure of quality of care. While not capable of capturing all aspects of quality, particularly those relating to qualitative aspects of care, this would offer the opportunity to examine quality of care in new ways that complement existing methods.

The following chapters will outline the methods used to create a "Quality Index" (QI), as well as providing examples of its use to examine patterns in quality of maternal and neonatal care for three Southeast Asian countries.

3 Methodology

As this is the first attempt to utilise standard DHS data to measure quality of maternal and neonatal health care, the development of an appropriate methodology to achieve this goal is in itself one of the major results of this study. An earlier version of this methodology, as well as the preliminary results of its trial using a single DHS dataset was adapted for publication in 2016[67] (see Appendix 1), however there have been substantial modifications to the process since. This chapter outlines the background for, and final form of, the methodology used to create and test the construction of the "Quality Index" (QI) as well as performing the equity based analysis of quality of care.

The research broadly comprises of three substantive parts. First is the development of a methodology to measure quality of care using DHS data and the trial of this methodology using a single country data set to test the feasibility of the process. The results of this initial testing are more fully covered in Chapters 4 and 5, however this chapter will start by outlining the methodology used to select an appropriate dataset for testing, identify potential indicators of quality care and combine these indicators into a single measure for use in further analysis. The methods used to test the validity, robustness and internal coherence of the resulting QI will also be covered.

The second element of this research involves the use of the QI to undertake an equity based analysis of trends in quality of care for a selected group of Southeast Asian countries that have experienced rapid expansions in access to health care, but for whom there is limited information on the quality of care provided. The focus on assessing the quality of services received by different sub-populations within each country provides insights into the strengths and limitations of current health systems. This chapter will therefore also discuss the methods used to identify additional datasets and equity markers for analysis.

Thirdly, this research will examine the feasibility of extending within-country measures of quality of care to allow for direct comparisons across countries. This allows not only for the possibility of benchmarking and identification of high and low performing countries for additional research, but also provides additional context in which to understand cross country trends in the determinants of quality of care for maternal and neonatal health. The methods used to create and examine cross-country QI are thus the last aspect discussed in this chapter. Unless otherwise noted, Stata 13 statistical software was used for all data analyses.

Together this represents a novel approach to utilising existing data to examine equity based trends in quality of maternal and neonatal care, which while not as comprehensive as specifically targeted data collection, will nevertheless offer some level of understanding in currently data deficient contexts.

3.1 Constructing a measure of quality of care

The majority of existing methods for measuring quality require some form of primary data collection either through synthesis of facility records, performance of direct monitoring or administration of tailored surveys and interviews (see Section 2.2). The application of these methods may be both expensive and time consuming, particularly if a large, representative sample is desired. Consequently, national level monitoring of trends in quality is all but impossible in many LMIC settings. The use of existing population surveys such as the DHS to create composite indicators of quality of care represent the potential for wide scale monitoring of quality for little or no marginal cost.

3.1.1 Overview of DHS surveys

The Demographic and Health Survey (DHS) program is an international effort designed to collect accurate, nationally representative data on health and population in developing countries through the use of household surveys[68]. The program has been active since 1984, and has conducted surveys in over 90 countries in Africa, Asia, Latin America and the Caribbean.

The survey itself consists of household interviews, supplemented by the collection of biomarkers and geographic information related to the household. Early surveys contained two questionnaires – a household questionnaire administered to the head of the household, and a women’s questionnaire administered to all ever married women of reproductive age in the household. This was sufficient to provide basic demographic and fertility data; however the program has since expanded the number and scope of topics explored. The most recent surveys consist of three questionnaires (household, all women of reproductive age, and selected men of reproductive age) covering a wide range of topics from maternal and child health to women's empowerment and attitudes towards HIV/AIDS, as well as the collection of biometric data used to estimate the prevalence of conditions such as anaemia, high blood pressure, HIV and malaria.

MNCH related indicators are primarily drawn from the women's survey, where women with a live birth in the last 3 or 5 years (depending on the interval between surveys) are asked a series of questions about healthcare received during pregnancy, birth and within the first five years of the child's life. The majority of ANC and Birth related questions were only asked with regards to the lastborn child, however questions related to post-neonatal interventions such as immunisation and diarrhoea treatment will be asked with regards to all living children under the age of five.

Typically, households are chosen based on a two stage cluster design, whereby enumeration areas drawn from census files are used to obtain a large sample of households that are representative at national, rural, urban and regional levels. Sample weights are then used to adjust for over and under-sampling as well as different response rates in different regions. As a result, the DHS can compare estimates of key demographic and health indicators across different subgroups and equity markers.

Additionally, the DHS survey methodology is standard to all surveys conducted by the program, following identical sampling, data collection, calculation, and tabulation protocols. While individual surveys may be tailored to the specific needs of a particular country by adding or removing particular sets of questions (modules), each survey will share a core set of questionnaires, which are reviewed and updated approximately every five years. As a result of the modular nature of the survey, the indicators generated by DHS surveys can be reliably compared across countries, and, in countries that regularly conduct these surveys every 3 to 5 years, over time.

These features of the DHS make them a major source of data on maternal and child health within developing countries. In particular, the estimates of maternal and child mortality, nutrition and intervention coverage drawn from DHS surveys often form the basis of national policymaking with regards to MNCH. As such, DHS surveys have great potential in relation to the estimation and monitoring of quality of care should it be feasible to derive such estimates from the available data.

3.1.1.1 Prior use of DHS for measurement of quality of care

One major limitation of using DHS data for the estimation of quality of care is that the survey is not primarily designed to collect data related to the functioning of the health system. The population based design of the survey that makes it appropriate for measuring the coverage of health services unfortunately equally makes the identification of specific health practices provided by such services difficult.

Recall bias and the lack of independent verification from medical records would be problematic enough; however the DHS also has only a limited number of questions related to the timing and content of maternal and child health services. Additionally, the DHS tends to focus on primary and preventative services such as ANC, use of a Skilled Birth Attendant (SBA) and immunisation – the calculation of coverage of more complex services such as EMOC, treatment of childhood pneumonia and Prevention of Maternal To Child Transmission of HIV (PMTCT) is hindered by the need for a medical diagnosis and survivorship bias within the sample.

As a result of these data limitations, the only published studies related to quality of care based on DHS datasets have focused solely on ANC, for which the number of questions asked about the type of care received has increased since the introduction of the Phase 5 questionnaire. For example, Mbuagbaw *et al*[28] proposed a combined measure of antenatal care based on the 2004 Cameroon DHS of "at least four visits, first visit in first trimester, last visit in third trimester and a professional provider of antenatal care".

In contrast, Kyei *et al*[27], using the 2007 Zambia DHS, defined "good quality ANC" as attending at least 4 ANC visits with a skilled health worker (with the first visit occurring in the first trimester), and receiving more than 8 of the following elements: weight measured, height measured, blood pressure measured, urine sample taken for analysis, blood sample taken for analysis, voluntary counselling and testing for HIV offered, iron supplementation provided, antimalarial drug provided for intermittent preventive treatment for malaria in pregnancy (IPT), birth preparedness plan discussed, treatment provided for intestinal parasites, and tetanus toxoid vaccination.

Similarly Joshi *et al*[26] using the 2012 Nepal DHS defined good quality ANC as "blood pressure measurement; urine tests (assumed to be used for detecting bacteriuria and proteinuria); blood tests (assumed to be used to diagnose conditions such as syphilis and anaemia); and provision of iron supplementation, intestinal parasite drugs, tetanus toxoid injections and health education" – attendance at four of more ANC visits was considered as a separate element, which the authors found was correlated with the content of visits. Additionally, by excluding "ANC from a skilled provider" as an indicator of quality, the authors were able demonstrate that skilled providers were associated with women being provided quality care. This separation of service use and provider type from the underlying metric of quality is an important consideration, as without this separation it is impossible to test underlying assumptions about "skilled" versus "unskilled" providers.

While the quality of ANC is undoubtedly an important measure of MNCH, it is not in itself sufficient as a way of monitoring quality. With a large proportion of maternal and neonatal deaths occurring during the perinatal period[58,59], any measure of routine MNCH care must include indicators related to delivery care. An ideal measure would also include information regarding routine childhood care.

3.1.2 Dataset selection

As previously mentioned, the DHS is limited in the availability of data related to the type and timing of care. For example, while a child's immunisation status is available for most DHS, the timing of each immunisation is only available for children with complete vaccination cards. Similarly, for a long time the only indicators available with regards to delivery care were coverage of SBA and Facility Based Delivery (FBD). Both these indicators make assumptions about the provision of good quality care by particular providers, limiting their use.

With the introduction of the Phase 6 DHS questionnaire, several additional variables related to the timing and content of particular actions during pregnancy and in the immediate postnatal period were included in the survey design. These questions were asked with regards to the last pregnancy experienced by all women with a live birth in the past five years. It is these questions that were used to create quality of care measure associated with routine pregnancy and delivery care, initially for the Indonesia 2012 DHS dataset and then for a selection of other Asian countries.

3.1.2.1 Sample selection and plan for missing data

The sample was limited to women of reproductive age with at least one live birth in the past five years since, as previously mentioned, this is the sample used to derive estimates of MNCH coverage. For all indicators only the most recent live birth was considered. Due to difficulties in reconciling different populations at risk, childhood healthcare was omitted from the analysis, and the unit of observation will be the mother and lastborn child with the postnatal experience of the child will be considered as a continuation of the mother's experience during pregnancy and birth. Where possible, indicators were transformed into binary variables taking a value of either 0 (not present) or 1 (present).

Following the standard statistical practice of case-wise deletion, observations with missing data for any of the indicators were excluded from the analysis. This method is however known to be quite sensitive to the presence of non-random missing values, particularly when the number of cases with missing data makes up more than a small faction (~5%) of the total[69] In order to minimise the impact of missing observations, particularly from under-sampled areas, a combination of mean estimation and assumptions based on prior knowledge regarding the nature of the survey were used to impute additional data for some variables:

1. For variables related to yes/no questions, a response of “don’t know” was treated the same as a “no” response, under the assumption that with regards to medical procedures a lack of recall is more likely to occur in the absence of a service rather than the reverse. This assumption does potentially increase the risk of recall bias affecting the sample, and creates a more conservative estimate, however unless there is a large proportion of cases where this response is prevalent it is unlikely to have a major effect on the overall validity of the sample. For the purposes of this analysis, if more than 5% of responses for a given indicator fall into this category chi-square tests were used to determine if these responses significantly varied from non-missing with regards to key demographic factors. If there was substantial bias in the make-up of the missing responses, or if more than 20% of responses fall into this category than the indicator would be dropped.

2. For indicators where a quantitative value such as timing or quantity of service provided is missing or coded as “don’t know” , but other variables indicate that the service did occur, the observation was given the mean value of the quantitative variable. This approach is less likely to exclude observations for which recall bias hinders accurate quantification and is unlikely to be problematic unless a large proportion of observations are missing this data. As with the “don’t’ know” responses, chi-square tests were used to examine the demographics of the affected observations, and the variable dropped as necessary.

In general the application of these imputation rules prevented large numbers of cases from being dropped from the analysis as the result of missing data for a small number of variables.[i]

As mentioned above, the potential for non-random distribution of missing data may result in the introduction of bias into the dataset [69]. As the DHS are designed to provide a representative sample of the general population, the deletion of observations may affect the validity of the conclusions if missing variables are associated with either an underlying demographic factor (such as age) or one of the equity categories of interest (such as wealth). To test for such issues, several steps were undertaken on each dataset.

Firstly the total proportion of observations missing any variables was considered. If the fraction of observations with missing or imputed data was less than 5% of the sample, then the dataset was considered to have a low chance of bias. Otherwise the non-missing, imputed and dropped observations were compared across demographic factors using chi-square tests in order to identify potential sources of bias. If there were substantial differences between the groups, and the proportion of the sample affected is such that representativeness of the sample was affected, then the dataset would be dropped.

Secondly, in addition to the main analysis performed on the non-missing and imputed observations, an additional sensitivity analysis was performed for the test dataset based on only the non-missing observations. The results were compared to see if the omission of the imputed observations significantly affects the results. Should the impact of the imputed observations be substantial, then the dataset would be dropped.

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[i] In the preliminary analysis of the 2012 Indonesia dataset, these rules prevented 1917 observations (or 12.6% of the sample) from being dropped from the analysis. The majority of these observations were missing data for less than three variables, and were predominantly the result of “don’t’ know” responses for quantitative questions.

3.1.3 Defining the choice of indicators

As previously established there are multiple and conflicting definitions of quality in maternal and neonatal care. To create a series of indicators to measure quality of care a standard to represent "quality care" is required. As standard DHS do not contain questions related to patient satisfaction, or to health inputs or outcomes, the definition of quality to be used for this analysis by necessity must be based on process indicators representing actions taken during contact with the health services in question.

The WHO Standards for Improving Quality of Maternal and Newborn Care in Health Facilites[39] is a recently compiled comprehensive set of standards regarding quality of care based upon the WHO framework that frames quality as "the extent to which health care services are safe, effective, timely, efficient, equitable and people-centred"[37]. Unfortunately many of these standards relate either to the practice of emergency obstetric care at the time of delivery or to facility based elements that fall outside the scope of the DHS questions. It has also been noted that some key elements of preventative care during the antenatal and postnatal period are not clearly incorporated into the standards in their current form[40].

As a result, indicators were instead identified based on the recommended actions outlined in the WHO's Integrated Management of Pregnancy and Childbirth (IMPAC) guidelines[70]. These guidelines are designed to outline essential practices for routine management of maternal and neonatal care by front line health staff. As such, they provide an objective, albeit heavily service oriented, framework on which to base indicator selection, given the limitations of the dataset, that aligns with the current evidence base[3] regarding best practice in maternity care.

3.1.3.1 Indicators chosen for the analysis

As the modules included in the DHS may be subject to country specific needs, the exact indicators used in each country's analysis may differ. The following sections detail the indicators included in the core DHS 6 questionnaire; those included in HIV and Malaria endemic areas; and additional indicators that have been included in recent DHS not covered in the standard questionnaire.

A summary of potential indicators available in typical DHS questionnaires are provided in Tables 3.1.1, 3.1.2 and 3.1.3, with the following subsection providing an example rationale for each indicators use. The final selection of indicators for inclusion in each country's analysis will vary depending on availability and relevance; however a standard set of indicators will be used for the cross-country analysis. As such, at least two indicator sets will be constructed for each country; a "Core DHS" set, representing the standard indicators collected across all countries, and a "Country Specific" set that encompasses all eligible indicators within the dataset.

There are thirteen potential quality indicators available in the core DHS questionnaire, seven relating to ANC and six relating to birth and delivery care.

The first potential indicator relates to the number and timing of ANC visits. According to IMPAC guidelines, pregnant women should ideally have a minimum of 4 ANC visits, starting with at least one visit in the first trimester, one in the second trimester, and at least two in the third trimester. As the total number of visits may better reflect coverage rather than quality, the chosen indicators instead represent the presence or absence of appropriately timed visits. However, in the core DHS questionnaire, timing of ANC visits is only asked in regards to the first ANC visit- the final indicator thus makes the assumption that a correctly timed first visit is itself an indicator that additional visits also occurred at appropriate intervals.

Table 3.1.1 Potential Quality Indicators based on Core DHS questionnaire

Indicator	**DHS recode VI variables**
At least 1 ANC visit in 1st Trimester	m14_1 (# of ANC visits) m13_1 (Timing of 1st visit - months)
Blood Pressure measured during ANC	m42c_1
Urine sample taken during ANC	m42d_1
Blood sample taken during ANC	m42e_1
270+ days of Iron Supplementation during pregnancy	m45_1 (ever taken iron supplements during pregnancy) m46_1 (days of iron supplementation during pregnancy)
Fully protected from Tetanus during pregnancy	m1_1 (number of TT injections this pregnancy) m1a_1 (number of TT injections prior to this pregnancy)
Told about pregnancy complications during ANC and where to seek help	m43_1 (Told about pregnancy complications) m44_1 (Told where to go for complications)
Baby was weighed at birth	m19a_1
Baby was breastfed within 1 hr of birth	m4_1 (Baby ever breastfed), m34_1 (Time after birth baby first breastfed)
No liquids given before milk began to flow (no prelacteal feed)	m4_1 (Baby ever breastfed), m55z_1 (First 3 days, given nothing (but breastmilk))
Maternal postnatal check within 2 hrs of delivery	m50_1 (Mother received checkup after delivery), m51_1 (Timing of mother's checkup after delivery)
Neonatal postnatal check within 2 hrs of delivery	m70_1 (Baby received checkup after delivery), m71_1 (Timing of baby's checkup after delivery)
Mother received postpartum Vitamin A within 2 months of delivery	m54_1

Another group of indicators relate to the actions undertaken as part of the ANC process. In particular, the DHS asks about whether particular diagnostic tests were provided to the patient. These include whether or not the patient's blood pressure was checked (used to screen issues related to high or low blood pressure), if a blood sample taken (to screen for various conditions such as anaemia and HIV) and if a urine sample taken (to screen for conditions such as pre-eclampsia and some STDs). These tests are indicative of specific provider actions that should be undertaken in every pregnancy as part of good quality care, regardless of the presence or absence of other maternal risk factors.

In addition to these diagnostic tests, the DHS also collects information about preventative care in the form of iron supplementation and tetanus immunisation during pregnancy. These questions were asked of all women regardless of whether or not they sought ANC, however they are a critical component of good quality ANC. Two more indicators are based on this set of questions.

According IMCPAC guidelines, all women should be routinely taking Iron/Folic Acid (IFA) supplements once daily until 3 months post-delivery. The DHS asks if iron supplementation was taken during the pregnancy, and if so, for how many days was it taken. While the standard for "best quality" coverage according to IMPAC guidelines is 270 days or more of supplementation, this is not always feasible given delays in the diagnosis of pregnancy and beginning of antenatal care. It is possible however that lower levels of coverage may still represent a non-ideal, but still beneficial definition of "quality". To explore the potential role of "partial" levels of quality several categories of iron supplementation were included in the initial analysis to allow for comparison between groups. The IMPAC guidelines recommend that three months of supply be provided at each antenatal visit, and additional categories used for the analysis were thus: Less than a month of iron supplementation, 1-3 months of iron supplementation, 3-6 months of iron supplementation and 6-9 months of iron supplementation. Examination of the association between these categories and other indicators, as well as practical considerations regarding the provision of supplements in Southeast Asian contexts were then used to decide upon the final definitions used to construct the QI.

To prevent tetanus IMPAC recommends that a woman should receive at least 5 Tetanus Toxoid (TT) vaccine doses over a minimum 3 year period (3 in first year and one each in year 2 and 3). In practice, this means for women who have never received TT prior should receive at least 2 doses during their pregnancy, women with less than 5 doses in total should receive at least 1 dose during pregnancy and women with 5 doses do not need further immunisation. This definition does differ slightly from the standard DHS algorithm for determining tetanus protection, however for consistency IMPAC definitions were used. As with Iron supplementation, it is possible that there may be some effect of partial coverage, and as such the following categories were used in the analysis: full protection (received 2 or more TT in this pregnancy, or received 1 TT this pregnancy and at least 1 TT prior, or received at least 5 TT prior to this pregnancy), partial protection (received 1 TT this pregnancy with none prior, or received no TT this pregnancy but 1-4 doses prior) and no protection (no TT).

As well as providing clinical elements of care, ANC is considered a particularly important opportunity to advise expectant mothers on relevant issues that may arise as a result of their pregnancy. The content covered as part of an ANC visit may vary depending on local conditions; however one of the most important issues to cover is potential warning signs that may indicate a problem with the pregnancy. The core DHS includes a question asking if women were told about potential signs of pregnancy complication, and, in some surveys, if they were also advised about where to seek treatment. This question regarding warning signs is the only indicator regarding advice provided by health staff during ANC that is available as part of the standard DHS. While it is far from comprehensive, it does at least provide some indication that discussion of appropriate pregnancy care has occurred.

One major limitation of the standard DHS questionnaire is the lack of questions regarding actions taken during the delivery itself (although this may change in future revisions)[ii]. Instead, the following indicators reflect actions taken immediately following the delivery. The first of these relates to the child's birth weight. Weighing the newborn to determine if it is low birth weight is an important step in determining the health of the baby after birth – low birth weight (LBW) may be an indicator that additional supportive care is required. The DHS collects information about whether or not the baby was weighed at birth and it has been included as an indicator of quality care in the analysis as the identification of LBW is one of the key steps outlined in the IMPAC guidelines for immediate newborn care.

IMPAC guidelines also recommend that breastfeeding be initiated within one hour of delivery, and that no prelacteal feed[iii] should be given in order to provide the maximum health benefit. While decisions regarding infant feeding ultimately rest with the mother, good quality care should include appropriate advice and support for breastfeeding. Inappropriate breastfeeding may be indicative that the support provided at the time of delivery was inadequate. It is for this reason that breastfeeding initiation and exclusivity for the first three days are included as the second and third birth related indicators.

The final group of indicators relate to the postnatal care received by mother and child. According to IMPAC both the woman and baby's health should be monitored throughout the birth with the first (formal) examination occurring at least one hour post-delivery, with further check-ups until discharge (which should not be for at least 12 hours post-delivery). The DHS however only records the timing of the first reported health check - a mother who was checked immediately post-delivery as part of the birth monitoring may also have been checked more formally after the first hour. In terms of mortality, the most dangerous period of time is the first couple of hours following the birth. For this reason "good quality" has been defined as having had a check-up within two hours of delivery. As the DHS collects information on both maternal

[ii] While some DHS may carry information about sterile birth practices and temperature control, the inclusion of these questions are non-standard and they are not always asked of facility deliveries

[iii] This denotes the provision of non-colostrum liquids such as water or sugar water within the first three days following birth, before breast milk starts to flow regularly.

and neonatal check-up these questions will be treated as two separate indicators.

Ideally both a maternal and a neonatal check should have occurred within the first two hours, however as with other quantitative indicators, additional categories have been included in the analysis representing lower levels of quality in order to provide a more thorough exploration of the issue. The categories used initially were: check-up 3-12 hours post-delivery, check-up 13-24 hours post-delivery, and check-up 49 or more hours post-delivery. The same categories were applied to both maternal and neonatal indicators

The last indicator for PNC is whether or not the mother was provided with a postpartum dose of vitamin A. Supplementation ideally occurs soon after delivery as a preventative measure to support maternal health during the postpartum period. There is no information regarding the timing of the dose in the DHS, only whether or not it was given within two months of delivery. Given the paucity of postnatal indicators in the standard DHS dataset, this indicator is an important representation of content within PNC visits, which is often missed when looking only at the timing of care.

In addition to the core DHS questionnaire, countries with a high HIV or Malaria prevalence often include additional modules covering programs designed to address these diseases as part of ANC and delivery care. Six potential disease specific indicators were identified, one related to malaria prevention during pregnancy, four related to HIV testing and knowledge and one related to treatment for intestinal parasites.

In areas of high malaria transmission it is recommended that, during pregnancy, women receive Intermittent Preventative Therapy (IPT) for malaria. The appropriate regimen may vary depending on the species of malaria present and the level of drug resistance in the area. Thus good quality ANC should include a locally appropriate regimen for malaria treatment and prevention.

Table 3.1.2 Potential Quality Indicators based on additional modules in DHS questionnaire

Indicator	**DHS recode VI variables**
Received IPT during pregnancy to prevent malaria	m49a_1 (During pregnancy took SP/Fansidar for malaria) - m49y_1 (took no drug for malaria)
Offered AIDS test prior to delivery	v839 (Offered AIDS test during ANC) v839a (Offered HIV test between time went for delivery and before baby was born)
Advised about AIDS transmission from mother to child during ANC	v838a
Advised about things to do to prevent AIDS during ANC	v838b
Advised about getting tested for AIDS virus during ANC	v838c
Took drugs for intestinal parasites during pregnancy	m60_1

In countries with a high prevalence of HIV, it is recommended that all women be offered voluntary counselling and testing regarding HIV during ANC. This initially involves the provision of advice about the transmission of HIV, advice about prevention of HIV and advice about the need for HIV testing. Good quality ANC should involve counselling on all these topics. HIV testing should also be offered as part of good quality ANC as early detection will allow for the timely initiation of PMTCT if it is required. Women who are not tested as part of ANC should be offered a test when they arrive for delivery – this would be treated as a category of lower quality.

While deworming is technically included in the core DHS questionnaire, the process is not a standard part of ANC in all countries, and has been excluded from at least one eligible survey[iv]. For this reason this indicator is included in

[iv] Indonesia 2012 DHS

the disease related category of indicators, as when it is present it is another indicator of appropriate ANC.

The decision to include or exclude disease specific indicators was made based on country specific factors such as disease prevalence and/or national health policy. In particular, if the indicators were not relevant for all regions within the country, or recommended courses of care varied by location then the indicators were excluded. This ensured that the resulting index will not reward inappropriate care or penalise observations that did not require care in the first place.

As the DHS collects data for a 3-5 year period, it is possible that disease specific guidelines may have changed at some point during the recall period. If this was the case, a decision on the appropriateness of conducting an additional analysis on a time restricted sample was made based on the potential effect of the reduced sample size and the importance of the policy change.

For countries who wish to examine particular health issues not otherwise covered by existing DHS modules, additional questions may be inserted into the questionnaire. As these questions may be specific to only one DHS, their inclusion must be considered on a case by case basis. Where possible, IMPAC guidelines were used to determine eligibility of indicators, however national guidelines were also considered in order to best reflect local definitions of quality care. The following section provides an example of questions included specifically in the Indonesia 2012 and demonstrates the types of questions that may be available. Each additional survey was screened for such questions individually in order to include them in the analysis, and a rationale for their inclusion is included in the country analysis where relevant.

Table 3.1.3 Potential Quality Indicators Specific to Indonesia 2012 DHS questionnaire

Indicator	**DHS recode VI variables**
At least 1 ANC visit in 2nd Trimester	s412bb_01 (# of ANC visits in 2nd Trimester)
At least 2 ANC visits in 3rd Trimester	s412bc_01 (# of ANC visits in 3rd Trimester)
Weight measured during ANC	m42a_1
Height measured during ANC	m42b_1
Stomach examined during ANC	s413f_01
Consultation during ANC	s413g_01
Received MNCH book during ANC	s409b_01
Discussed place of delivery during pregnancy	s414ba_01
Discussed transportation to place of delivery during pregnancy	s414bb_01
Discussed who would assist delivery during pregnancy	s414bc_01
Discussed payment for delivery during pregnancy	s414bd_01
Discussed possible blood donor during pregnancy	s414be_01

In addition to questions regarding the initiation of ANC, the Indonesia 2012 DHS also included questions about the number of ANC visits occurring in each trimester. As a result, two additional indicators (at least one visit in 2nd trimester; at least two visits in 3rd trimester) may be included in the analysis. An additional category of “1 visit in 3rd trimester” was also be included as a lower quality measure for the initial testing of methodology.

As well as questions about blood pressure, urine and blood testing during ANC, the Indonesia 2012 DHS included questions about whether the patient’s weight and height were measured, if the stomach was examined, if a consultation[v] was given and if the patient was provided with a "MNCH book" to keep track of health visits. These actions represent specific aspects of ANC considered by the Indonesian government to be representative of national guidelines regarding good quality care. For this reason they were included as indicators in the analysis.

Another Indonesia specific set of indicators is the set of questions regarding birth preparedness. These questions ask if the respondent discussed issues such as place of delivery, transportation, birth assistance, payment for delivery and blood donation with anyone during her pregnancy. Ideally, these issues should be brought up as part of ANC advice and discussed with both the health provider and immediate family. If the woman does not report having discussed these issues, then she has not received the best possible ANC care. For this reason these questions as indicators might be included.

The Indonesian dataset did not provide additional questions regarding the birth and postnatal phases of care, however if it had, similar guideline based judgement would have been used to determine eligibility for inclusion in the final indicator sets.

3.1.4 Construction of a Quality Index

In order to provide a meaningful analysis of quality of care based on the available indicators, it is necessary for these indicators to be summarised into one quantitative variable. However, the construction of such an index may be complex, with different methods requiring different assumptions about the nature to the underlying data. Consequently, each of these methods is accompanied by different limitations with regards to the conclusions that may be drawn from the analysis. The following sections outline the background and final considerations that guided the methods used to construct the QI from individual quality indicators

[v] The definition of consultation used in the questionnaire is somewhat vague, and based on contextual factors the assumption is that it represents a one-on-one discussion with a provider regarding the pregnancy.

3.1.4.1 Background to the use of composite indicators

The use a composite index[vi] to provide a representation of a diverse range of indicators is an accepted practice within the development literature[71]. Well known examples include the Human Development Index and the Corruptions Perceptions Index. Within MNCH the use of composite indicators has been rather limited, with separate health related measures such as mortality rates or intervention coverage being considered on an individual basis. More recently the Countdown to 2015 provided a Composite Coverage Index representing a weighted average of eight interventions (Met need for family planning, ANC, SBA, Measles vaccination, DTP vaccination, BCG vaccination, coverage of oral rehydration therapy for diarrhoea and antiretroviral treatment for HIV) along the MNCH continuum of care as part of its country profiles[72]. An additional co-coverage index represents the proportion of individuals receiving all eight interventions. These measures are typically derived from DHS survey data and have been used to examine inequities in health within the countries profiled.

With regards to quality of care in MNCH, composite indicators have rarely been used. In previously mentioned studies of ANC quality[26-28] based on DHS data, the prevalence of quality indicators was compared individually, with no aggregate measure. Indeed the majority of quality of care studies, including those based on non-survey data, opted to examine a small number of indicators separately rather than consolidating them into a single index. An exception to this trend occurs when quality is measured as adherence to a specific set of guidelines that apply to all individuals in the study. For example, the "Skilled Attendance Index" proposed by Hussein and colleagues[55] assigned each delivery in the study a score representing the percentage of 43 predetermined criteria met by that delivery (based on facility records). Four additional criteria were included for subgroup analysis of complicated

[vi] A composite index is formed by averaging together a number of individual measures in order to provide a single measure representing the overall performance of the particular area being investigated. In this case, a number of individual measures of quality of care for different maternal and newborn services will be averaged together to provide an overall measure of quality of care for maternal and newborn care in general.

deliveries. In this manner the authors were able to estimate minimum, maximum and mean scores across a range of facility and birth attendant types, as well as more complex figures, such as the proportion of cases with more than 75% of criteria met. Here the large number of criteria made the use of a simple index both useful and necessary; however it is not known how reliable such an index may be using the much more limited DHS data.

The DHS is however the source of a composite index commonly employed in MNCH studies; the Wealth Index is a composite measure used to estimate a household's wealth from survey data where Household Income and Household Consumption Expenditure cannot be directly measured[73]. The index was devised following the 1997 World Health Organization conference "Health Equity for All in the New Millennium" where the need for a way to monitor and measure health equity based on DHS data was raised. Based on the assumption that wealth can be considered as an underlying unobserved variable, the wealth index uses that pattern of observed indicators that are associated with a household's relative socioeconomic position to rank households. The indicators used frequently include ownership of household assets such as radios, television and vehicles, as well as services such as household water supply and sanitation facilities.

In an early test of the validity of the Wealth Index Pritchett and Filmer[74] used India's 1992-93 National Family Health Survey[vii] to examine the relationship between educational enrolment and the wealth index. The wealth index results were found to correspond to State Domestic Product and poverty rate data collected from external sources. The authors further examined data from three additional countries using the World Bank's Living Standard Measurement Surveys which collected data not only on asset ownership, but also household consumption expenditures. They concluded that the wealth index actually performed better than the traditional consumption expenditure index in explaining differences in educational attainment and attendance. Since then the wealth index has become the primary measure used to estimate

[vii] Which utilises very similar methodology to that used in the DHS.

socioeconomic status in DHS data. The methodology used to create the wealth index thus provides a sound starting point on which to base the creation of a Quality Index for MNCH.

3.1.4.2 Weighting in Composite indicators

Perhaps one of the most important considerations in the construction of any composite index is the use of indicator weights to determine the final score. The simplest option is to apply equal weighting, where all indicators contribute equally to the index and the final score is a simple average of all indicators. The "Skilled Attendance Index" mentioned above provides an example of such weighting. It also demonstrates one of the major disadvantages of the method – using equal weighting the provision of routine oxytocics contributed the same amount to the index as recording that the patient had started labour. While ideally these are both a part of good quality care, from a health perspective the provision of necessary drugs is more likely to have a greater impact on maternal and neonatal outcomes.

More commonly, composite indicators will separate indicators into theoretically derived sub-components before applying equal weighting[71]. The Human Development Index for example divides its six indicators into three component areas – life expectancy, income per capita, and skills and knowledge. While the first two components each have only one indicator, the skills and knowledge component consists of four indicators (adult literacy, primary school enrolment, secondary school enrolment and university enrolment). Each component carries equal weight, meaning that the four education variables will each carry 1/4th the weight of the life expectancy and income per capita variables.

A more complex method is to apply differing variable weights – however here difficulty arises when deciding the exact weight to apply to each variable. Most attempts to determine the relative importance of different indicators have relied upon modified Delphi techniques – essentially multiple rounds of consultation with nominated experts[71]. The weighting derived from this method does tend to be subject to the biases of the experts consulted – consultation of obstetricians, for example, may lead to clinical measures being emphasised while consultation of patients may bolster measures of client-provider interactions.

Another, more data driven method of deriving weights is through the use of a statistical analysis of the dataset itself. The most commonly used technique creating these data derived weights is Principal Components Analysis (PCA). Examples of indexes using PCA derived weights include the Wealth Index [73] and the Indices of Social Development[71].

PCA as a technique is derived from Factor Analysis (FA): a multivariate statistical technique designed to identify underlying processes that have resulted in correlation between variables. In essence, it uses the correlation between multiple variables to determine the presence of coherent subsets of variables that may collectively represent an underlying component (or factor) that cannot be directly measured[69].

Mathematically the process used to derive these components is similar to that used in regression techniques – based on a set of observations a function is derived that minimises the unexplained variance within the sample. In the case of FA, the observations in question are based the correlation or covariance matrix formed by the initial variables and the function representing this "line of best fit" is the component. Each factor is a linear, weighted combination of the initial variables, where the sum of the squared weights is equal to one:

$$\text{Component} = w_1X_1 + w_2X_2 + \ldots + w_nX_n$$

$$1 = w_1^2 + w_2^2 + \ldots + w_n^2$$

It should be noted that PCA and FA are functionally identical with the exception of the type of variance analysed. PCA analysis involves all observed variance in the sample, while in FA only the variance shared by the initial variables is examined. The variance for each component is given by the eigenvalue of the corresponding vector – this value is divided by the number of initial variables to estimate the proportion of total variation in the original dataset accounted for by each factor. Components are ordered such that the first component explains the largest possible amount of variation, the second (uncorrelated) components explaining additional variation, and with further components explaining progressively less and less variation. The more highly correlated the initial variables are, the fewer factors are necessary to explain the majority of variation. Typically, the output from the PCA process consists of a summary of components in terms of variance explained, and a table of variable weights for each component.

Before carrying out PCA, several issues must be addressed. Firstly, all categorical variables must be converted to binary variables, so that correlation may be calculated. Secondly, the dataset should be checked for the presence of variables with particularly high or low variance – such variables may dominate the results and lead to misleading conclusions about the actual nature of variance within the sample. Thirdly, a decision must be made as to whether to use the correlation or covariance matrix. PCA is sensitive to the difference in the units of measurement among variables, and thus if all variables are in the same units then the covariance matrix should be used, if not, the correlation matrix is the standardised form of the covariance matrix and may be used instead.

PCA is heavily limited by its reliance upon the quality of the underlying data. Small sample sizes, missing data, skewed distributions and limited numbers of variables can drastically affect the end result. Similarly, if the variables are all highly correlated then there may be difficulty in assuming that they can be used to measure an underlying unobserved variable.

The most direct method of creating weights from the results of PCA is to assume that the first component corresponds to the underlying process that the index is attempting to measure. For example, in the case of the Wealth Index, it is assumed that the first principal component provided a measure of wealth[74,75]. It is important to test that this assumption makes sense – if the weights are clustered on a particular subset of variables (for example, water source or type of flooring in the case of the Wealth Index) this may indicate that the index is not actually measuring what it is intended to. Another option is to use an average of variable weights from multiple components – however few studies have explored this option, as often the first component provides substantially greater explanatory ability, and including additional components results in minimal changes to the results[75].

Once the weights have been calculated, the index is created by calculating a score for each observation based on the following formula:

$$\text{Index score} = w_1 \times (X_1^i - X_1) / (S_1) + ... + w_n \times (X_n^i - X_n) / (S_n)$$

where w_1 is the weight for the first variable, X_1^i is the observation's value for the first variable and X_1 and S_1 are the mean and standard deviation of the first variable.

It should be noted that the index produced by this method will be a relative one – as the index is based on the unique properties of the dataset itself, the resulting scores are not comparable between datasets. A variable with a positive weight in one dataset may have a negative weight in another – in terms of the Wealth Index, ownership of an asset in Country 1 may be associated with higher wealth, while in Country 2 it may be associated with lower wealth. Likewise, it is possible that the principal components may vary between subgroups within the dataset – rural populations may have a different asset profile to those in urban areas. PCA derived indexes may therefore be of limited use in producing cross country comparisons, but are well suited for examining within country differences.

3.1.4.3 Choice of Weighting Methods for Quality Index

There are both advantages and disadvantages in the use of the weighting methodologies outlined above. Because PCA weights are based on the underlying structure of the data, they produce an index that is very much relative - it can differentiate between observations with many of the markers that are correlated with each other and those without, but it does not provide an objective measure of how many of these indicators each observation had. In contrast the use of equal or theoretically derived weights provides a clearly understood measure that can be compared over different datasets, but the index will not be sensitive to changes in the relative importance of different variables in different contexts.

It is for this reason that as a part of the initial trial of the methodology, two methods were used for the creation of QI – one based on PCA derived weights, and a second based on a slightly modified version of equal weighting. Both indexes contained the same indicators, varying only in the weights used.

The PCA index utilised similar methodology to that used in the Wealth Index. All indicators were transformed into binary variables, the PCA process was run, and the resulting weights from the primary component used for the index. Analysis of the PCA results was undertaken to ensure that the necessary assumptions for this process can be reasonably made and to provide insights into the pattern of association between various indicators.

The Equal Weight (EW) index used a slight modification to equal weighting, similar to the theoretical component method used by the Human Development Index. All original indicators carried equal weight in the final index; however indicators which did not take a binary form (that is, indicators where multiple levels of quality were being examined) were treated as if made up of equally weighted subcomponents. For an indicator with N categories representing different levels of quality, the weight given to each category was equal to 1/N. The overall score for a non-binary indicator thus consisted of x/N where x is the number of categories the observation met. This allowed for some level of discrimination between different levels of coverage for some indicators in the initial test of the methodology, while keeping to the equal weighting principle. Analysis was done based on initial results to determine if the number of categories for non-binary indicators affects the robustness of the results, and if so whether or not the partial quality categories were used in the final QI used for analysis.

3.1.5 Accounting for differences in access to care

As mentioned in Chapter 2 the definition of "quality" can vary substantially depending on the viewpoint used. In particular, it is necessary to consider the role of access to services in the functional definition of quality. From an overall health perspective, women who do not have access to services are receiving a poor quality of care; however from a health systems perspective there is a necessary distinction between access to and utilisation of health services and the quality of care received by those who do utilise services. It is therefore necessary to ensure that the QI reflects the quality of services provided rather than acting as a proxy for service use.

In general, the quality indicators fall into two categories; indicators representing antenatal care and indicators representing delivery and postnatal care. There is thus a distinct possibility that unadjusted QI scores will reflect coverage of ANC and SBA services i.e. those without ANC or SBA will, by default, score extremely lowly and thus produce a strong negative skew for populations with limited access to or utilisation of services. To correct for this it is necessary to limit the sample size to those who can be considered to have received services.

One of the difficulties in accounting for service use is determining who is considered to have used a service. For the purposes of the QI, two elements must be considered: usage of ANC and usage of delivery services. As it is theoretically possible to attain some measure of quality care from a single contact with the health system, observations with at least 1 ANC visit will be considered to have used ANC services and observations that had a SBA delivery will be considered to have used delivery services[viii].

[viii] The definition of an SBA delivery is country specific, however in all cases those who are considered to be SBAs are affiliated in some manner with the formal health system.

Another difficulty occurs when determining how usage of two different, but intrinsically linked services should be used in order to restrict the dataset. There are three options in particular that should be considered:

1) Restricting the dataset to only those with at least 1 ANC visit:

    ANC is seen as the first step along the continuum of care stretching from the first trimester through to the late postnatal period[8,76,77]. As such, an argument could be made that all women who have at least one ANC visit have access to health services, and should therefore be receiving all other services. This is, however, not the case in many contexts, as the provision of delivery care often requires a higher level of health system inputs compared to ANC. Limited access to SBA services is a known issue in many countries, and the use of this set of restrictions may result in an index that reflects these known access issues.

2) Restricting the dataset to only those with both ANC and SBA

    As the majority of interventions that are meant to be provided during the delivery and postnatal period are considered the responsibility of the SBA[4], those with both ANC and SBA might be reasonably expected to be capable of achieving good quality care. Additionally, as all observations can be linked to a type of provider, the measures created by these restrictions may provide an appropriate method of examining the variations in care provided by different levels of the health system. There are however several distinct disadvantages in using this criteria. Firstly, in areas of low SBA coverage the restriction of the dataset may result in the number of observations falling to such a point that the representativeness of the sample is affected. Secondly, many countries have recently introduced policy changes aimed at providing community level postnatal care targeted at women who did not necessarily receive SBA[60]. While delayed PNC is not considered an optimal level of care, it does represent a certain level of quality of care above that of women who received no PNC.

3) Restricting the dataset to only those with either ANC or SBA

   This is the least restrictive set of potential criteria, as access is here defined as having at least one contact with the health system over the course of the pregnancy. While it carries the same disadvantages as the ANC only restriction, it does allow for those who received SBA, or the previously mentioned community PNC, to be counted as having partial levels of quality.

In the vast majority of LMIC settings ANC is almost universal among those with SBA, due to the higher level of health resources required to provide delivery care in a timely manner. As such, options 1 and 3, which include women who had ANC but not SBA, still carry a considerable risk of reflecting access to facility based healthcare rather than the quality of care provided. At the same time an argument can be made that in countries with high levels of partial coverage, which would see a large drop in observations using the restrictions outlined in option 2, health system priorities will largely be focused on increasing service coverage. Given that one of the goals of this analysis is to examine quality within the context of the rapid expansion of health service coverage in Southeast Asia, such countries are of limited interest to the analysis. Therefore the decision was made to limit all datasets to those observations reporting at least one ANC visit and a SBA delivery as per option 2.

3.1.6 Piloting the Quality Index in a single country

The DHS dataset chosen for the pilot was Indonesia 2012. This dataset was recent, includes non-standard quality indicators (as outlined previously) and had sufficiently high coverage of MNCH services such that the sample was not heavily weighted towards those that received no services. Multiple indices were created, differing both in the choice of indicators and the weighting methodology used. The results of the initial construction of QI may be found in Chapter 3.

Once the quality indices were created for this dataset, they were used in a number of different analyses examining their suitability as quality measures. In particular, the aim of this process was to assess whether the resulting QI:

1. Provided consistent and reliable scores across the sample (reliability of the process)
2. Were consistent with existing understandings of quality of care within the context (validity of the process)

These factors were used to make a final determination as to whether the QI were appropriately measuring quality of care in the Indonesia 2012 dataset, and thus if the methodology was to be extended to additional countries.

3.1.6.1 Testing reliability of quality indices

The concept of reliability can be quite nebulous[78], however in general it can be expressed as the proportion of variance in a sample that is due to true differences between subjects rather than random error. There are many methods available for measuring and interpreting reliability in the context of health related indices, however the nature of DHS data precludes many of the techniques from being used in this analysis. In particular, the comparison of multiple observations of the same subjects (either through test-retest or multiple observers) is necessary for many of the classical tests of reliability[78]. As the DHS comprises of cross sectional data derived from single interviews with each participant such methods cannot be undertaken.

One measure of reliability that can be considered is the internal consistency of the index. Indicators should tend to be at least moderately correlated with each other and with the total score produced by the index. Ideally, the indicators used in a measurement scale should be relatively homogenous, however Streiner and Norman[78] note that this is only theoretically correct in situations where the indicators reflect the effects of an underlying construct rather than being causal indicators that define the construct by their presence.

Given the multifaceted nature of quality, and that the QI is a composite index rather than a measurement scale it is apparent that the latter situation will most likely apply in the case of the QI. Regardless, tests of homogeneity of indicators within the index were performed through the calculation of Cronbach’s alpha[79,80] for each indicator set.

Cronbach's alpha is an estimation of the average correlation of all indicators within a given set and can be calculated as

$$\alpha = \frac{K\bar{c}}{(\bar{v} + (K-1)\bar{c})}$$

Where K is the number of indicators, $\bar{v}$ is the average variance of each indicator and $\bar{c}$ the average of all covariances between the between indicators. The higher the value of the alpha the more homogenous the scale can be considered; in general a scale with a coefficient of 0.7 or above is considered to acceptably consistent. It should be noted that Cronbach's alpha will generally increase as the number of indicators increase, and for this reason it is often recommended that extraneous indicators be removed if possible to prevent artificial inflation of this measure[78,79].

Given the relatively limited number and range of potential indicators available within the DHS dataset, and the fact that quality of care is known to not be unidimensional, there was limited facility for such indicator restrictions to be applied in this analysis. However for each country an additional indicator set will be created in which indicators with extremely high or extremely low coverage (>90% and < 10%) are removed (by their nature such indicators will not tend to affect patterns of correlation as they will be near universally correlated with all other indicators due to their prevalence in the sample).

Additionally, as Pritcher and Filmer[74] noted with regards to the development of the wealth index, if the index being tested is truly reflecting some part of the factor being measured, then the classifications of observations into quintiles should not change substantially when different subsets of variables are excluded from the index. In this case, the availability of country specific versus standard DHS variables provides an intuitive way in which to test these classifications. An individual should not be classified as being in the lowest quality group based on the country specific index while simultaneously being classified as being in the highest quintile based on the standard DHS index. Similarly it would be expected that in a consistent index little variation would be seen between the PCA derived weights for the sample as a whole and those produced from a randomly selected subsample of observations.

As such, a comparison of quintile assignments and overall correlation between scores produced by different QI was included in the analysis, as well as a comparison of PCA results derived from multiple rounds of random sampling from the dataset. The cumbersome nature of the quintile and random sampling techniques combined with their limited utility (see Chapter 3.4) resulted in them being included only in the pilot dataset. Cronbach's alpha and QI correlation calculations were done for all countries in the study.

3.1.6.2 Testing validity of quality indices

As mentioned in previous sections, due to existing limitation in available data there is no "gold standard" measure of quality of care in the absence of reliable HIS data, and certainly not one that can be used to directly assess the validity of the QI. Existing measures tend to be too specialised (either disease related or specific to particular types of provider) or unavailable for more than a very small segment of the population (e.g. one location or a particular risk group).

Additionally, unlike the Wealth Index, which can be compared to other wealth related indicators such as the poverty rate[74], the quality indices have no related coverage indicator or health outcome against which they can be directly compared. While we would expect high quality of care to be linked to lower rates of maternal and neonatal mortality and morbidity, the lack of indicators related to emergency obstetric care services severely limits the ability of the QI to appropriately reflect access to life-saving care. Even if indicators related to emergency care are were available, survivorship bias would preclude the DHS from providing reliable measures relating to the treatment of potentially fatal conditions.

The large scale nature of the DHS also complicates potential comparisons; the DHS tends to be designed to produce reliable estimates at a regional level, meaning that any measure used for comparison must also be available at a similar level. A district level estimate of ANC practices, for example, is not an appropriate comparison unless it is considered to be generalizable to wider population of the region it resides in.

As such, the validity of the QI was primarily tested through the use of known group analysis[78]. Existing literature was searched in order to identify groups known to experience high or low quality care within the given country. The QI score for similar groups in the DHS dataset were then examined to determine if they demonstrated the expected tendency to be significantly higher or lower than the sample mean. While only providing an estimate of face validity, this enabled a decision to be made as to the viability of extending the process to additional countries.

3.1.6.3 Determining the final QI to be used in the analysis

As part of the pilot testing using the Indonesia 2012 dataset, multiple combinations of indicator sets and weighting techniques were considered. However to continue the analysis it was necessary to decide upon which QI was to be used for comparison of quality of care within different population subgroups.

Conceptually, there were benefits to both the PCA and EW derived QI. The variable weights from the PCA derived QI allowed for greater discrimination between observations and thus potentially better insights into relative variation in quality of care, however the EW derived QI were more transparent in terms of what they represented as they directly related to the overall number of indicators a given observation had. As these may have different policy implications, a decision was therefore made to include both a PCA and EW derived QI in the equity analyses to examine the impact of these differences on the understanding of quality of care within each country.

The decision on which indicator set to utilise was based on the need to have no negatively weighted indicators, sufficient indicators to allow for discrimination between observations and, a lack of undue emphasis on one section of the continuum of care over others. While the rationale for each selection is outlined in the respective country chapters, in general the full indicator set was chosen for use in the equity analyses.

3.2 Analysis of within country quality by equity markers

Once the overall acceptability of the methodology was established, similar quality indices were computed for additional country datasets. Within each dataset the distribution of quality scores was compared across markers known to affect healthcare equity within that country. This involved the use of graphical and tabular comparisons of mean scores as well as the use of multivariate regression to untangle potentially confounding factors.

The following sections outline the criteria for selecting additional countries, the equity markers to be included in the country analyses and the methods used to examine sub-national trends.

3.2.1 Additional datasets to be included in the analysis

As a result of the data limitations outlined in Section 3.1, only DHS datasets using the DHS 6 revision or later can be considered for further analysis. In addition, as the focus of this research was quality of care within the context of the rapidly expanding Southeast Asia, only datasets relating to countries considered part of the United Nations defined South-East Asian region were eligible for inclusion. As of February 2016, there were 5 surveys (in addition to Indonesia 2012) meeting these criteria (see Table 3.2.1).

One dataset (Bangladesh 2011) was excluded from the final selection due to the omission of a large number of standard DHS quality indicators from the survey[ix]. Another dataset (Timor-Leste 2009) was discarded due issues with service use; as SBA coverage was only 30% the resulting dataset would be too small to provide reliable estimates of population subgroups given the DHS sampling frame[x].

[ix] In addition to the lack of standard indicator precluding the use of this dataset in the multi-country analysis, the remaining indicators were deemed insufficient for producing a robust measure of quality care.

[x] See section 2.1.5 for discussion regarding access.

Table 3.2.1 DHS datasets meeting criteria for inclusion

Country Wave
Bangladesh 2011^
Cambodia 2010
Cambodia 2014
Indonesia 2012
Timor-Leste 2009^
Philippines 2013

^omitted from analysis

As such, the final analysis examined data from three countries: Indonesia, Cambodia and the Philippines. These three countries have all seen increases in economic activity accompanied by large increases in coverage of health services over past decades[81,82] and have seen quality of care raised as a potential impediment to better maternal and neonatal outcomes[63,83-85]. Additionally, these countries have all implemented decentralisation policies within very different health system contexts, providing potential insights into how health system structures may influence patterns of quality care. As Indonesia and the Philippines have only one DHS meeting the inclusion criteria no trend or time based analysis were conducted for these countries, however both the 2010 and 2014 DHS datasets for Cambodia were examined.

3.2.2 Equity markers to be examined

As one of the major hypotheses of this research is that the factors driving unequal distribution of quality are related to those driving other health indicators, the equity markers included in the country level analysis are largely based on existing literature regarding health disparities in developing countries[86]. Mean QI scores for each of these markers, both singly and in combination as required, were compared to identify trends in the data. A brief rationale for the inclusion of each marker is outlined below.

3.2.2.1 Wealth quintiles

The DHS-based Wealth Index is widely used to explore issues related to socioeconomic status. It is widely assumed that those who are wealthier will receive a higher quality of health care to those who are poor[83,87,88]. However, there is some evidence that while access to services may increase with wealth, the quality of those services may not follow the same pattern[89,90].

3.2.2.2 Urban Rural status

It is well known that access to services can substantially differ between urban and rural areas[83,91]. However it is not always apparent that those who do access services receive a similar quality of care to their urban counterparts[92].

3.2.2.3 State/Region

Geographic location is known to affect the coverage of health interventions in many countries[9,86,93], particularly in the context of decentralised health systems. It is likely that quality of care may also vary considerably depending on local conditions.

3.2.2.4 Maternal Education

Maternal education has long been linked to both healthcare usage[94] and maternal and neonatal outcomes[95]. More directly, there is some evidence that quality of care may vary based on maternal education[96,97].

3.2.2.5 Maternal Age

Use of health services can vary across different age groups; both very young (<20yrs) and very old (45+yrs) mothers are known to face additional barriers to accessing care despite being at higher risk of complications [98,99]. Additionally, social stigma surrounding teenage pregnancy may affect the usage and quality of services that are provided[100,101].

3.2.3 Examining time based trends in Cambodia

As the only country with more than one eligible dataset, Cambodia provided an opportunity to explore how patterns of quality of care change over time. The 2010 and 2014 datasets were first examined individually, utilising the same protocols used for the other countries to identify indicator sets and create dataset specific QI. The country-specific indicator sets identified in the initial analysis were then compared in order to create a third, combined set of indicators that were present in both the 2010 and 2014 datasets. The datasets were then pooled, using the same methods used for the multi-country analysis (see Section 3.3) QI that encompass both surveys. QI scores were then directly compared across the two datasets for notable equity markers in a pre-post fashion.

3.2.4 *Use of multivariate regression*

One limitation of directly comparing mean scores across different equity markers is that it can be difficult to disentangle underlying issues with confounding. Wealth and education are, for example, often strongly linked. Without further analysis it is difficult to determine the level to which each factor is driving overall patterns. Similarly, differences in the proportion of rural population within regions may result in an apparent urban-rural difference that is actually more closely linked to regional variation.

Thus in addition to direct comparisons of mean QI scores, multivariate regression analysis was used to examine the associations between different equity markers and QI scores. Standard multivariate regression techniques were employed[69], using standardised QI scores as the dependent variable and equity markers such as rural-urban status, region and wealth as independent variables as applicable. The general equation to be used was:

$$QI_i = \alpha + \beta_1 EquityMarker1_i + \beta_2 EquityMarker2_i + \cdots + \varepsilon_i$$

Where QI is the quality score, EquityMarker is a binary variable representing membership in a given category for a relevant equity marker, ε is the error term and i is the unit of observation. Consideration was be given to standard specification issues as well as appropriate sensitivity analysis and robustness testing.

3.3 Analysis of Quality of Care across Multiple Countries and time periods

In addition to these within country analyses, additional multi-country comparisons of equity trends were also undertaken in order to provide further insight into how quality of care varies across contexts. However to analyse the factors affecting quality of care at a multinational level requires that the measures of quality used are comparable across all countries. While the set of indicators used to create the core DHS quality indices provided a stable set of variables across datasets, it was also necessary to ensure that the construction of the index was also consistent across datasets.

As has been noted elsewhere[102] one of the difficulties in using the Wealth Index produced from DHS datasets to examine cross country trends in wealth based inequality is that it is a relative measure – the weight assigned to each indicator will vary considerably between countries. That is, an item that is associated with greater household wealth in one country may be not be associated with wealth in another. Similarly, the relative importance of individual quality indicators may vary, and so the PCA based QI created for individual country analyses cannot be directly used to compare observations from different datasets.

The simplest option was to only utilise EW based QI for the multi-country analysis. As all indicators carry the same weight in all countries, these scores were directly comparable regardless of the originating dataset. However as mentioned Section 3.1.4, equal weighting carries some limitations. Not only does it fail to reflect the relative importance of different indicators but the limited number of potential scores may hinder the differentiation between levels of quality - particularly if overall quality is high. Thus while the EW score was created, it was also preferable to construct a PCA based quality index for which variable weights were calculated for the entire sample of countries.

This first involved the pooling of multiple country data into one large dataset on which the PCA process was carried out as per single-country methods. To prevent larger samples from dominating the process, weights were used to ensure that each country contributed equally to the final variable weights regardless of the total number of observations it has; similar methods have been used elsewhere to create cross country estimates of household wealth[103]. The methodology for examining equity trends across countries then otherwise followed that set out in the individual country analyses.

The results of these analyses may be seen in Chapter 8.

4 Piloting the Quality Index Methodology Using the Indonesia 2012 DHS

As mentioned in Chapter 3, the development of the methodology for constructing and utilising the QI and the trial of these methods are inherently intertwined. This chapter explores the creation of the QI and the testing of its reliability and validity as a measurement of quality of care using data from the 2012 Indonesian DHS.

The results of preliminary testing using an earlier adaptation of the QI methodology have been published[67] , however additional research and refinement has resulted in a much stronger and comprehensive methodology on which all additional analyses were based. Despite the many limitations involved, this section demonstrates that it is indeed possible to create a multifaceted indicator of quality of care provided that certain criteria are met.

4.1 Overview of the Indonesia 2012 DHS

The 2012 Indonesian DHS collected data from 43852 households throughout the country, with the individual Women's Questionnaire being used to collect data from 45607 women between the ages of 15 and 49. The two-stage stratified sampling design enabled the data to be representative of urban and rural populations at the provincial level.

At the time of survey design Indonesia consisted of 33 provinces (Aceh, North Sumatera, West Sumatera, Riau, Jambi, South Sumatera, Bengkulu, Lampung, Bangka Belitung, Riau Islands, Jakarta, West Java, Central Java, Yogyakarta, East Java, Banten, Bali, West Nusa Tenggara, East Nusa Tenggara, West Kalimantan, Central Kalimantan, South Kalimantan, East Kalimantan, North Sulawesi, Central Sulawesi, South Sulawesi, Southeast Sulawesi, Gorontalo, West Sulawesi, Maluku, North Maluku, West Papua, and Papua), however in October 2012 several districts in East Kalimantan were split off to form the new province of North Kalimantan. As such, estimates using the 2012 Indonesian DHS can only be considered representative of the pre-2012 region rather than the current provincial boundaries.

Of the 45607 women interviewed, 15262 reported having had at least one live birth in the last five years, and thus were potentially eligible for inclusion in the analysis according to the methods outlined the previous chapter. Coverage of ANC was generally high, with 96% of women reporting at least one ANC visit with a skilled provider, 88% reporting at least four ANC visits and 74% reporting at least one visit in the first trimester, at least one in the second and at least two in the third[xi]. Overall, 63% of women delivered in a health facility and 83% were assisted by a skilled birth attendant (SBA). In total, 12076 women reported having had both ANC and SBA services (at least 1 ANC visit and delivery performed by Nurse, Midwife, Doctor or Obstetrician/Gynaecologist[xii]).

4.2 Identification and Construction of Indicators

As outlined in Chapter 2, the 2012 Indonesia DHS questionnaire was reviewed for the presence not only of Core DHS indicators, but also disease related and country specific indicators. The full rationale for the inclusion of each indicator can be found in section 4.1.3, however a brief overview of available indicators identified in the 2012 Indonesia DHS may also be seen Table 4.2.1. The indicators have been organised thematically, roughly according to their occurrence across the continuum of care.

While many of these indicators can be immediately expressed as a binary "did/did not have indicator" variable, others such as iron supplementation, tetanus immunisation and postnatal checks could have multiple forms: as mentioned in Section 3.1.3 these indicators utilised of additional "partial quality" variables as a part of the initial analysis.

Table 4.2.1 Brief Overview Potential Quality Indicators identified in the 2012 Indonesian DHS

Indicator	**Brief Rationale**
ANC visit in 1st Trimester	A minimum of 4 ANC visits are recommended for all women; one in each of the 1st and 2nd trimesters, and two in the 3rd trimester
ANC visit in 2nd Trimester	
ANC visits in 3rd Trimester	

Table 4.2.1 cont.

[xi] The timing of subsequent ANC visits is specific to the 2012 IDN DHS, and is not available for other DHS datasets.

[xii] Definition used for SBA calculations in 2012 IDHS; respondents were asked to identify all persons involved and birth was classified based on highest qualified individual.

Weight measured during ANC	In order to detect and appropriately treat issues that may affect maternal health, it is recommended that several diagnostic tests be undertaken as parts of ANC. Additionally Indonesian government guidelines specify that women should receive a “MNCH book” to keep track of health visits
Height measured during ANC	
Blood Pressure measured during ANC	
Urine sample taken during ANC	
Blood sample taken during ANC	
Stomach examined during ANC	
Consultation during ANC	
Received MNCH book during ANC	
Iron supplementation during pregnancy	Appropriate preventative care may reduce both mortality and morbidity due to anaemia and tetanus infection
Tetanus Immunisation	
Pregnancy complication Advice	In order to prevent delays in care, women should be counselled about potential symptoms of pregnancy complications and the need for an appropriate birth plan.
Discussed place of delivery during pregnancy	
Discussed transportation to place of delivery during pregnancy	
Discussed who would assist delivery during pregnancy	
Discussed payment for delivery during pregnancy	
Discussed possible blood donor during pregnancy	
Baby was weighed at birth	Both maternal and neonatal health should be checked immediately following birth, and regularly thereafter. These checks should be used identify and treat potential complications as well as providing appropriate health advice and preventative care.
Baby was breastfed within 1 hr of birth	
No liquids given before milk began to flow (no prelacteal feed)	
Maternal postnatal check	
Neonatal postnatal check	
Postpartum vitamin A within 2 months of delivery	

Each variable was initially created based only upon clear responses; if a variable recorded a response of “don’t know” or was otherwise unclear in its meaning it was treated as if it were missing that variable. The rules for dealing with missing data outlined in section 3.1.2 were then applied. For variables related to yes/no questions, a response of “don’t know” was treated the same as a “no” response, while for indicators where a quantitative value such as timing or quantity of service provided is missing or coded as “don’t know”, but other variables indicate that the service did occur, the observation was given the mean value of the quantitative variable. Observations for which at least one variable had the additional rules applied were then tagged to allow for further analysis of potential bias. The remaining observations, which contained at least one variable with missing data, were also tagged with the intention of allowing for case wise deletion once the initial data inspection was concluded.

Table 4.2.2 outlines the final variables used for the initial analysis, as well as the proportion of observations that had complete responses, required imputation rules, or had missing data. In total, of the 15262 women reporting at least one birth in the past 5 years, 1917 had at least one variable that required imputation but were otherwise complete while 398 had at least one variable with missing data making them eligible for deletion.

As can be seen from this table, most indicators recorded a high rate of complete responses; only the variables relating to Iron Supplementation have more than 5% of observations that are either missing or required imputation rules. The majority of these were observations that responded “don’t know” in response to the question “How long did you take [Iron Supplement] for during your pregnancy?”

Table 4.2.2 Final variables used for Initial Analysis and Proportion of Observations with Complete Responses

Indicator	**Categories**	**% Complete**	**% Requiring Imputation**	**% Missing Data**
ANC visit in 1st Trimester		99.0	1.0	0.0
ANC visit in 2nd Trimester		99.0	1.0	0.0
ANC visits in 3rd Trimester	1	99.0	1.0	0.0
	2	99.0	1.0	0.0
	None	99.0	1.0	0.0
Weight measured during ANC		100.0	0.0	0.0
Height measured during ANC		99.9	0.0	0.1
Blood Pressure measured during ANC		100.0	0.0	0.0
Urine sample taken during ANC		99.9	0.0	0.1
Blood sample taken during ANC		99.9	0.0	0.1
Stomach examined during ANC		100.0	0.0	0.0
Consultation during ANC		99.7	0.0	0.3
Received MNCH book during ANC		99.5	0.2	0.3
Iron Supplementation during pregnancy	1-29 days	93.1	6.5	0.4
	30-89 days	93.1	6.5	0.4
	90-179 days	93.1	6.5	0.4
	180-269 days	93.1	6.5	0.4
	270+ days	93.1	6.5	0.4
	None	93.1	6.5	0.4
Tetanus Immunisation	Full	99.5	0.1	0.4
	Partial	99.5	0.1	0.4
	None	99.5	0.1	0.4

Table 4.2.2 cont.

Pregnancy complication Advice		99.5	0.4	0.0
Discussed place of delivery during pregnancy		99.6	0.0	0.4
Discussed transportation to place of delivery during pregnancy		99.6	0.0	0.4
Discussed who would assist delivery during pregnancy		99.6	0.0	0.4
Discussed payment for delivery during pregnancy		99.6	0.0	0.4
Discussed possible blood donor during pregnancy		99.3	0.0	0.7
Baby was weighed at birth		99.3	0.3	0.4
Baby was breastfed within 1 hr of birth		98.9	0.8	0.4
No liquids given before milk began to flow (no prelacteal feed)		98.8	0.7	0.5
Maternal postnatal check	<2hrs	97.3	2.0	0.7
	3-12 hrs	97.3	2.0	0.7
	13-24hrs	97.3	2.0	0.7
	25-48hrs	97.3	2.0	0.7
	49hrs +	97.3	2.0	0.7
	None	97.3	2.0	0.7
Neonatal postnatal check	<2hrs	96.5	2.8	0.7
	3-12 hrs	96.5	2.8	0.7
	13-24hrs	96.5	2.8	0.7
	25-48hrs	96.5	2.8	0.7
	49hrs +	96.5	2.8	0.7
	None	96.5	2.8	0.7
Postpartum Vitamin A within 2 months of delivery		96.6	2.5	0.9

Similarly, variables related to PNC visits also had fewer complete observations due to issues with recollection of the timing of the visits. This does suggest that indicators relating to quantitative factors are more likely to be subject to recall bias, however the use of mean-value substitution will hopefully minimise the impact of such bias on the analysis as a whole.

Overall approximately 85% of the sample had complete data relating to the quality indicators, with another 13% having at least one variable requiring imputation but otherwise being complete. This is, however, the complete sample including women who would be excluded from the analysis due to not having both ANC and SBA services. Following the omission of these individuals, the dataset comprised of 12076 observations, 10322 (86%) of which were complete, 1499 (12%) had at least one imputed variable and 245 (2%) had at least one variable with missing data. These proportions are quite similar to the unrestricted dataset including those who did not access services, suggesting that the completeness of data is not strongly related to ANC or SBA usage.

4.3 Analysis of Data Quality

As mentioned in the previous section, approximately 86% of observations had complete data regarding all of the indicators. As this fell below the 95% threshold outlined in Section 2.1.2 the dataset was further examined to determine if there is a potential bias that might affect the results based on the treatment of missing data.

The first step in this process was to examine the different categories of observations (Complete, Imputed, and Missing) by key demographic factors to determine if there is a significant difference between groups. Two proportion z-tests were used to compare the imputed and missing observations to those with no missing data, the results of which can be seen in Table 3.3.1.

There are no significant differences between the complete and missing observations outside of wealth and region, with the dropped observations containing a higher proportion of observations from the poorest wealth quintile, as well as from the North Sulawesi province. In contrast, the imputed observations do appear to vary substantially from the complete observations with regards to urban rural residence, education and wealth. Notably, the imputed observations tend to have a higher proportions of individuals from urban areas, completed secondary and higher education groups as well as the richer and richest wealth groups. Regional differences are less well marked than those seen between the complete and missing groups; while outlying regions tend to be overrepresented among the imputed group there is no single province or geographic region to which the differences can be attributed.

Table 4.3.1 Distribution of Observations with Complete, Imputed or Missing Variables, Indonesia 2012

Category	**Complete**		**Imputed**		**Missing**	
	#	%	#	%	#	%
Urban	5431	*52.6%*	851	*56.8%*	117	*47.8%*
Rural	4901	*47.4%*	648	*43.2%*	128	*52.2%*
p-value			0.002		0.136	
15-19	329	*3.2%*	36	*2.4%*	13	*5.3%*
20-24	1907	*18.5%*	257	*17.1%*	51	*20.8%*
25-29	2943	*28.5%*	413	*27.6%*	60	*24.5%*
30-34	2573	*24.9%*	381	*25.4%*	52	*21.2%*
35-39	1755	*17.0%*	263	*17.5%*	44	*18.0%*
40-44	702	*6.8%*	126	*8.4%*	20	*8.2%*
45-49	123	*1.2%*	23	*1.5%*	5	*2.0%*
p-value			0.097		0.178	
No education	105	*1.0%*	13	*0.9%*	3	*1.2%*
Incomplete primary	736	*7.1%*	94	*6.3%*	18	*7.3%*
Complete primary	1860	*18.0%*	242	*16.1%*	46	*18.8%*
Incomplete secondary	2725	*26.4%*	354	*23.6%*	84	*34.3%*
Complete secondary	3309	*32.0%*	532	*35.5%*	67	*27.3%*
Higher	1597	*15.5%*	264	*17.6%*	27	*11.0%*
p-value			0.005	0.000	0.061	
Poorest	2015	*19.5%*	252	*16.8%*	72	*29.4%*
Poorer	2163	*20.9%*	263	*17.5%*	46	*18.8%*
Middle	2141	*20.7%*	321	*21.4%*	45	*18.4%*
Richer	2120	*20.5%*	322	*21.5%*	50	*20.4%*
Richest	1893	*18.3%*	341	*22.7%*	32	*13.1%*
p-value			0.000		0.002	
Aceh	333	*3.2%*	82	*5.5%*	3	*1.2%*
North Sumatera	471	*4.6%*	68	*4.5%*	14	*5.7%*
West Sumatera	333	*3.2%*	68	*4.5%*	0	*0.0%*
Riau	398	*3.9%*	68	*4.5%*	9	*3.7%*
Jambi	262	*2.5%*	25	*1.7%*	0	*0.0%*
South Sumatera	370	*3.6%*	45	*3.0%*	6	*2.4%*

Table 4.3.1 cont.

Bengkulu	223	*2.2%*	37	*2.5%*	11	*4.5%*
Lampung	332	*3.2%*	42	*2.8%*	11	*4.5%*
Bangka Belitung	306	*3.0%*	39	*2.6%*	1	*0.4%*
Riau Islands	216	*2.1%*	113	*7.5%*	6	*2.4%*
Jakarta	573	*5.5%*	85	*5.7%*	11	*4.5%*
West Java	465	*4.5%*	101	*6.7%*	11	*4.5%*
Central Java	490	*4.7%*	49	*3.3%*	5	*2.0%*
Yogyakarta	374	*3.6%*	14	*0.9%*	3	*1.2%*
East Java	469	*4.5%*	56	*3.7%*	7	*2.9%*
Banten	441	*4.3%*	68	*4.5%*	13	*5.3%*
Bali	385	*3.7%*	28	*1.9%*	5	*2.0%*
West Nusa Tenggara	384	*3.7%*	11	*0.7%*	2	*0.8%*
East Nusa Tenggara	243	*2.4%*	16	*1.1%*	7	*2.9%*
West Kalimantan	290	*2.8%*	42	*2.8%*	12	*4.9%*
Central Kalimantan	243	*2.4%*	22	*1.5%*	2	*0.8%*
South Kalimantan	280	*2.7%*	51	*3.4%*	6	*2.4%*
East Kalimantan	272	*2.6%*	30	*2.0%*	2	*0.8%*
North Sulawesi	257	*2.5%*	47	*3.1%*	37	*15.1%*
Central Sulawesi	255	*2.5%*	15	*1.0%*	2	*0.8%*
South Sulawesi	333	*3.2%*	60	*4.0%*	16	*6.5%*
Southeast Sulawesi	265	*2.6%*	12	*0.8%*	8	*3.3%*
Gorontalo	241	*2.3%*	30	*2.0%*	5	*2.0%*
West Sulawesi	138	*1.3%*	47	*3.1%*	10	*4.1%*
Maluku	205	*2.0%*	10	*0.7%*	2	*0.8%*
North Maluku	203	*2.0%*	20	*1.3%*	5	*2.0%*
West Papua	196	*1.9%*	57	*3.8%*	10	*4.1%*
Papua	86	*0.8%*	41	*2.7%*	3	*1.2%*
p-value			0.000		0.000	
Total	**10332**		**1499**		**245**	
(% of Total)	86%		12%		2%	

These results are potentially problematic, and must be considered carefully. For example, nearly a third of the observations from North Sulawesi are in either the imputed or missing groups; this may severely affect the representativeness of the sample, particularly with regard to the missing data observations which are greatly disproportionate both in terms of the regional sample but also the missing data group as a whole. Of the 37 observations from North Sulawesi with at least one missing variable, 30 occur because information related to postpartum vitamin A supplementation was not recorded in the dataset: of these 7 were also missing data on neonatal PNC with another 14 missing data on both maternal and neonatal PNC. This suggests a there may be a systematic error with how the data was collected in this province.

Indeed over a third of the observations with missing data were administered by the same interviewer, with a different interviewer accounting for another quarter of the observations. As the DHS asks slightly different questions regarding PNC depending on the place of delivery it is possible that misreading of the questionnaire is responsible for these errors – further examination showed that 26 of the observations with missing variables were home based SBA deliveries. While it is unlikely these observations will have a substantial impact on estimates produced for the sample as a whole, estimates for North Sulawesi will need to be carefully interpreted, particularly with regards to home based SBA.

To a lesser extent similar care must also be taken when considering estimates based on wealth and education. As the assumptions used in the imputation process will tend to create a more conservative estimate of quality, groups that are overrepresented in the imputed sample may produce lower QI scores than might otherwise be expected. It is also possible that the relatively high (12%) proportion of imputed observations might have an effect on the results of the PCA process for the sample as a whole. To test this a sensitivity analysis was conducted utilising a dataset with all imputed observations omitted, and the variable weights of the PCA process and the mean values of the resulting scores were compared to the results from the dataset including the imputed observations[67]. There were no significant differences in variable weights or mean scores both overall and for rural-urban, wealth or regional subgroups. As such the impact of the imputed variables on overall findings is expected to be minimal, and the imputed observations will be included in the final dataset used for the analysis.

4.4 Creation and Testing of Initial Quality Indices

Before analysis of the reliability and consistency of the QI to be used in the later analysis could begin it was necessary to decide upon which indicators would be included in each index, as well as what form they would take. The first issue to be considered was with regards to the treatment of partial indicators of quality.

The initial categories used to create indicator variables included multiple partial levels of quality: iron supplementation for example included five categories (No supplementation, 1-29 days. 30-89 days, 90-179 days, 180-269 days, and 270+ days), as did both maternal and neonatal PNC. It was unknown however if such level of detail is beneficial in increasing the explanatory ability of the QI, and it was possible that the inclusion of so many partial levels of quality may in fact hinder the validity and interpretability of the index.

The second issue pertains to the inclusion of indicators that either contributed very little to the overall index or were otherwise problematic based on the results of the data. For example, as the PCA process is based on shared correlation between indicators it is possible for a variable that should be associated with underlying quality of care may carry a negative PCA derived weight if its prevalence among those who have many other quality indicators is less than those who have relatively few indicators. In this case, an individual with this variable will score lower than an otherwise identical case without, despite evidence that the indicator is in fact beneficial in terms of health outcomes. A decision must therefore be made as to whether to include such an indicator in the final QI.

The PCA process was initially performed using all partial quality levels and all indicators (including both Core DHS and Indonesia- specific). The variable weights derived from these conditions showed several potential issues. While it might be expected that variables representing “no care”, such as no iron supplementation, would have negative weights (as they are negatively associated with the underlying factor representing quality care) and variable representing higher quality care would have more positive weights, the variable weight for one of the partial levels of iron supplementation (90-179 days) was greater than that of the “full quality” variable (270+ days). Less markedly, the weights for variables representing delayed PNC were did not always reduce as the magnitude of the delay increased; for both maternal and neonatal PNC the variable representing a first check up within 24-48 hrs of birth had a higher weight than the 3-12hr and 13-24hr variables.

These unexpected results reflect the underlying nature of the PCA process; weights are based on patterns of correlation between variables within the data, and the limited nature of the available indicators means that the process in this case will expose underlying associations in the manner of care provided to the client rather than with quality of care per se. As previously mentioned, if individuals who otherwise receive good quality care (as defined by receipt of the services represented by each indicator) are not receiving a particular indicator, or are receiving less than the expected full quality care, then the PCA weights will reflect this by assigning these variables a negative weight. If the prevalence of full iron supplementation is low and most of those women who are otherwise receiving the best available care are only receiving 180 days of supplements then it would be expected that the weight for that category is assigned a higher weight. An additional concern with the use of multiple partial quality variables is the potential that these additional variables will affect overall representation of the indicator within the dataset; as all categories relate to the same indicator the variables will inherently carry a certain level of internal correlation.

To explore these issues Table 3.4.1 presents the PCA derived variable weights under several different conditions. The first column shows the results of the initial scenario in which all potential indicators were included and up to five categories of quality were available for each indicator. The second column shows the results of the same scenario using only the core DHS indicators. The next columns present a scenario in which the levels of quality allowed for each indicator were limited to “Full”, “Partial” and “None”. The change in classification only affected three indicators; iron supplementation during pregnancy, maternal PNC and neonatal PNC. The final two scenarios completely omit partial levels of quality, only considering whether or not the individual received full quality or not. The difference between the two occurs with regards to what is considered full quality with regards to iron supplementation.

Table 4.4.1 PCA derived variable weights under different inclusion (All indicators vs Core DHS indicators) and classification scenarios (# of categories, partial quality indicators, 90+ days Iron), Indonesia 2012

Indicator		**Scenario**							
		All <5 cat.	**Core <5 cat.**	**All <3 cat.**	**Core <3 cat.**	**All no partials**	**Core no partials**	**All, no partials 90+ Iron**	**Core, no partials 90+ Iron**
ANC visit in 1st Trimester		0.096	0.088	0.082	0.041	0.104	0.109	0.105	0.115
ANC visit in 2nd Trimester		0.043		0.039		0.041		0.043	
ANC visits in 3rd Trimester	2	0.082		0.074		0.070		0.072	
	1	-0.011		-0.010					
	None	-0.070		-0.064					
Weight measured during ANC		0.071		0.066		0.071		0.070	
Height measured during ANC		0.256		0.229		0.284		0.281	
Blood Pressure measured during ANC		0.048	0.040	0.044	0.021	0.048	0.041	0.047	0.041
Urine sample taken during ANC		0.283	0.299	0.256	0.170	0.317	0.406	0.313	0.397
Blood sample taken during ANC		0.254	0.262	0.229	0.151	0.294	0.374	0.285	0.363
Stomach examined during ANC		0.017		0.015		0.018		0.017	
Consultation during ANC		0.127		0.113		0.138		0.135	
Received MNCH book during ANC		0.144		0.135		0.141		0.140	
Iron Supplementation during pregnancy	Full (270+ days)	0.033	0.034	0.022	0.016	0.034	0.038	0.192	0.249
	1-29 days	-0.036	-0.042	0.170	0.109				
	30-89 days	0.030	0.040						
	90-179 days	0.065	0.071						
	180-269 days	0.079	0.088						
	None	-0.171	-0.19	-0.192	-0.125				
Tetanus Immunisation	Full	0.232	0.299	0.214	0.154	0.186	0.245	0.187	0.248

Table 4.4.1 cont.

	Partial	-0.073	-0.110	-0.068	-0.056				
	None	-0.159	-0.188	-0.146	-0.098				
Pregnancy complication Advice		0.276	0.259	0.247	0.133	0.304	0.312	0.297	0.309
Discussed place of delivery during pregnancy		0.217		0.191		0.254		0.249	
Discussed transportation to place of delivery during pregnancy		0.332		0.294		0.390		0.380	
Discussed who would assist delivery during pregnancy		0.221		0.195		0.260		0.255	
Discussed payment for delivery during pregnancy		0.233		0.207		0.276		0.268	
Discussed possible blood donor during pregnancy		0.176		0.155		0.206		0.199	
Baby was weighed at birth		0.042	0.038	0.038	0.021	0.041	0.037	0.041	0.037
Baby was breastfed within 1 hr of birth		0.113	0.198	0.118	0.151	0.119	0.311	0.116	0.285
No liquids given before milk began to flow (no prelacteal feed)		0.074	0.150	0.077	0.112	0.082	0.264	0.078	0.237
Maternal postnatal check	Full (<2hrs)	0.215	0.386	0.308	0.532	0.195	0.381	0.190	0.360
	3-12 hrs	-0.050	-0.146	-0.244	-0.490				
	13-24hrs	-0.057	-0.098						
	25-48hrs	-0.009	-0.013						
	49hrs +	-0.027	-0.047						
	None	-0.072	-0.083	-0.064	-0.042				
Neonatal postnatal check	Full (<2hrs)	0.246	0.398	0.291	0.421	0.200	0.344	0.204	0.343
	3-12 hrs	-0.010	-0.051	-0.095	-0.296				
	13-24hrs	-0.013	-0.030						
	25-48hrs	0.000	-0.001						
	49hrs +	-0.001	-0.019						
	None	-0.223	-0.297	-0.196	-0.125				
Postpartum Vitamin A within 2 months of delivery		0.199	0.272	0.187	0.151	0.190	0.302	0.192	0.300
Rho		**0.1161**	**0.1223**	**0.1335**	**0.1624**	**0.1589**	**0.1834**	**0.1555**	**0.1774**

The seventh and eighth columns retain the 270+ days iron supplementation measure while the final two columns consider 90+ days of supplementation to be full quality. This more lenient definition of quality is based upon the IMPAC guidelines recommendation that three months' worth of supplements be provided in a single visit. An additional benefit of this definition is that it allows for women who received incomplete or delayed ANC to still be counted as having had the best care achievable under the circumstances; the indicator might otherwise run the risk of becoming a proxy variable for ANC timing.

As can be seen, removing additional levels of quality as seen in the third and fourth columns substantially increases the variance explained by the principal component, but overall does not change the weights of non-partial variables. There are still discrepancies however: most notably the weight for having no maternal PNC is higher than for having delayed PNC. Removing all partial quality variables, including that of delayed PNC, results in no contradictory variables, however the weight for the timely PNC variables decreases noticeably. This suggests that in this context, the factors associated with having no PNC are likely to be different for those associated with having delayed PNC. Unfortunately, the Indonesia 2012 DHS does not include variables relating to the content of PNC, so determining the nature of the care those with delayed PNC do receive is not possible with the current dataset. The binary "PNC <2hrs" classification does however still appear to be strongly associated with other quality indicators, and as such represents the preferred option for classification of this variable.

In terms of iron supplementation, the change in the classification "full quality" does appear to have a dramatic impact on indicator weight. Iron supplementation only negligibly contributes to the overall indicator score in the 270+ day scenario but a strong contributor in the 90+ day scenario. Iron supplementation is considered an important preventative intervention within the Indonesian context[104,105] , however given the limitations of timing very few women achieve a full period of supplementation. Additionally, it is possible that an index utilising the higher standard is conflating issues of ANC usage and quality of care. As the inclusion criteria for this analysis require having at least one ANC visit, and IMPAC guidelines recommend the provision of three months' worth of supplements per visit, the use of the 90 day standard is more likely to reflect the type of care that is provided regardless of the number of visits rather than indirectly reflecting access to care. As this issue is likely to exist regardless of the specific country context, and the change does not overly affect explanatory ability of the index, the final definitions chosen for the remainder of the analysis were those of the last set of scenarios; no partial quality variables, and the use of 90+ days of iron supplementation as standard.

Having determined the final variables to be included, Table 4.4.2 outlines the sample mean for each of the chosen indicators. Indicator prevalence ranged from 99% for stomach examination during pregnancy to 18% for discussion of potential blood. As mentioned in section 2.1.6, in order to examine reliability issues, an additional indicator set was to be created, excluding indicators with a mean prevalence of >90% or <10%.

In the 2012 Indonesia DHS this led to the exclusion of five indicators relating to ANC (Number of second trimester visits, number of third trimester visits, maternal weight measurement, blood pressure testing and stomach examination) as well as one related to birth practices (Weighing of newborn) from the "Key" indicator set.

Table 4.4.2 Potential Quality Indicators Identified with mean prevalence in population with both ANC and SBA services, Indonesia 2012

Indicator	**Mean**	**Std. Err.**	***95% CI Lower***	***95% CI Upper***
1+ ANC visit in 1st Trimester	0.819	0.004	*0.812*	*0.826*
1+ ANC visit in 2nd Trimester	0.961	0.002	*0.958*	*0.965*
2+ ANC visits in 3rd Trimester	0.919	0.003	*0.914*	*0.923*
Weight measured during ANC	0.955	0.002	*0.952*	*0.959*
Height measured during ANC	0.479	0.005	*0.470*	*0.488*
Blood Pressure measured during ANC	0.968	0.002	*0.965*	*0.971*
Urine sample taken during ANC	0.461	0.005	*0.452*	*0.470*
Blood sample taken during ANC	0.428	0.005	*0.419*	*0.437*
Stomach examined during ANC	0.986	0.001	*0.983*	*0.988*
Consultation during ANC	0.855	0.003	*0.849*	*0.861*
Received MNCH book during ANC	0.837	0.003	*0.830*	*0.844*
90+ days Iron supplementation during pregnancy	0.306	0.004	*0.298*	*0.315*
Fully protected from Tetanus during pregnancy	0.654	0.004	*0.646*	*0.663*
Told about pregnancy complications during ANC	0.549	0.005	*0.540*	*0.558*

Table 4.4.2 cont.

Discussed place of delivery during pregnancy	0.851	0.003	*0.844*	*0.857*
Discussed transportation to place of delivery during pregnancy	0.647	0.004	*0.638*	*0.655*
Discussed who would assist delivery during pregnancy	0.837	0.003	*0.831*	*0.844*
Discussed payment for delivery during pregnancy	0.800	0.004	*0.793*	*0.807*
Discussed possible blood donor during pregnancy	0.182	0.004	*0.175*	*0.189*
Baby was weighed at birth	0.969	0.002	*0.966*	*0.972*
Baby was breastfed within 1 hr of birth	0.482	0.005	*0.473*	*0.491*
No liquids given before milk began to flow (no prelacteal feed)	0.354	0.004	*0.345*	*0.362*
Maternal postnatal check within 2 hrs of delivery	0.537	0.005	*0.528*	*0.546*
Neonatal postnatal check within 2 hrs of delivery	0.336	0.004	*0.328*	*0.345*
Mother received postpartum Vitamin A within 2 months of delivery	0.503	0.005	*0.494*	*0.512*

PCA analysis was performed on three indicator sets (All, Key and Core), with the results presented in Table 4.4.3. Cronbach's alpha is also presented with regards to each indicator set; it is apparent that the indicators do not appear to be strongly homogenous, with only the All indicator set reporting an alpha above 0.7. Similarly, the proportion of variance explained by the primary component is not particularly high (<0.2) in any of indicator sets. As such the indicator weights for the secondary component have also been reported in order to examine additional patterns of correlations within the indicators that may potentially affect the results.

Despite concerns regarding the homogeneity of indicators, the primary components for all sets do appear to be reflecting an underlying factor that is associated with all the quality indicators. As PCA derived weights reflect the level to which a given indicator is associated with the underlying trend of correlation in the data represented by the primary component, more positive weights indicate that a variable tends to be more strongly correlated while a negative weight indicates a variable that is inversely correlated. As theoretically all indicators are reflective of good practice they should all be positively correlated (or at least not negatively correlated) with the underlying component if it is in fact reflecting quality of care. This is the case for all indicator sets in this example.

Table 4.4.3 Results of PCA carried out on 3 Indicator sets, Indonesia 2012

Indicator	**All Indicators**		**Key Indicators**		**Core Indicators**	
	Comp 1	**Comp 2**	**Comp 1**	**Comp 2**	**Comp 1**	**Comp 2**
1+ ANC visit in 1st Trimester	0.105	-0.011	0.103	-0.011	0.115	-0.082
1+ ANC visit in 2nd Trimester	0.043	0.002				
2+ ANC visits in 3rd Trimester	0.072	0.005				
Weight measured during ANC	0.070	0.017				
Height measured during ANC	0.281	0.136	0.282	0.135		
Blood Pressure measured during ANC	0.047	-0.001			0.041	-0.023
Urine sample taken during ANC	0.313	0.098	0.314	0.099	0.397	-0.235
Blood sample taken during ANC	0.285	0.140	0.287	0.140	0.363	-0.195
Stomach examined during ANC	0.017	-0.004				
Consultation during ANC	0.135	-0.060	0.134	-0.060		
Received MNCH book during ANC	0.140	0.075	0.138	0.074		
Iron supplementation during pregnancy	0.192	0.060	0.191	0.060	0.249	-0.075
Fully protected from Tetanus during pregnancy	0.187	0.113	0.185	0.112	0.248	-0.082
Told about pregnancy complications during ANC	0.297	-0.062	0.300	-0.061	0.309	-0.243
Discussed place of delivery during pregnancy	0.249	-0.251	0.252	-0.250		
Discussed transportation to place of delivery during pregnancy	0.381	-0.306	0.386	-0.305		
Discussed who would assist delivery during pregnancy	0.255	-0.268	0.259	-0.266		
Discussed payment for delivery during pregnancy	0.268	-0.291	0.272	-0.289		
Discussed possible blood donor during pregnancy	0.199	-0.069	0.201	-0.069		
Baby was weighed at birth	0.041	-0.007			0.037	-0.027
Baby was breastfed within 1 hr of birth	0.116	0.503	0.118	0.504	0.285	0.664
No liquids given before milk began to flow	0.078	0.475	0.080	0.475	0.237	0.608
Maternal postnatal check within 2 hrs of delivery	0.190	0.257	0.192	0.258	0.360	0.017
Neonatal postnatal check within 2 hrs of delivery	0.204	0.188	0.206	0.190	0.343	-0.038
Mother received postpartum Vitamin A < 2 months of delivery	0.192	0.162	0.194	0.163	0.300	-0.124
Rho	**0.156**	**0.093**	**0.163**	**0.099**	**0.177**	**0.130**
Cronbach's α	**0.710**		**0.687**		**0.537**	

The secondary components provide a contrasting picture; while breastfeeding indicators have a strong positive association with the secondary underlying component, indicators relating to birth preparedness (in the All and Key sets) and ANC components (in the Core set) have a strongly negative association.

This secondary component appears to be reflecting a trend in observations which do have breastfeeding indicators being less likely to have the birth preparedness indicators. This is perhaps unsurprising as levels of exclusive breastfeeding are higher in poorer and more rural populations in Indonesia, and these population are more likely to experience barriers to receiving appropriate health education and care[106]. Quality of care issues relating to breastfeeding may thus not be full represented in the index formed from the primary component, although the majority of other indicators will be unaffected.

In terms of individual indicators within the primary components, blood testing, urine testing and pregnancy complication advice during ANC remain relatively highly weighted across all sets, birth preparedness indicators have high weights when they are present, and tetanus immunisation, iron supplementation and timely PNC indicators are moderate to highly weighted depending on the indicator set. These indicators are thus the elements that will form the basis of discrimination between levels of quality care in the resulting PCA derived QI.

As the primary component does overall appear to be reflective of good quality care in terms of the provision of services, the use of PCA based QI in further analysis was determined to be feasible, although care should be taken when examining the results. Furthermore, these results demonstrated that the exclusion of high prevalence indicators from the Key indicator set did not appear to have a large impact on the resulting PCA based index, as the excluded indicators carry very minor weight in the formation of each observation's score.

Accordingly, six QI were created for reliability testing;

1) All indicators, PCA weighting
2) All indicators, EW weighting
3) Key indicators, PCA weighting
4) Key indicators, EW weighting

5) Core indicators, PCA weighting
6) Core indicators, EW weighting

Standardised scores were produced for each observation using the QI, Table 4.4.4 shows the correlation between QI as well as the mean, minimum and maximum scores for each. There is generally a high level of correlation between QI scores and as seen in Table 4.4.5 with relatively small differences in how observations are classified across different QI.

Table 4.4.4 Summary statistics of and Correlation between QI created for reliability testing

Corr. between scores	**QI1 - All indicators PCA weighting**	**QI2 - All indicators EW weighting**	**QI3 - Key indicators PCA weighting**	**QI4 - Key indicators EW weighting**	**QI5 - Core indicators PCA weighting**	**QI6 - Core indicators EW weighting**
QI 1	1					
QI 2	0.969	1				
QI 3	0.999	0.962	1			
QI 4	0.976	0.987	0.975	1		
QI 5	0.794	0.842	0.793	0.856	1	
QI 6	0.789	0.862	0.784	0.865	0.982	1
Mean	-1.60E-10	-1.24E-08	3.34E-11	1.06E-08	-1.44E-09	-6.57E-09
Min	-3.263	-4.384	-2.977	-3.293	-2.357	-3.250
Max	2.191	2.329	2.207	2.438	2.490	2.486

Table 4.4.5 Correlation between quintile assignments between QI created for reliability testing

Corr. between Quintiles	**QI1 - All indicators , PCA weighting**	**QI2 - All indicators , EW weighting**	**QI3 - Key indicators , PCA weighting**	**QI4 - Key indicators , EW weighting**	**QI5 - Core indicators , PCA weighting**	**QI6 - Core indicators , EW weighting**
QI 1	1					
QI 2	0.933	1				
QI 3	0.993	0.929	1			
QI 4	0.939	0.986	0.938	1		
QI 5	0.759	0.816	0.757	0.822	1	
QI 6	0.748	0.835	0.745	0.835	0.947	1

These results indicate a reasonably high level of consistency in measurement, as does the comparison of indicator means by quintile assignment, an example of which can be seen in Table 4.4.6 which shows the mean indicator value by quintile assignment for QI1 and QI6 – the two QI with the greatest difference in indicator sets and weighting methodology.

While no indicator shows a decreasing in indicator mean as the QI quintile increases, there are differences; QI1 provides much greater discrimination in terms of pregnancy planning indicators while QI6 produces larger differences with regards to breastfeeding indicators. Overall however the QI appear to consistently show increasing indicator means with increasing QI scores.

As mentioned in section 3.6.1 the reliability of the PCA based weighting technique was also tested by recalculating variable weights using multiple random samples of observations. To provide an appropriately large subsample “split-half” samples were chosen, in which observations were randomly assigned to two groups and one group randomly selected for use in the reanalysis. This procedure was carried out ten times, the results of which can be seen in Appendix 2. Differences in variable weights were minor with all variable weights reporting a standard error below 0.0015. In combination, all these measures suggest that the QI constructed in the initial analysis reliably classified observations by indicator prevalence, which in turn appear to reflect an underlying aspect reflecting quality of care.

Unfortunately while the reliability of the QI may be assumed to be reasonably good, its validity in terms of the ability of these indicators to measure “true quality of care” is more difficult to ascertain.

Table 4.4.6 Indicator means by Quintile Assignment (1-5 from Lowest to Highest) for QI1 and QI6

Indicator	**QI1 - All indicators, PCA weighting**					**QI6 - Core indicators, EW weighting**				
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
1+ ANC visit in 1st Trimester	0.692	0.789	0.825	0.867	0.921	0.623	0.811	0.873	0.905	0.949
1+ ANC visit in 2nd Trimester	0.908	0.952	0.973	0.981	0.993	0.904	0.963	0.982	0.983	0.991
2+ ANC visits in 3rd Trimester	0.824	0.908	0.933	0.952	0.975	0.846	0.912	0.938	0.952	0.971
Weight measured during ANC	0.857	0.947	0.981	0.994	0.998	0.87	0.961	0.983	0.99	0.996
Height measured during ANC	0.195	0.322	0.445	0.596	0.836	0.277	0.436	0.524	0.591	0.662
Blood Pressure measured during ANC	0.905	0.964	0.981	0.991	0.997	0.893	0.978	0.992	0.993	0.999
Urine sample taken during ANC	0.157	0.28	0.395	0.611	0.864	0.131	0.349	0.538	0.654	0.825
Blood sample taken during ANC	0.175	0.25	0.351	0.534	0.831	0.137	0.32	0.489	0.601	0.768
Stomach examined during ANC	0.963	0.985	0.992	0.99	0.998	0.968	0.988	0.993	0.988	0.993
Consultation during ANC	0.674	0.823	0.889	0.925	0.963	0.748	0.853	0.887	0.892	0.927
Received MNCH book during ANC	0.652	0.795	0.868	0.923	0.947	0.677	0.834	0.883	0.911	0.933
90+ days Iron supplementation during pregnancy	0.11	0.196	0.298	0.383	0.544	0.069	0.219	0.344	0.415	0.617
Fully protected from Tetanus during pregnancy	0.435	0.584	0.673	0.724	0.856	0.358	0.622	0.725	0.795	0.887
Told about pregnancy complications during ANC	0.207	0.406	0.551	0.716	0.863	0.231	0.489	0.631	0.711	0.826
Discussed place of delivery during pregnancy	0.454	0.863	0.954	0.984	0.997	0.747	0.839	0.878	0.897	0.932
Discussed transportation to place of delivery during pregnancy	0.109	0.523	0.758	0.883	0.962	0.476	0.614	0.697	0.728	0.797
Discussed who would assist delivery during pregnancy	0.439	0.831	0.94	0.983	0.995	0.744	0.813	0.872	0.883	0.922
Discussed payment for delivery during pregnancy	0.396	0.782	0.886	0.952	0.983	0.7	0.785	0.826	0.851	0.879
Discussed possible blood donor during pregnancy	0.01	0.06	0.138	0.221	0.481	0.08	0.139	0.198	0.252	0.309

Table 4.4.6 Cont.

Baby was weighed at birth	0.914	0.959	0.986	0.99	0.995	0.901	0.976	0.994	0.991	0.996
Baby was breastfed within 1 hr of birth	0.373	0.406	0.477	0.531	0.621	0.206	0.394	0.531	0.625	0.8
No liquids given before milk began to flow (no prelacteal feed)	0.288	0.302	0.338	0.373	0.466	0.135	0.269	0.363	0.472	0.656
Maternal postnatal check within 2 hrs of delivery	0.348	0.44	0.522	0.609	0.769	0.236	0.448	0.602	0.696	0.865
Neonatal postnatal check within 2 hrs of delivery	0.138	0.23	0.3	0.409	0.604	0.083	0.221	0.35	0.481	0.707
Mother received postpartum Vitamin A within 2 months of delivery	0.31	0.39	0.495	0.593	0.728	0.209	0.434	0.567	0.661	0.787

Without a known group to compare quality scores against, the external validity of the QI, that is, how well it reflects “true” quality of care, cannot be reliably established. As mentioned in chapter 2, attempting to assess the validity of the QI using mortality rates is similarly problematic due to lack of information regarding EMOC and the fact that mortality estimates are only available at the national level in the case of maternal mortality and provincial level in the case of neonatal mortality. Perhaps the closest source of data surrounding relative quality of care in Indonesia comes from the Indonesia Family Life Survey (IFLS)[107]. The IFLS is a panel study with multiple survey rounds following a sample of households in 13 Indonesian provinces since 1993. The sample was designed to be representative at urban-rural and Java/Bali-Non-Java/Bali levels and the household survey included relatively few questions regarding maternal and neonatal care; as such it is does not directly align with the DHS survey set.

All IFLS rounds did however include facility surveys broadly representative of health providers in the communities which the surveyed households lived. Diana et al[108] found that in terms of physical resources, public facilities were generally of a higher quality, primarily due to their ability to provide laboratory tests and immunisation services, although both public and private health facilities showed a modest increase in quality between 1993 and 2007. While these physical aspects of quality cannot be compared to anything in the existing DHS, the survey also conducted interviews with staff providing prenatal care, child curative care and adult curative care in order to assess the activities performed during a health visit[109]. While a lack of birth and PNC related indicators precludes direct comparison with the QI, the 2007 survey did demonstrate that prenatal care was generally of low quality, with providers in Java-Bali performing better than those in outer Java-Bali regardless of urban rural status[109].

Table 4.4.7 shows the mean QI score for observations in the regions sampled as part of the IFLS; Java-Bali (containing Jakarta, West Java, Central Java, Yogyakarta, East Java and Bali regions) and Outer Java-Bali (containing North Sumatra, West Sumatra, South Sumatra, Lampung, West Nusa Tenggara, South Kalimantan and South Sulawesi) both in total and by urban rural status as well as t-test results for significance. As can be seen, all QI regardless of weighting or indicator set used, produced results consistent with the IFLS findings for prenatal care regarding location. This is a positive finding as despite the mismatch in indicator topics between the two surveys, the general pattern of quality is consistent.

Table 4.4.7 Mean QI scores for IFLS regions in Indonesia 2012 DHS by Rural Urban status

	Total			**Urban**			**Rural**		
	Java-Bali	**Outer Java-Bali**	***p-value***	**Java-Bali**	**Outer Java-Bali**	***p-value***	**Java-Bali**	**Outer Java-Bali**	***p-value***
QI1 - All indicators, PCA weighting	0.242	-0.229	*0.000*	0.314	-0.132	*0.000*	0.122	-0.301	*0.000*
QI2 - All indicators, EW weighting	0.287	-0.248	*0.000*	0.346	-0.152	*0.000*	0.187	-0.321	*0.000*
QI3 - Key indicators, PCA weighting	0.235	-0.227	*0.000*	0.306	-0.135	*0.000*	0.116	-0.296	*0.000*
QI4 - Key indicators, EW weighting	0.269	-0.249	*0.000*	0.326	-0.171	*0.000*	0.174	-0.307	*0.000*
QI5 - Core indicators, PCA weighting	0.290	-0.246	*0.000*	0.324	-0.209	*0.000*	0.234	-0.274	*0.000*
QI6 - Core indicators, EW weighting	0.309	-0.246	*0.000*	0.340	-0.202	*0.000*	0.256	-0.279	*0.000*

Another potential source of validation is to consider the health policies in place within a country, which may implicitly identify groups who are not currently receiving adequate health services. In Indonesia primary health services are usually provided through health centres known as Puskesmas, which are supplemented at the village level by delivery posts known as Polindes (staffed by Village Midwives) and outreach services provided at integrated service posts known as Posyandu (usually on a monthly basis) [110]. Physical proximity to health services is considered a major factor influencing utilisation rates in Indonesia[110,111] however several studies have noted that village level services, are often irregular due to limitations in staff availability and resourcing[110,112,113] which is known to limit coverage of ANC and PNC services in those relying upon such facilities for maternal and neonatal health care. As such, we would expect that those reporting usage of Polindes or Posyandu to be more likely to have experienced interrupted, and accordingly lower quality, care than those utilising other service providers.

Table 4.4.8 Mean QI scores for Village Based vs Non-Village Based Services

	ANC			**SBA**			**ANC&SBA**		
	Village	**Non-Village**	***p-value***	**Village**	**Non-Village**	***p-value***	**Village**	**Non-Village**	***p-value***
QI1 - All indicators PCA weighting	-0.198	0.022	*0.000*	-0.320	0.125	*0.000*	-0.239	0.015	*0.000*
QI2 - All indicators EW weighting	-0.181	0.020	*0.000*	-0.324	0.127	*0.000*	-0.218	0.014	*0.000*
QI3 - Key indicators PCA weighting	-0.190	0.021	*0.000*	-0.312	0.122	*0.000*	-0.229	0.015	*0.000*
QI4 - Key indicators EW weighting	-0.149	0.016	*0.000*	-0.294	0.115	*0.000*	-0.173	0.011	*0.000*
QI5 - Core indicators PCA weighting	-0.003	0.000	*0.914*	-0.215	0.084	*0.000*	-0.013	0.001	*0.738*
QI6 - Core indicators EW weighting	-0.030	0.003	*0.311*	-0.239	0.094	*0.000*	-0.045	0.003	*0.245*

As the sample has already been limited to only those with both ANC and SBA services, and questions are asked regarding where each of these services were provided, observations can be classed by their usage of village based services[xiii]. Table 4.4.8 shows the mean QI score for observations reporting village based services (Home, Polindes or Posyandu) compared to those utilising other services as well as t-test results for

[xiii] It should be noted that while the DHS asks questions relating to the place where PNC checks occurred, this cannot be used to form an independent group as having maternal and neonatal is implicitly included in the quality indicators.

significance. Three categories are considered; those utilising village based ANC services (10% of sample), those utilising village based SBA services (28% of sample) and those who utilised village based services for both ANC and SBA (6% of sample).

It is apparent that while the QI based on the All and Key indicator sets show a statistically significant difference between village and non-village based services across all categories, DHS based QI only produced statistically significant differences for the SBA group. Overall this suggests that for our known group at risk of low quality care, only the All and DHS indicator sets are reliably classifying them as such. This is not overly surprising, as the number of indicators in the DHS based indicator set is quite low, making discrimination between observations more difficult than the QI based on more diverse indicator sets. Additionally, the DHS indicator set carries far fewer indicators related to patient-provider interactions (such as discussions about birth preparedness or supply of MNCH book), which may be an indicator of more comprehensive visits. This suggests that the QI chosen for analysis should be based on the larger indicator sets.

This is a promising, but far from conclusive indication that the QI is reflecting quality of care. However until such time as additional studies are undertaken to establish variation in quality of care using different investigative tools the overall validity of the QI as a measurement of quality of maternal and neonatal care cannot be appropriately addressed.

4.5 Decision on Feasibility of Quality Indices and Choice of Indicator Set

The aim of piloting the QI methodology in a single country dataset was to determine the feasibility of the process. This required that an appropriate set of indicators could be drawn from the existing data, that an index could be constructed from these indicators and that the resulting index could be demonstrated to be both reliable in classifying observations and produce general results that were valid given existing knowledge of variation in quality of care.

With regards to the identification of indicators and the construction of the QI, the above section demonstrated that not only could indicators of good quality care be found within the existing dataset, but as shown in the results of the PCA, these indicators did appear to share an underlying level of correlation despite their diverse nature. Testing of “partial” levels of quality demonstrated that while the inclusion of these could provide a certain level of insight into underlying patterns of care, it could come at the expense of producing an appropriate combined measure of quality of care. The testing of different indicator sets similarly demonstrate that the Core DHS set of indicators, while better than nothing, may not produce as reliable an index as more comprehensive indicator sets.

Despite this, all the QI demonstrated a high level of correlation in terms of classification of observations, and the variable weights assigned by the PCA process were largely unaffected by either random sub-sampling or omission of particular indicators. As such, the QI methodology appears to be largely reliable. Similarly, while there is no “gold standard” against which to directly test the QI, the results of the QI produced similar results to what was expected given existing knowledge of both variation in the quality of prenatal care and population groups known to be at high risk of poor quality care.

Having ascertained that it was possible to create the QI and that the resulting index demonstrated notable reliability and face validity, a decision needed to be made as to the final QI to be used in the equity based analyses. As mentioned in Chapter 2, it is desirable to utilise both PCA and EW based indicator weighting in the final analysis in order to examine the difference the theoretical concept of quality (as represented by having as many indicators of good quality practice as possible) and the relative concept of quality (based on assigning different levels of importance to various indicators). Based on the results of the known-group testing, as well as the desirability for a broad range of indicators, QI based on the Core DHS indicator set are not desirable for use in the analysis.

From this point of view, including only quality indicators that the data suggests are relevant, the Key indicator set would be preferable, however in terms of representing multiple aspects of quality the All indicator set benefits from including one of the few indicators available in this dataset relating to birth practices (Baby weighed at birth) and additional indicators relating to ANC visits in the second and third trimester. The correlation between QI scores based on these indicator sets is high (> 95%), which suggests that in practical terms there would be little difference in the results of the analysis regardless of which set was chosen. Therefore, the final QI used in the Indonesia equity analysis was based on the All indicator set, using both EW and PCA weighting. This provides the broadest conceptualisation of quality while maintaining reliability of scoring. The next chapter will utilise these QI results to examine variation in quality of care in Indonesia across a number of demographic categories, including wealth, region, age and education, as well as between different healthcare providers.

5 Variation in the Quality of Maternal and Neonatal care in Indonesia

The testing of the QI methodology using the Indonesia 2012 DHS dataset identified several potential themes relating to quality of maternal and neonatal care within the country. Most notably residence in outlying regions[114 109], and use of certain types of provider[108,110,113] were likely to affect the quality of care received. Given the highly decentralised nature of the Indonesian healthcare system, and the historical emphasis on expanding access to basic, primary level care, the QI based analysis may provide important insights not only into whether or not these inequities are evident for the population at large, but also into how these elements interact with one another within the Indonesian context.

5.1 Country Background

Indonesia is one of Southeast Asia's largest countries, with a population of over 260 million inhabiting over 13 000 islands stretching over five thousand kilometres from east to west. It has experienced both rapid population and economic growth in recent decades, and is the largest economy in Southeast Asia with a per Capita GDP of US$3346[115]. The country is divided into 34 provinces, which are in turn grouped into geographical regions roughly corresponding to island groups; Sumatra, Java, Lesser Sunda Islands, Kalimantan, Sulawesi, Maluku Islands and Western New Guinea. Provinces are further divided into regencies and cities, which in turn are formed from multiple subdistricts (*kecamatan*) including several villages.

Nearly 60% of the country's population live on the island of Java, and in general population density decreases with distance from the capital of Jakarta[116]. Despite increasing urbanisation, the majority of the population live in rural areas; outlying provinces tend to be less urbanised, however even the heavily populated provinces of Java contain a large population of rural residents (e.g. 16% of East Nusa Tenggara is urban compared to 58% in Yogyakarta[116]. Much of the archipelago is mountainous, and often tectonically active; access to services in rural areas can often be problematic and affected by seasonal constraints. The country is highly diverse both geographically and culturally; while Indonesian remains the official language~~s~~ , at least 700 regional languages exist and are spoken by approximately 300 different ethnic groups[117]. Similarly, while Islam is the dominant religion (accounting for 87% of the population) notable Christian, Hindu and Buddhist minorities exist.

At a national level, coverage of MNCH services has increased substantially in the last decade, with at least one ANC visit increasing from 66% in the 2007 DHS to 74% in 2012 and SBA coverage rising from 73% to 83% over the same period[118], however neonatal and maternal mortality have not improved at a similar rate. Neonatal mortality remained stable, estimated at 19 deaths per 1000 live births in both the 2007 and 2012 DHS – estimates derived from other sources similarly report extremely limited progress over this period[119]. Rates of maternal mortality are also worrying; while the apparent increase in mortality from 228 to 359 deaths per 100 000 live births as estimated through the DHS may be the result of statistical limitations[120] even modelled 2015 estimates place Indonesia's MMR well above other countries in the region at 126 deaths per 100 000 compared to 40 for Malaysia and 114 for the Philippines[121].

Nationally, health is considered the responsibility of the Ministry of Health however following the rapid rollout of decentralisation policies in 2001 the delivery of health services was devolved to local government units[9,122]. Provincial Health Offices are theoretically responsible for coordination between District Health Offices, who are in turn responsible for overall policy, planning and budgeting. In practice however varying levels of institutional capacity to appropriately deal with increased autonomy has led to increasing inequity in the provision of health services, particularly with regards to underdeveloped regions[9,63,109,112,122]

Due to the large population and large geographic area requiring access to services, the Indonesian Health System is heavily reliant on community based programs centred on the Primary Health Centre (*Puskesmas*) found in each subdistrict[110]. The services available at each Puskesmas vary, ranging from 24hr facilities capable of providing simple surgical and Basic EMOC services to outpatient facilities providing basic preventative and curative care as well as limited health promotion activities. Puskesmas are generally supported by village level services including integrated health posts (*Posyandu*) that utilise volunteers to provide health promotion and preventative services, maternity posts (*Polindes*) staffed by village midwives providing maternal health services including ANC, delivery and PNC, and in remote areas Sub-Health Centres (*Pustu*) which provide a reduced range of Puskesmas activities. In addition to these primary health services, hospital care is provided at the district, provincial and national levels; theoretically all referral hospitals are capable of providing comprehensive EMOC, with provincial and central hospitals providing additional specialised care[110].

In general, public facilities tend to be heavily under-resourced, relying upon often insufficient user fees to finance the non-salary costs of providing care[109,111]. Additionally, low remuneration in the public sector has led to the proliferation of dual public-private practicing among health staff, leading to difficulties in obtaining staff for remote and regional areas as well as high rates of absenteeism[110,112,123]. Unsurprisingly, this has led to the rapid growth of the private health sector; the 2012 DHS estimates that only 17% of deliveries occur in government facilities compared to 46% for private facilities[118]. The private sector remains largely unaccredited, and access to facilities is heavily dependent both on location and wealth[109,111,124], with many private providers consisting of health professionals practicing solo[109].

Health financing in Indonesia has traditionally been reliant upon Out of Pocket (OOP) expenditure; the 2012 DHS reported that 63% of women aged 15-49 and 69% of men aged 15-54 had no health insurance. Another 26% or women were covered by social health insurance including the Jamkesmas program targeting the poor and near-poor, the Askes program covering civil servants and the Jamsostek program for formal sector workers[111]; of these the Jamkesmas program was the largest, however the program experienced difficulties in providing the complete benefits package in rural and remote areas and OOP payments even for those covered by the program remained high[110,111,124].

As part of a move towards universal health coverage, Indonesia began the roll out of the Jaminan Kesehatan Nasional (JKN) program in 2014; a mandatory insurance scheme designed to provide access to public sector services to all Indonesian residents, primarily through the strengthening of the Puskesmas system to provide primary health care and referral only access to referral facilities. The initial phase involved the transition of all existing Jamkesmas, Askes and Jamsostek participants into the new scheme, with the intention to cover the entire population by 2019[111]. As this significant change to Indonesian health policy occurred after the data collection phase of the 2012 DHS the results of this study may be considered as a baseline for investigating the potential effect of the JKN on quality of care in future DHS.

There are very few studies regarding the quality of maternal or neonatal care in Indonesia, as noted in a recent systematic review[81], and these tend to be either impact assessments of training programs or reports of single-site assessments of hospital care, which do not provide a comparison across sub-populations. There has been one study assessing of the quality of hospital care for children[114] in 18 randomly sampled hospitals across six provinces that included an assessment of routine neonatal care, however the study found that while quality of care was sub-optimal across all sites, and there was no clear region, or hospital type, that performed substantially better than any other. As mentioned in Section 4.4, data from the IFLS similarly found deficiencies in terms of routine quality of care, with substantial variation for both physical and technical quality along both regional and public-private provider lines[108,109]. More specifically relating to the quality of maternal health, a recent analysis of qualitative data from poor women in Banten and Jakarta has indicated that overcrowding and lack of trained staff at Puskesmas influences the limited use of facility based delivery among these women[125].

5.2 QI score by Key Equity Markers

As outlined in Chapter 3, the final QI used to examine variation in quality of care are those utilising PCA and EW based weighting using all available indicators. DHS calculated survey weights have been applied as necessary to present representative estimates.

5.2.1 Variation by Wealth and Urban Rural Status

As can be seen in Figure 5.2.1, scores are much higher in urban Indonesia as a whole compared to rural areas regardless of the QI used. Given the known constraints regarding the difficulties in providing care to rural populations in Indonesia, and higher proportion of rural residents in remote regions, this is not an unexpected finding. Similarly, the apparent wealth gradient shown in Figure 5.2.2 where QI scores are much lower for the poor aligns with existing knowledge about usage of health services. As mentioned in previous sections, financial access is a major determinant of provider type in Indonesia, and user fees combined with a reluctance of private providers to accept patients covered by the Jamkesmas social insurance program for the poor can result in a reliance upon intermittent and under-resourced village level services[113,124]. At the same time, there does not appear to be a consistent increase in QI scores across all wealth quintiles – the difference between the poorer and middle wealth quintiles for example is quite small, suggesting a non-linear relationship between wealth and quality.

Figure 5.2.1 Mean QI scores for Urban and Rural populations using PCA and EW based QI with All Indicators, Indonesia 2012

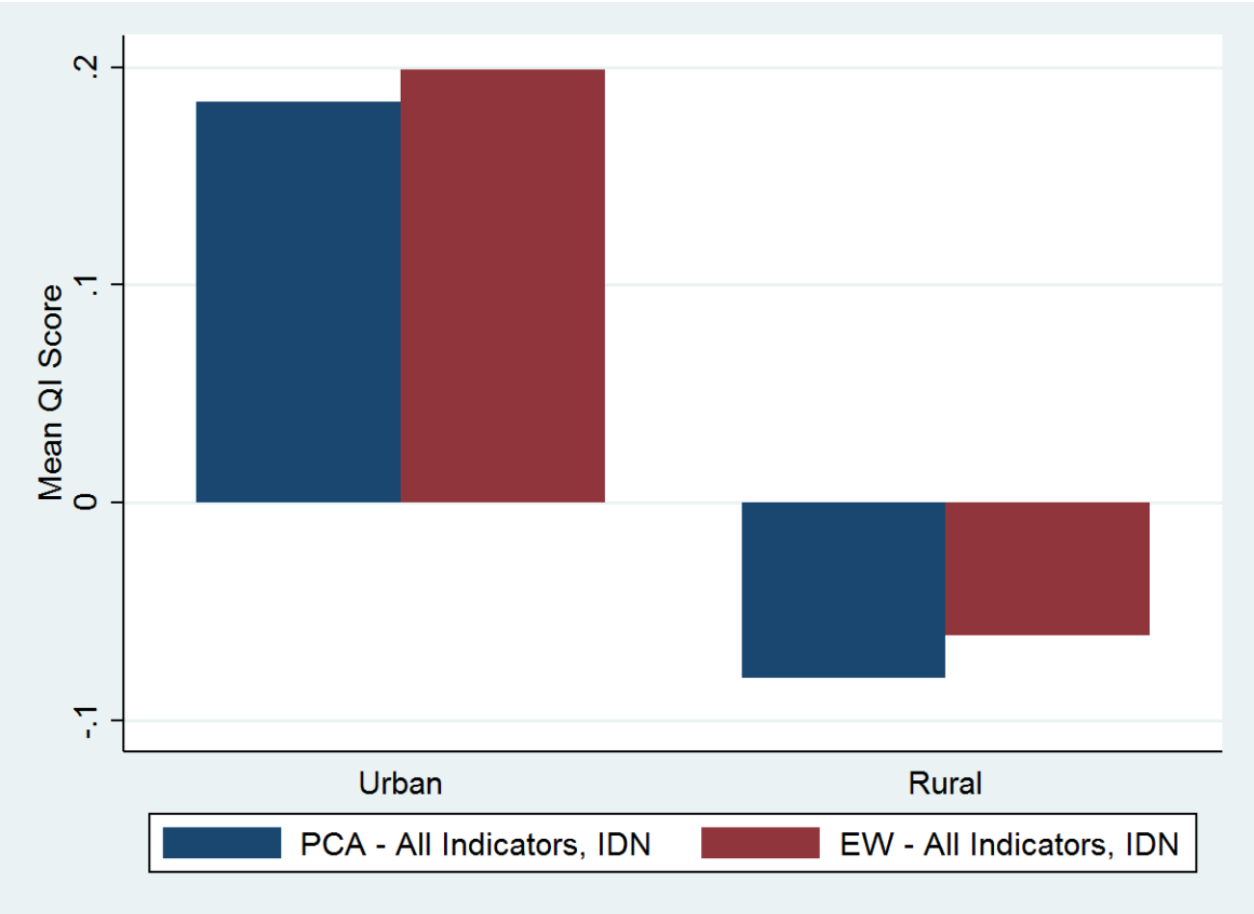


Figure 5.2.2 Mean QI scores by Wealth Quintile using PCA and EW based QI with All Indicators, Indonesia 2012

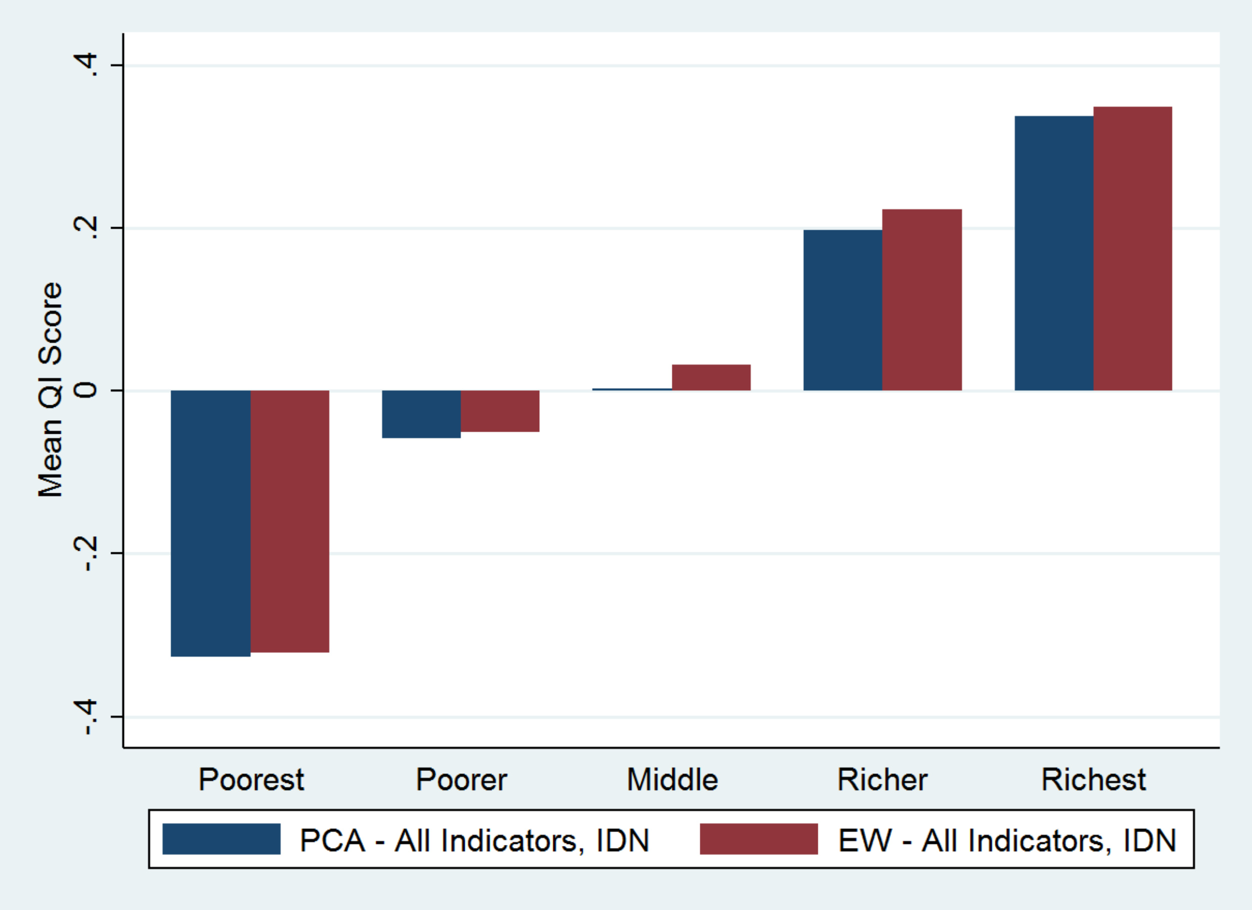
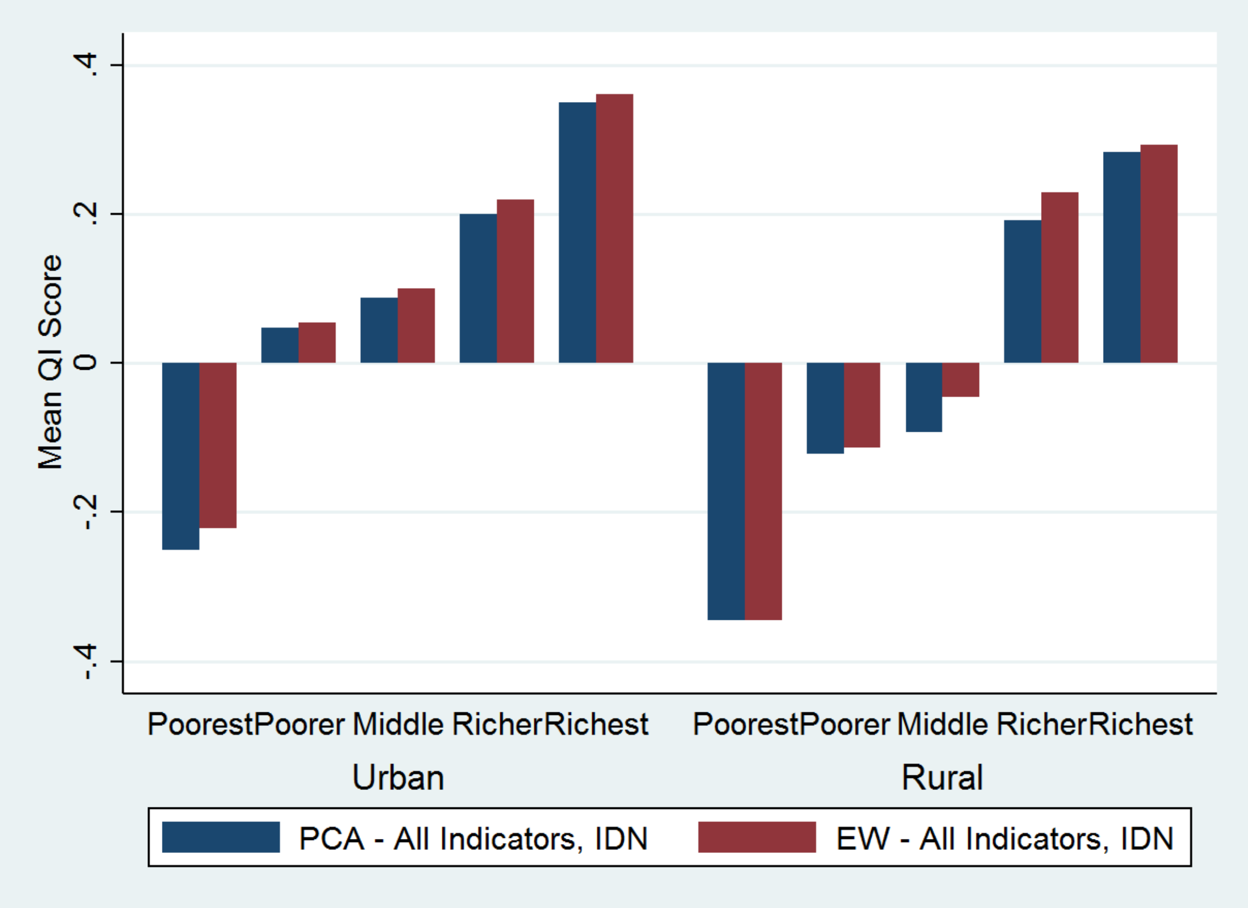


Figure 5.2.3, which shows mean QI scores by wealth quintile for urban and rural populations separately, clarifies this relationship somewhat. In urban areas the greatest difference in QI scores is between the two lowest wealth quintiles. At the same time, there is an almost exponential increase with each wealth category thereafter. Rural areas show comparatively lower scores for the lowest three wealth quintiles followed by a large increase between the Middle and Richer quintiles - indeed, wealthier rural residents are not substantially worse off than their urban counterparts. These contrasting trends open the possibility that while access to good quality services is more common in urban areas, it is still available in rural areas for those who can afford it.

Figure 5.2.3 Mean QI scores by Wealth Quintile for Urban and Rural population, using PCA and EW based QI with All Indicators, Indonesia 2012



5.2.2 *Variation by Maternal Age and Education Level*

One difficulty in examining urban rural trends however is that they can be considerably different in terms of population makeup. It is therefore useful to determine if QI scores vary based on other common demographic factors.

As can be seen in Figure 5.2.4, maternal age does appear to be associated with variation in QI scores. In general scores are lower for younger mothers, particularly those who gave birth under the age of 20 years. As both rural and poorer women are known to begin childbearing at an earlier age[120] at this stage of the analysis it isn't possible to determine the level to which age itself may be a factor, however the lower QI scores for younger mothers is concerning, as teenage pregnancy is known to increase the risk of pregnancy complications.

There is also a decrease in quality scores for mothers over the age of 35, which possibly reflects differences in maternal practices for higher parity births – Table 5.2.5 shows the QI scores by birth order, and demonstrates that QI scores are much lower for third and higher births. While it is possible that this too reflects the higher birth rate in rural populations, there is evidence that ANC usage in particular is much lower for women who have already had previous births due to perceptions that such care is unnecessary[113].

Figure 5.2.4 Mean QI scores by Maternal Age at Birth, using PCA and EW based QI with All Indicators, Indonesia 2012

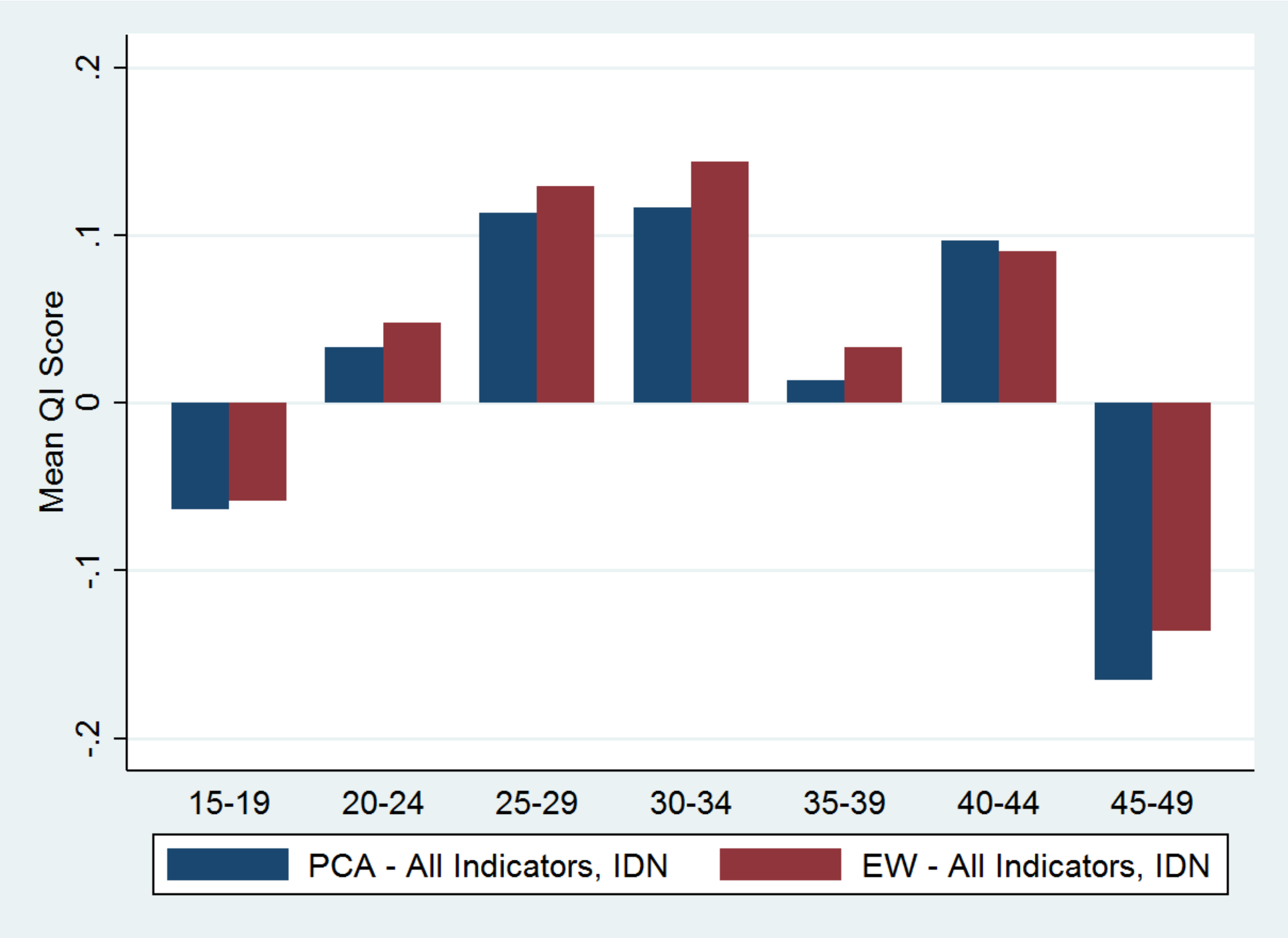
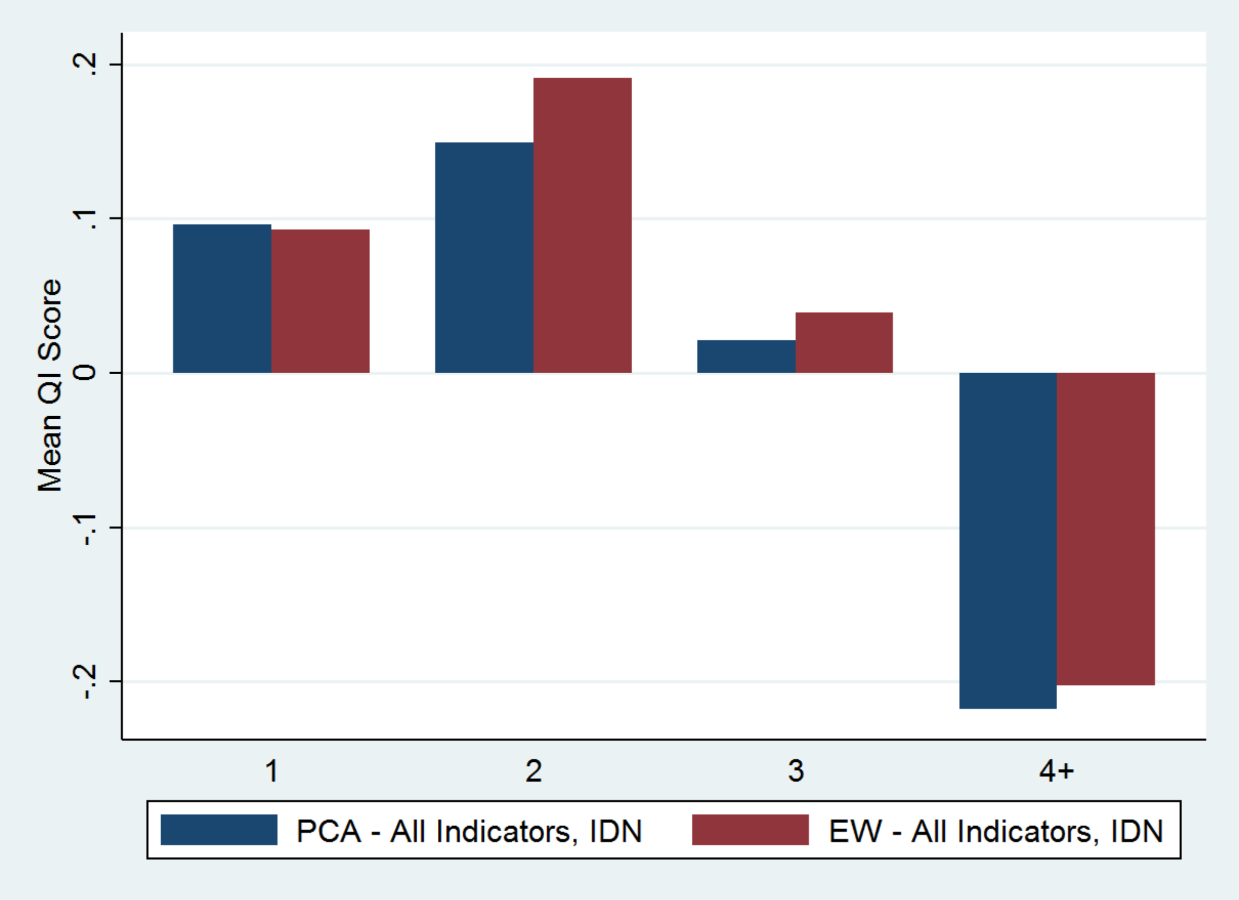
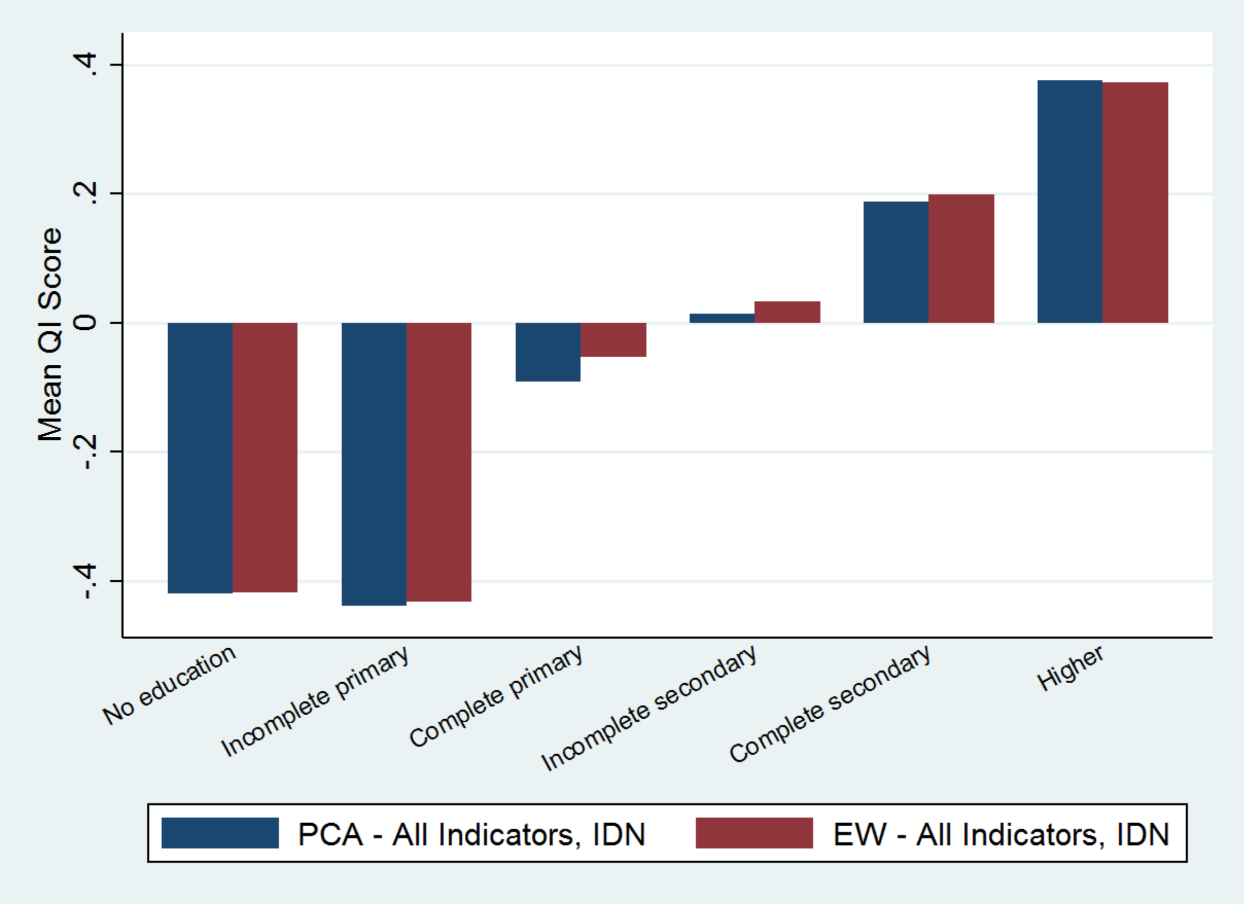


Figure 5.2.5 Mean QI scores by Birth Order, using PCA and EW based QI with All Indicators, Indonesia 2012



It is possible some of these trends may also be reflecting educational differences between younger mothers and the rest of the population; lower levels of maternal education may correspond with lower health literacy, and thus a lack of knowledge of what services are available. Figure 5.2.6 presents QI scores by maternal educational attainment; as expected not completing primary education is associated with very low quality, however QI scores also increase with every educational level thereafter. It is possible, again, that correlation between education and other factors such as wealth are responsible for these trends, however given the potential for education to affect health knowledge it cannot be discounted entirely.

Figure 5.2.6 Mean QI scores by Maternal Educational Attainment, using PCA and EW based QI with All Indicators, Indonesia 2012



5.2.3 Variation by Region

Given the highly decentralised nature of the Indonesian health system, and the known regional variation in both access to and use of health facilities, quality of care might also be expected to show very different patterns across provinces.

Figure 5.2.7 demonstrates that this certainly appears to be the case. QI scores are generally higher in more centralised regions closer to Java with the highest scores found in the Special Region of Yogyakarta[xiv]. This is relatively unsurprising given

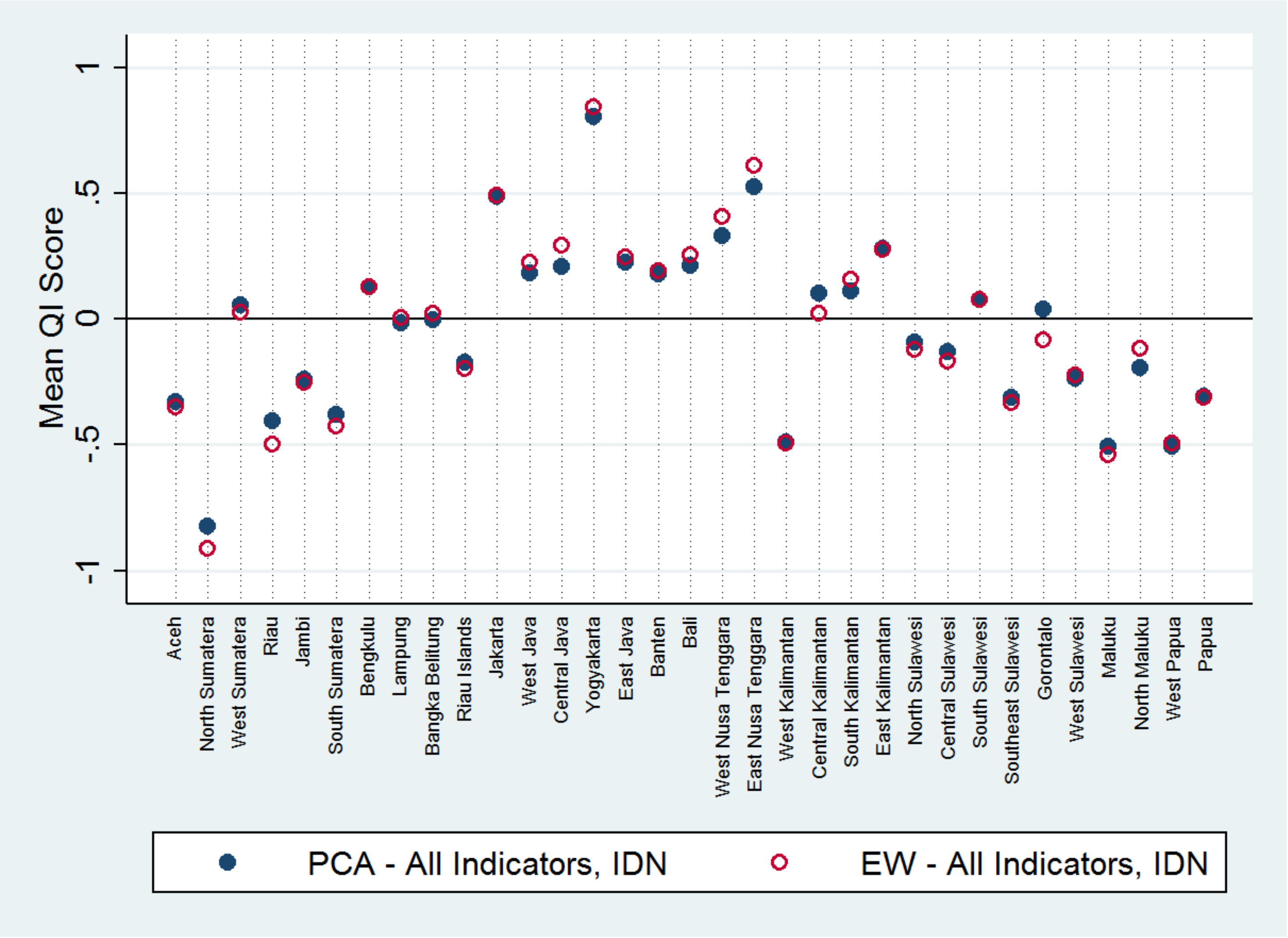
[xiv] Of the 34 Provinces in Indonesia, five have special administrative status allowing an increased level of autonomy; Aceh (Which implements Sharia law at provincial level), Yogyakarta (which maintains a hereditary monarchy in the form of its Governor and Vice Governor), Jakarta (encompassing the capital region), Papua and West Papua (annexed into Indonesia in the 1960's).

that this region is known to perform very well in other health related metrics and has a relatively wealthy population. At the same time Bali and Banten, which have similar wealth profiles, and Jakarta, where almost half the population falls into the highest wealth quintile, score somewhat lower suggesting it is not household wealth alone that contributes to this success. These provinces are however representative of more economically developed regions where access to services is generally higher.

In contrast East Nusa Tenggara and West Nusa Tenggara are relatively underdeveloped, with two thirds of households in East Nusa Tenggara and 38% in West Nusa Tenggara belonging to the lowest wealth quintile. Child mortality is also much higher than the national average in these provinces [118]as is the prevalence of malnutrition and low birth weight, potentially due to the prevalence of malaria and limitations in access to appropriate water and sanitation in some areas [126]. Despite this, both West and East Nusa Tenggara have some of the highest QI scores out of all the provinces, suggesting that those who can access care are receiving an acceptable standard of routine care.

At the other end of the spectrum North Sumatra is the lowest scoring province; while it does have a reasonably high proportion of home based deliveries, which tend to score lower than facility based deliveries, it is neither particularly poor nor rural (42% of the population is urban – comparable to Central and East Java). While appropriate breastfeeding practices are particularly low in this province this is not enough to explain the especially low score. West Kalimantan is another relative outlier; while other provinces in Kalimantan are comparable in terms of wealth, rurality and SBA coverage this province scores noticeably lower than expected.

Figure 5.2.7 Mean QI scores by Province, using PCA and EW based QI with All Indicators, Indonesia 2012



It is also interesting that the provinces in the Maluku and Papua regions, which are often are considered to have the worst performance in relation to health indicators, while still scoring lowly in terms of QI, are on par with other regions in Sumatera and Kalimantan despite their relative poverty (70% of households in Papua Province are from the poorest wealth quintile for example) and remoteness. This appears to highlight the dichotomy between access to services and quality of services; coverage of SBA is very low in Maluku and Papua (as little as 40% in Papua province) however those who do receive services appear to receive a similar level of care as in other parts of the country.

Figure 5.2.8 places these regional means into geographical context[xv]. While there does appear to be a trend towards quality decreasing with distance from the Java/Bali region it is by no means consistent. One reason for this inconsistency may be related to the varying proportions of urban population across regions – conversely, it may be the case that the overall rural-urban differences are in fact only reflections of underlying regional variation. To explore this, Figure 5.2.9 shows the mean QI scores for urban and rural populations in each region.

[xv] Scores due to extreme similarity in PCA and EW scores, the EW based map has been omitted as it provides no additional information

Figure 5.2.8 Map of mean QI scores by Region using PCA with All Indicators, Indonesia 2012

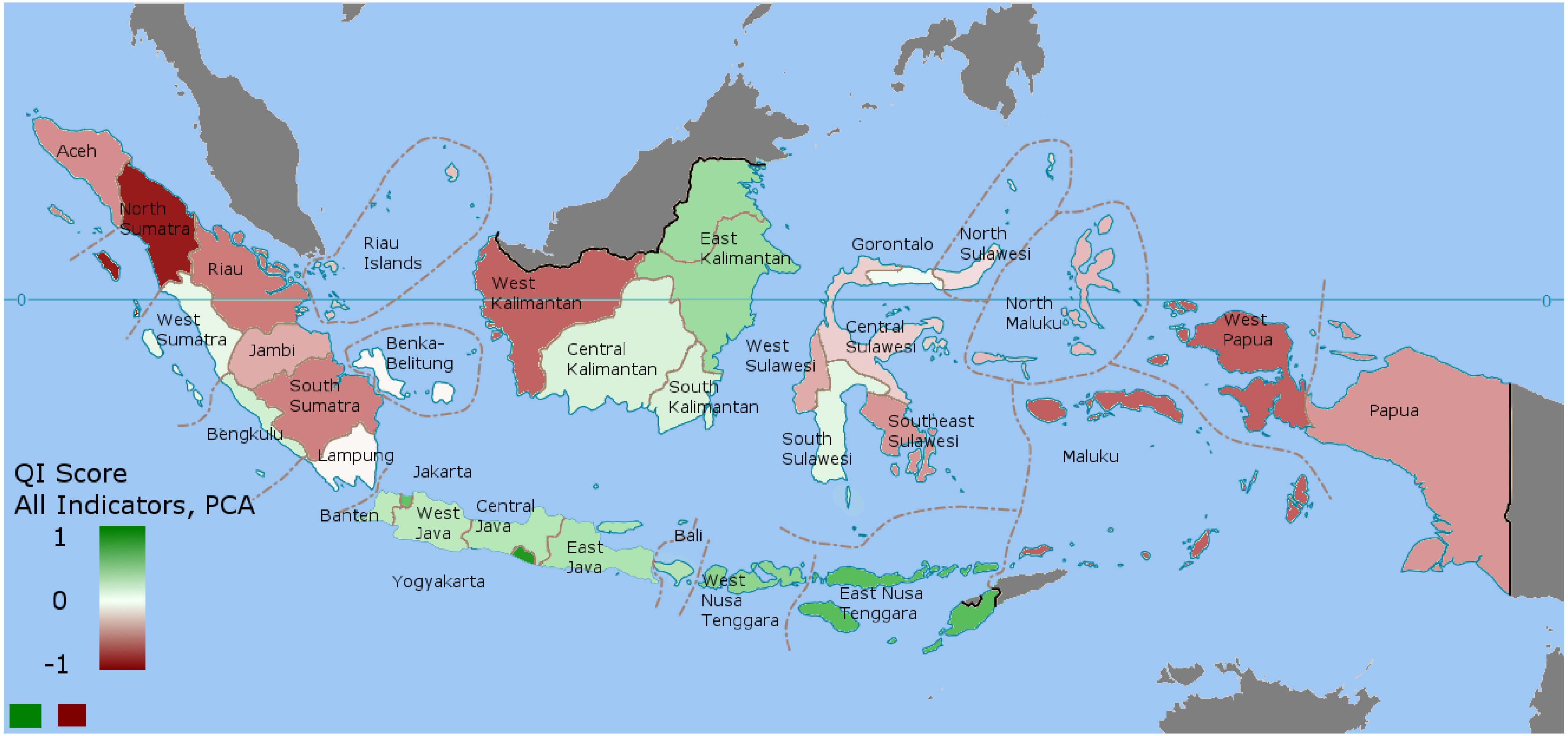
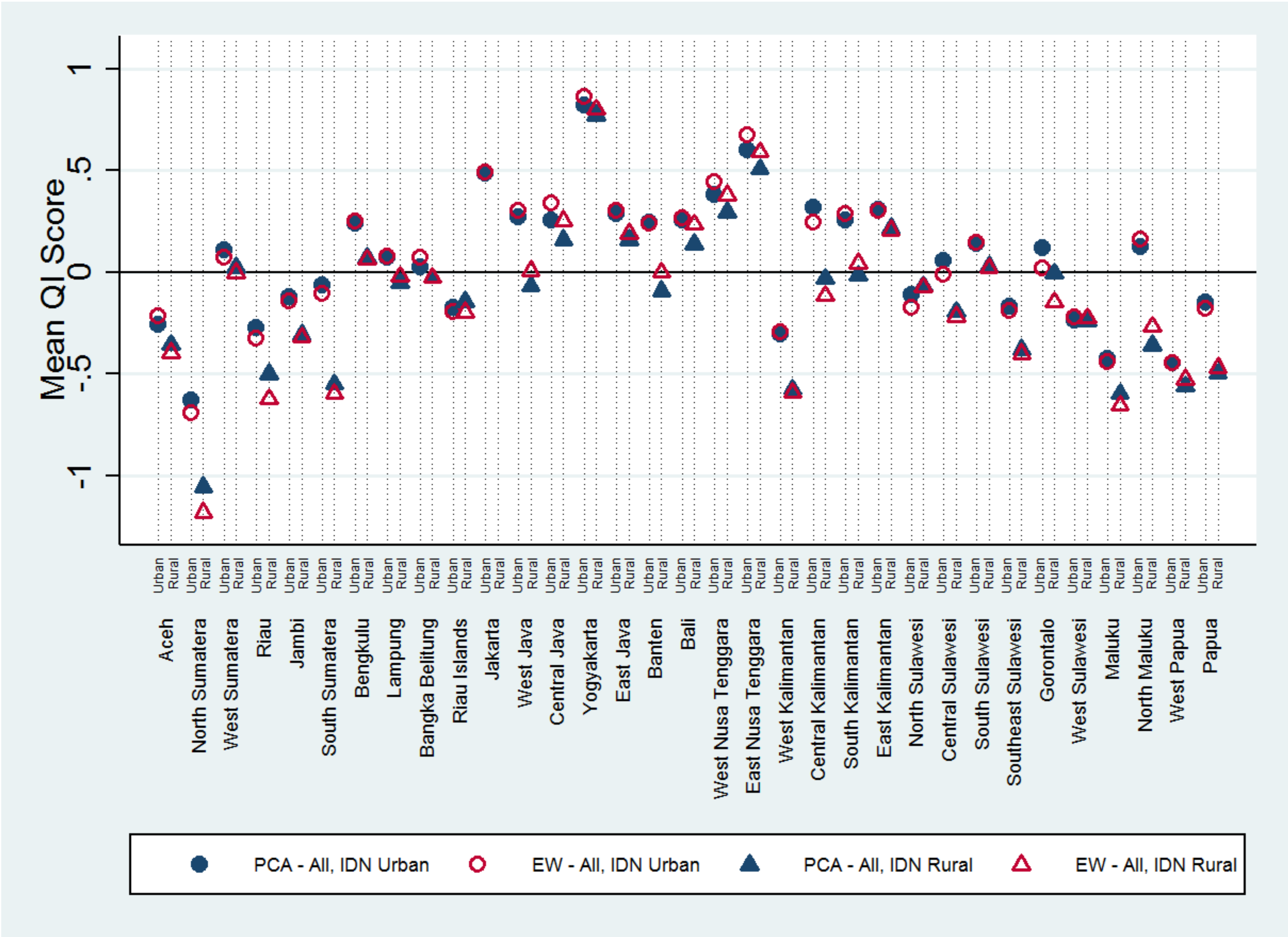


Figure 5.2.9 Mean QI scores by Province and Urban Rural Status, using PCA and EW based QI with All Indicators, Indonesia 2012



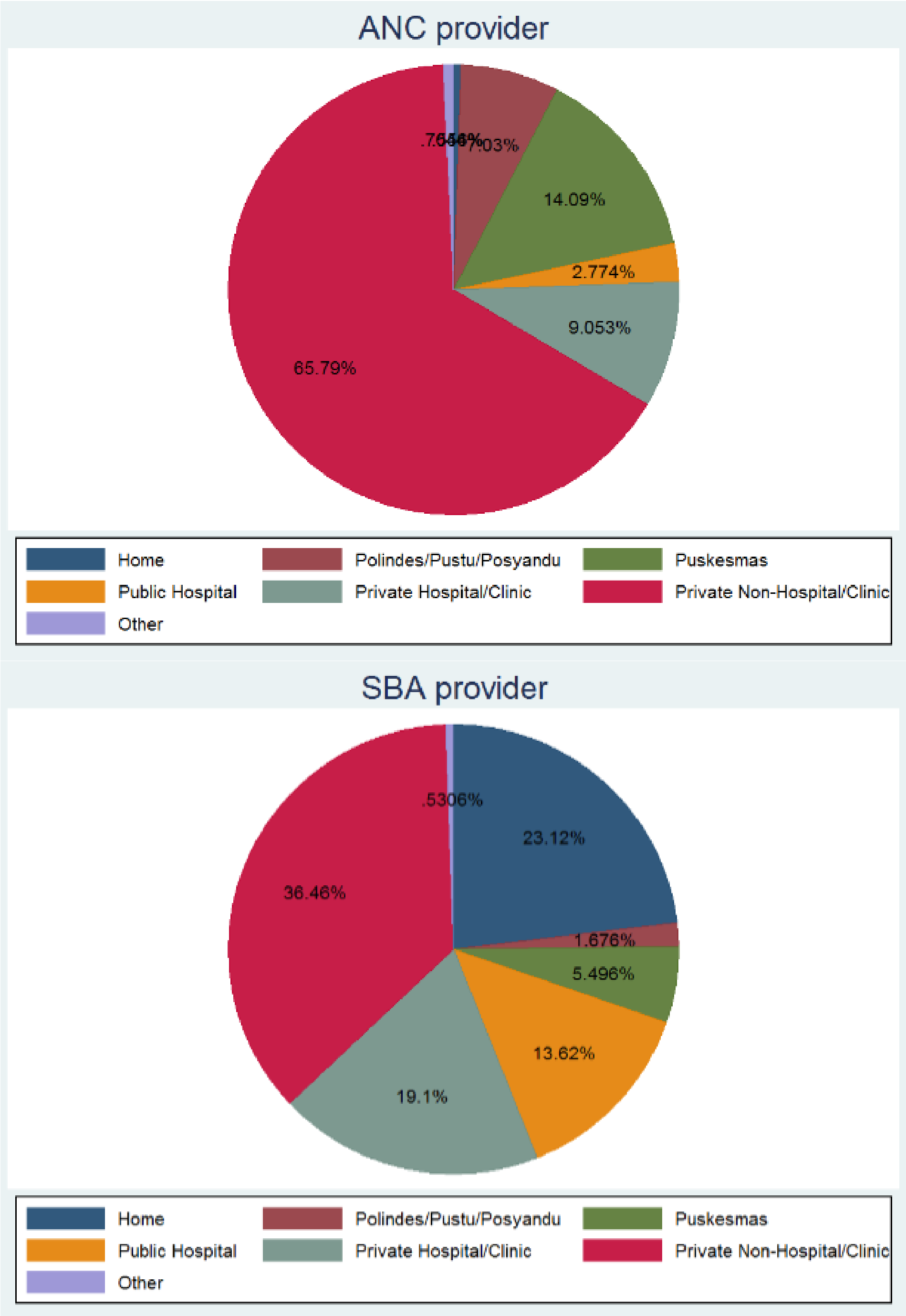
It is apparent that while some regions (such as North Sumatra, West Kalimantan, North Maluku and Papua) have substantial urban-rural variation many others (particularly those in Java and surrounding regions) show little difference between these groups. The provinces with large urban-rural differences tend to also have a less urbanised population in general, they also tend to have lower overall scores, suggesting that issues relating to rurality may be affecting QI scores for these regions, however overall variation between provinces is generally greater than within provinces. This would appear to support the theory that differences in local capacity within the decentralised heath system may be affecting the ability of health services to provide good quality care to the communities they serve.

5.2.4 Variation by Provider Type

The regional variation in QI scores suggests that local health system factors have a large impact on quality of care, particularly as the majority of indicators used in the QI relate to services provided by a health provider. As noted in earlier sections, there is evidence that quality of care differs very much between different types of facilities within Indonesia, however it is not known if there is variation within the same types of provider with regards to region or wealth.

Unlike other DHS, Indonesia 2012 collected information about the where the respondent received ANC services, as well as the more standard questions about delivery services. Figure 4.2.4.1 illustrates the share of ANC and SBA services provided at different points of delivery; home based, village level (Polindes, Posyandu, Pustu), health centres (Puskesmas), Public Hospitals, Private Hospital/Clinic, Private Non-Hospital/Clinic and Other.

Figure 5.2.10 Type of Provider for ANC and SBA services, Indonesia 2012



As can be seen, Private Non-Hospital/Clinic is the most prevalent category for both ANC and SBA services accounting for two thirds of ANC visits and just over a third of SBA deliveries. This category was used for women who indicated they delivered with a GP, Obstetrician, Midwife, Nurse or Village Midwife working in the private sector rather than specifically in a private facility such as a hospital, maternity home or clinic. The dominance of this sector is indicative of the growth in the use of small scale practices operated by individual health staff supplementing income provided by public-sector employment [112,127]. While less prevalent, private hospitals and clinics are also an important source of care, and account for 19% of SBA deliveries. As such, the majority of SBA deliveries in Indonesia occur outside of public facilities, emphasising the importance of being able to assess quality of care within the private sector.

With regards to those who do utilise the public sector, the majority of ANC care is provided at a local level by Polindes/Posyandu and Puskesmas facilities. The proportion using these services for SBA care is low however at approximately 7% combined. Public hospitals provide the majority of public facility based SBA, accounting for approximately 14% of deliveries. Based on the relatively low proportion of services provided by Polindes/Posyandu and Puskesmas facilities separately, these categories will be combined into a "Public Non-Hospital" category providing a more robust sample size for the remainder of the analysis.

Home based ANC is almost non-existent, however nearly a quarter of SBA deliveries occur at home. Of those who had home based SBA, most (52%) had ANC care through a private Non-Hospital/Clinic provider, with Puskesmas (24%) and Polindes/Posyandu (15%) making up the bulk of other providers. As non-facility delivery is generally considered to carry a higher risk of poor maternal outcomes in regions with limited access to EMOC, good quality routine care is essential in order to identify complications in time for treatment to be provided.

Figure 5.2.11 Mean QI scores by ANC Provider Type, using PCA and EW based QI with All Indicators, Indonesia 2012

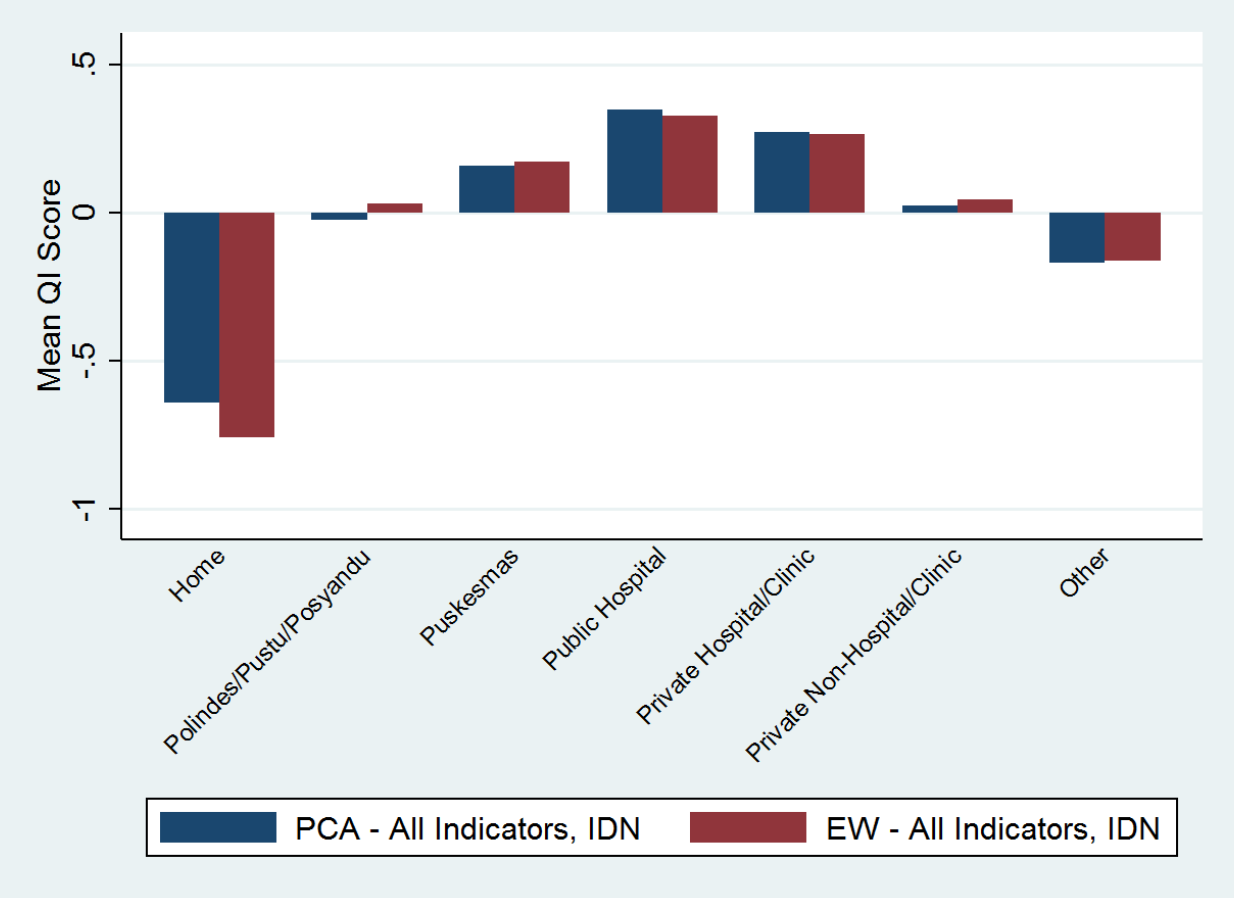
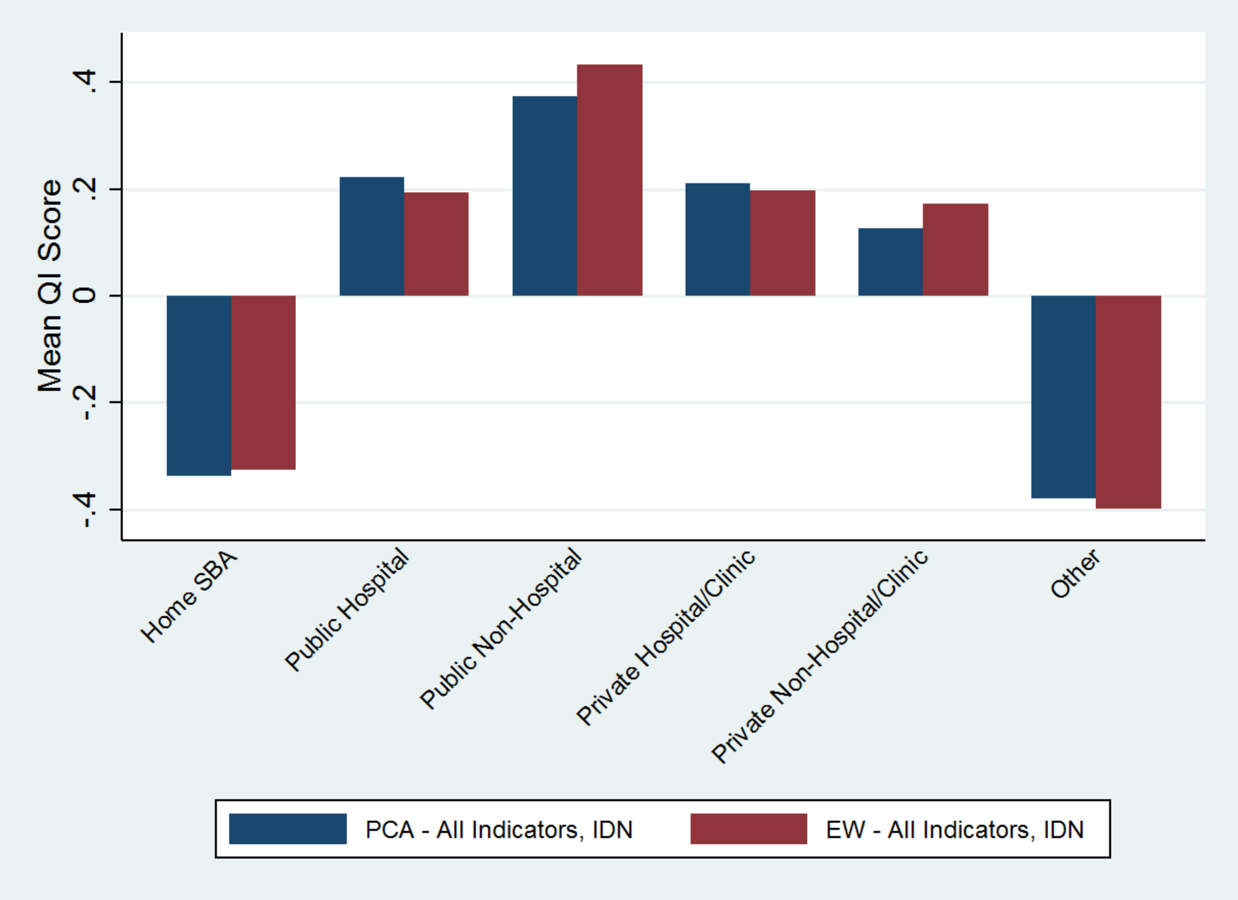


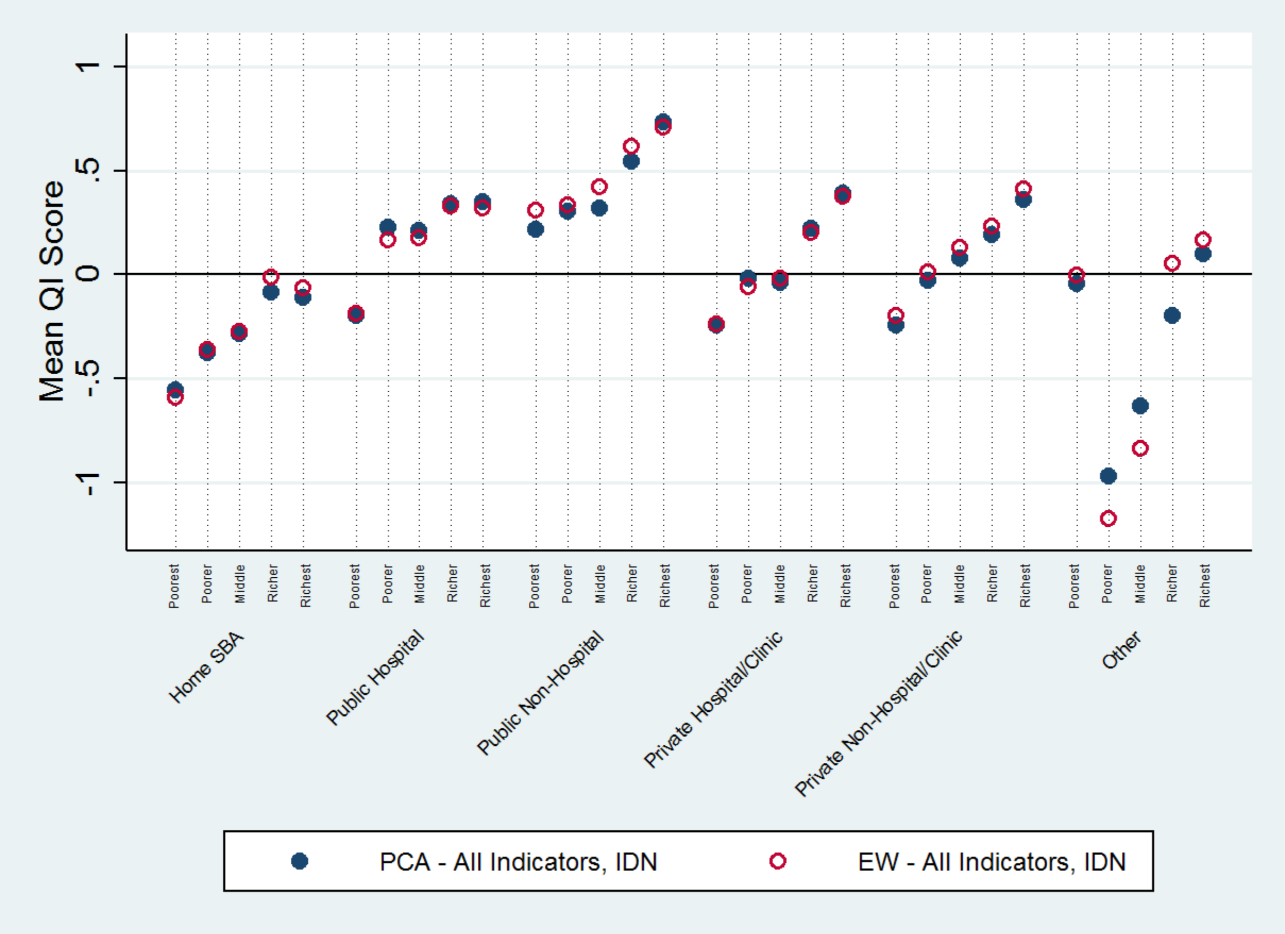
Figure 5.2.11 shows that QI scores are highest for those who received ANC at a hospital, clinic or public health centre. Interestingly, scores for Private Non-Hospital care are very similar to those for Polindes/Posyandu care – although this may be reflecting the relatively large proportion of women with home based SBA who utilised these forms of ANC. Indeed, as can be seen in Figure 5.2.12, which summarises QI score by the SBA provider, scores for Private Non-Hospital/Clinic deliveries were very similar to Private Hospitals and Public Non-Hospital care, while Home based SBA was substantially lower than all other types of provider (Public Hospitals scored the highest of all facility types). It is apparent that non-facility based delivery appears to be strongly associated with lower QI scores regardless of where ANC occurred. From a health system perspective, this suggests that SBA provider may have greater explanatory power when it comes to understanding trends in quality of care and as such is the focus of the remainder of the analysis.

Figure 5.2.12 Mean QI scores by Delivery Provider Type, using PCA and EW based QI with All Indicators, Indonesia 2012



While the difference between facility and non-facility deliveries is by far the most notable source of provider based variation in QI scores, it is interesting that Public Non-Hospital category scores the highest of all SBA provider types despite being utilised by less than 10% of the sample. The question is thus raised as to whether these findings reflect differences in the care provided by SBA provider or if the variation is due to underlying demographic variation in the populations who use them. Figure 5.2.13 provides an overview of wealth based variation in QI scores by type of provider.

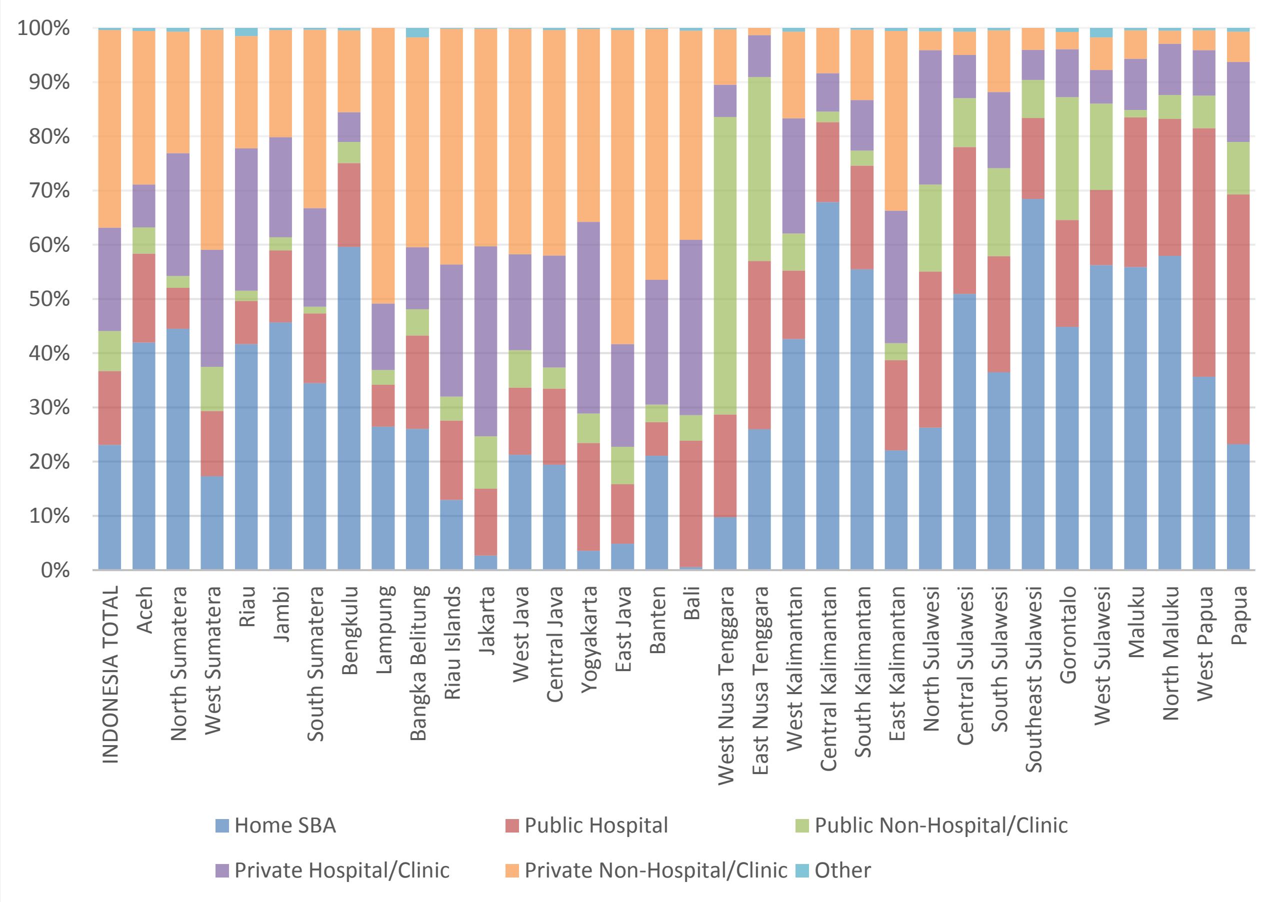
Figure 5.2.13 Mean QI scores by SBA provider and wealth quintile using PCA and EW based QI with All Indicators, Indonesia 2012



While all provider types show substantial wealth based variation in QI scores, what is striking is that the scores for those using Public Non-Hospital care are not only the highest for every wealth quintile, but that the scores for those in the lowest three quintiles are almost as high as those in the richest wealth quintile in any other type of provider. This does not appear to simply be a case of decreasing wealth based inequality within this type of provider however; scores for the Richer and Richest are still well above those for the lower wealth quintiles. Instead it appears that there is an underlying higher standard of care affecting all who use these services regardless of wealth.

Given these very different patterns of QI scores, it is possible that some of the regional variation noted in the previous section may reflect differences in facility usage. Figure 5.2.14 thus shows the proportion of SBA deliveries for each provider type by region, with the first column showing the national average for reference.

Figure 5.2.14 Proportion of SBA Deliveries by Provider Type, by Region, Indonesia 2012



What is immediately apparent is that the prevalence of Home SBA is typically greater in outlying provinces compared to those in the Java/Bali region. This may be contributing to the trend of generally lower QI scores in regions further removed from the capital. The pattern of SBA usage also helps explain the apparently counterintuitive findings regarding QI scores in East and West Nusa Tenggara.

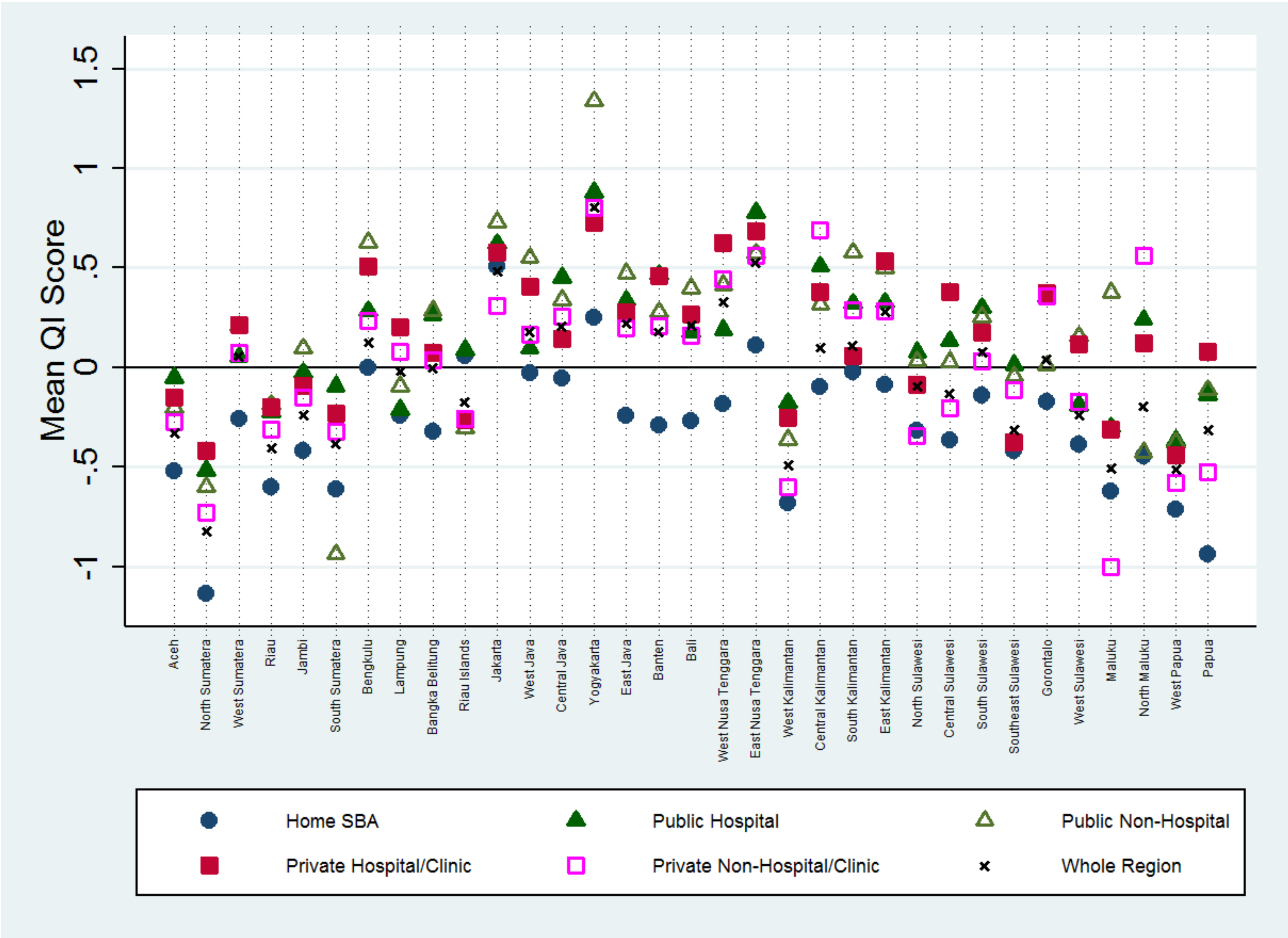
While coverage of SBA in East Nusa Tenggara is low at 57% of deliveries, three quarters of SBA deliveries are facility based. At 34% of deliveries, usage of public non-hospital facilities is much higher than in any province other than West Nusa Tenggara where 55% of deliveries occur in such facilities. This may in part be due to high proportion of households enrolled in the social insurance programs in these provinces (45% of women in West Nusa Tenggara and 61 % in East Nusa Tenggara), particularly Jamkesmas which promotes the use of Puskesmas based services. As these facilities generally score highly on the QI this may help explain the relatively high scores for these provinces. Care should be taken with regards to the interpretation of these results however, as it is also possible that a high quality of care at these facilities is in fact responsible for the greater usage rates. There is evidence from poor women in other provinces suggesting that these facilities will be bypassed in favour of other options such as home deliveries (including non-SBA deliveries) where the Puskesmas are of poor quality[125] .

Access to higher levels of care are also relatively limited in these provinces, with the rates of caesarean section are well below average. As the indicators in the QI are exclusively related to standard, non-emergency care, even with the best of local level delivery services, the inability to utilise higher level care may ensure that even the highest quality routine care will have only a marginal effect on maternal and neonatal outcomes. Evidence from a referral hospital in Yogyakarta notes that the timing of care is strongly associated with maternal outcomes, with timely referral being particularly important[128] . In contrast regions such as Bali where access to emergency care is greater still have lower rates of mortality despite a generally lower quality of routine care as represented by the QI scores.

While differences in usage patterns may account for some of the regional level differences, there is still the possibility that local factors affect the standard of care offered by different provider types in each region. This is particularly relevant given that provinces with fairly similar delivery profiles, such as Yogyakarta and Jakarta or West Java and Lampung, can have very different overall QI scores. Figure 5.2.15 thus shows the regional variation in provider QI scores compared to the mean QI score for that region[xvi] .

[xvi] The category of "other" has been omitted from the provider types shown on this graph due to the extremely low sample size (54) leading to a lack of meaningful estimates at this level.

Figure 5.2.15 Mean QI scores by Province and Provider Type, using PCA based QI with All Indicators, Indonesia 2012



Facility based services tend to be clustered together in all but a few regions (such as North Maluku, Papua and to a certain extent Yogyakarta), with Home SBA lagging well behind. There are however noticeable differences in the overall scores across regions as well as the difference in QI scores between providers within each region. As an example, even the highest scoring facility type in West Kalimantan and South Sumatra scores lower than Home SBA in West and Central Java, despite Home SBA being consistently the lowest scoring type of provider. Conversely, the overall QI score for Bengkulu is relatively high despite almost 60% of deliveries being Home SBA.

Public Non-Hospital care remains high scoring in many regions, however it is noticeably lower in provinces such as South Sumatra, Lampung and the Riau Islands. It would thus appear that while some types of provider do generally provide higher quality care, regional differences in the management of health services may substantially affect the overall quality of maternal and neonatal care provided by different types of provider.

5.3 Regression Analysis

To further untangle the relationship between wealth, province, provider type, and other equity markers and quality of care as measured by the QI score, linear regression was used to estimate variable coefficients for multiple categories relating to the factors outlined in the previous section. These coefficients represent the average increase or decrease in QI score associated with each category.

When conducting such an analysis it is important to determine which categories within each variable are to be defined as the standard. While some categories such as education have implicit measures of scale that define them, others, such as regions, have no fundamental rating that might determine the manner in which they should be considered. One option is to define the lowest scoring category in each variable as the reference category under the assumption that this represents the worst case scenario; the resulting coefficients can thus be interpreted as the increase in QI associated with belonging to each additional category.

Table 5.3.1 shows the results of linear regression carried out using QI scores based on All Indicators and PCA based weighting, for each variable individually as well as a combined model featuring multiple variables. This QI was chosen for its discriminatory ability, however results for the same analyses performed using the EW based indicated no substantial changes in the results. It should also be noted that these regressions are weighted; the DHS utilises sampling weights to adjust for under and over sampling of subjects in particular survey blocks; a necessary step in order to create representative estimates.

Table 5.3.1 Results of Linear Regression of Individual and Multiple variables against PCA based QI score with All Indicators, Indonesia 2012

		INDIVIDUAL REGRESSION						**MULTIPLE REGRESSION**			
Variable	**N**	**Coef**	**P>t**	**(95%CI)**		***R-Sqr***	***Prob-F***	**Coef**	**P>t**	**(95%CI)**	
RURAL-URBAN											
Urban	5549	0.265	0	*0.214*	*0.316*			0.025	0.385	*-0.031*	*0.082*
Rural	6282	(base)				*0.018*	*0*	(base)			
AGE											
15-19	365	(base)				*0.003*	*0.004*	-			
20-24	2164	0.096	0.07	*-0.008*	*0.2*			0.054	0.291	*-0.046*	*0.155*
25-29	3356	0.176	0.001	*0.074*	*0.279*			0.112	0.04	*0.005*	*0.219*
30-34	2954	0.179	0.001	*0.072*	*0.286*			0.128	0.034	*0.010*	*0.247*
35-39	2018	0.076	0.206	*-0.042*	*0.195*			0.114	0.094	*-0.020*	*0.248*
40-44	828	0.16	0.055	*-0.003*	*0.323*			0.205	0.018	*0.035*	*0.376*
45-49	146	-0.102	0.758	*-0.752*	*0.548*			0.202	0.53	*-0.427*	*0.831*
EDUCATION											
No education	118	(base)				*0.042*	*0*	(base)			
Incomplete primary	830	-0.019	0.905	*-0.339*	*0.3*			0.058	0.701	*-0.239*	*0.355*
Complete primary	2102	0.328	0.036	*0.021*	*0.636*			0.306	0.035	*0.021*	*0.592*
Incomplete secondary	3079	0.434	0.005	*0.128*	*0.739*			0.418	0.004	*0.134*	*0.702*
Complete secondary	3841	0.607	0	*0.302*	*0.911*			0.515	0	*0.231*	*0.8*
Higher	1861	0.795	0	*0.488*	*1.103*			0.619	0	*0.328*	*0.909*

Table 5.3.1 Cont.

WEALTH											
Poorest	2267	(base)				*0.047*	*0*	(base)			
Poorer	2426	0.268	0	*0.182*	*0.354*			0.132	0.002	*0.048*	*0.217*
Middle	2462	0.33	0	*0.248*	*0.412*			0.134	0.002	*0.047*	*0.22*
Richer	2442	0.524	0	*0.443*	*0.605*			0.225	0	*0.133*	*0.317*
Richest	2234	0.664	0	*0.582*	*0.745*			0.236	0	*0.135*	*0.337*
REGION											
Aceh	415	0.491	0	*0.371*	*0.611*			0.493	0	*0.379*	*0.607*
North Sumatera	539	(base)				*0.108*	*0*	(base)			
West Sumatera	401	0.877	0	*0.759*	*0.996*			0.777	0	*0.663*	*0.891*
Riau	466	0.418	0	*0.304*	*0.532*			0.419	0	*0.312*	*0.525*
Jambi	287	0.583	0	*0.434*	*0.732*			0.597	0	*0.454*	*0.74*
South Sumatera	415	0.441	0	*0.321*	*0.561*			0.447	0	*0.332*	*0.562*
Bengkulu	260	0.949	0	*0.815*	*1.084*			0.959	0	*0.830*	*1.089*
Lampung	374	0.805	0	*0.69*	*0.921*			0.792	0	*0.678*	*0.906*
Bangka Belitung	345	0.82	0	*0.695*	*0.944*			0.808	0	*0.687*	*0.928*
Riau Islands	329	0.651	0	*0.514*	*0.787*			0.489	0	*0.354*	*0.624*
Jakarta	658	1.309	0	*1.208*	*1.409*			1.065	0	*0.962*	*1.167*
West Java	566	1.004	0	*0.892*	*1.116*			0.886	0	*0.775*	*0.998*
Central Java	539	1.027	0	*0.916*	*1.138*			0.949	0	*0.839*	*1.059*
Yogyakarta	388	1.625	0	*1.518*	*1.733*			1.377	0	*1.268*	*1.485*
East Java	525	1.047	0	*0.937*	*1.157*			0.902	0	*0.792*	*1.013*
Banten	509	1.000	0	*0.889*	*1.111*			0.899	0	*0.791*	*1.008*
Bali	413	1.034	0	*0.925*	*1.142*			0.872	0	*0.764*	*0.981*
West Nusa Tenggara	395	1.152	0	*1.021*	*1.283*			1.011	0	*0.873*	*1.149*

Table 5.3.1 Cont.

East Nusa Tenggara	259	1.347	0	*1.204*	*1.49*			1.334	0	*1.195*	*1.472*
West Kalimantan	332	0.333	0	*0.205*	*0.462*			0.396	0	*0.274*	*0.519*
Central Kalimantan	265	0.921	0	*0.78*	*1.063*			1.058	0	*0.924*	*1.193*
South Kalimantan	331	0.93	0	*0.798*	*1.062*			0.992	0	*0.868*	*1.117*
East Kalimantan	302	1.102	0	*0.974*	*1.229*			1.007	0	*0.884*	*1.13*
North Sulawesi	304	0.731	0	*0.592*	*0.87*			0.632	0	*0.496*	*0.768*
Central Sulawesi	270	0.691	0	*0.542*	*0.839*			0.717	0	*0.575*	*0.859*
South Sulawesi	393	0.9	0	*0.777*	*1.022*			0.851	0	*0.734*	*0.968*
Southeast Sulawesi	277	0.508	0	*0.363*	*0.654*			0.559	0	*0.419*	*0.699*
Gorontalo	271	0.862	0	*0.728*	*0.995*			0.894	0	*0.764*	*1.023*
West Sulawesi	185	0.584	0	*0.42*	*0.747*			0.665	0	*0.509*	*0.821*
Maluku	215	0.316	0	*0.167*	*0.465*			0.331	0	*0.188*	*0.475*
North Maluku	223	0.629	0	*0.465*	*0.793*			0.62	0	*0.468*	*0.773*
West Papua	253	0.313	0	*0.163*	*0.463*			0.237	0.002	*0.091*	*0.384*
Papua	127	0.512	0	*0.302*	*0.722*			0.478	0	*0.286*	*0.669*
SBA PROVIDER											
Home SBA	3486	(base)				*0.055*	*0*	(base)			
Public Hospital/Clinic	1999	0.559		*0.478*	*0.64*			0.291	0	*0.206*	*0.375*
Public Non-Hospital/Clinic	983	0.712		*0.614*	*0.81*			0.461	0	*0.357*	*0.566*
Private Hospital/Clinic	2115	0.549		*0.477*	*0.622*			0.21	0	*(0.129*	*0.29)*
Private Non-Hospital/Clinic	3194	0.465		*0.398*	*0.532*			0.195	0	*(0.120*	*0.269)*

Table 5.3.1 Cont.

Other	54	-0.042		*-0.437*	*0.353*			-0.005	0.98	*(-0.396*	*0.386)*
PARITY											
1st Birth	4382	0.314		*0.23*	*0.398*			0.142	0.007	*0.039*	*0.246*
2nd Birth	3737	0.367		*0.281*	*0.452*			0.161	0.001	*0.070*	*0.253*
3rd Birth	2047	0.239		*0.141*	*0.336*			0.099	0.037	*0.006*	*0.192*
4+ Birth	1665	(base)				*0.013*	*0*	(base)			
_constant								-1.743	0	*-2.056*	*-1.43*
TOTAL	**11831**							**R-Sqr**	0.1729	**Prob-F**	0

Rural-Urban status, Maternal age, Parity, Maternal Education, Wealth and Region all individually produce models that are significant at the p=0.05 level, however the proportion of variance explained by the models is quite low. From the individual models, only the 25-29 and 20-34 year maternal age groups are significantly different from the reference category of 15-19 year olds, while all educational levels above incomplete primary education are significantly different from those with no education. In terms of wealth all categories are significantly better than the poorest quintile, and all other provinces are significantly better than North Sumatra. The only delivery type not found to be significantly better than Home SBA was the "other" category, which is expected given its small sample size.

As regression is sensitive to the combination of variables included in the model, and R-squared values will increase with the inclusion of additional independent variables, it is generally recommended that the optimal set of independent variables will be the smallest reliable, uncorrelated set that best explains the observed variance in the dependent variable [78]. As a first step in creating a multivariate regression, Figure 5.3.1 also shows the results of a combined linear regression including all variables, maintaining the lowest performing categories as the standard comparison group. In total the model explained 17.3% of variance in QI scores.

In this combined model, urban residence loses significance as a predictive factor for QI scores; it was thus removed from the final model. Similarly maternal age demonstrated substantial changes in both significance and coefficient size, most likely due to the inclusion of the Parity variable into the model, with older categories increasing in both significance and magnitude of coefficients. In terms of education, there does appear to be a significant and increasing trend with all educational categories above incomplete primary.

Table 5.3.2 Results of Linear regression of multiple variables with revised categorisation against PCA based QI score with All Indicators, Indonesia 2012

CATEGORY	N	Coef	P>t	95%CI		CATEGORY	N	Coef	P>t	95%CI	
RURAL-URBAN						REGION					
Urban	5549	0.021	0.469	*-0.036*	*0.078*	Aceh	415	0.489	0	*0.374*	*0.603*
Rural	6282	(base)				North Sumatera	539	(base)		*0*	*0*
						West Sumatera	401	0.778	0	*0.663*	*0.892*
AGE						Riau	466	0.416	0	*0.31*	*0.523*
<25 yrs	2529	(base)				Jambi	287	0.588	0	*0.445*	*0.732*
25-34yrs	6310	0.072	0.026	*0.009*	*0.136*	South Sumatera	415	0.444	0	*0.33*	*0.559*
35+ yrs	2992	0.078	0.112	*-0.018*	*0.174*	Bengkulu	260	0.955	0	*0.826*	*1.085*
						Lampung	374	0.797	0	*0.683*	*0.911*
EDUCATION						Bangka Belitung	345	0.785	0	*0.664*	*0.906*
Primary or Lower	3050	(base)				Riau Islands	329	0.488	0	*0.353*	*0.623*
Incomplete secondary	3079	0.167	0	*0.097*	*0.236*	Jakarta	658	1.067	0	*0.965*	*1.17*
Complete secondary	3841	0.267	0	*0.198*	*0.337*	West Java	566	0.894	0	*0.783*	*1.005*
Higher Education	1861	0.373	0	*0.284*	*0.461*	Central Java	539	0.956	0	*0.846*	*1.066*
						Yogyakarta	388	1.382	0	*1.273*	*1.49*
WEALTH						East Java	525	0.905	0	*0.795*	*1.016*
Poorest	2267	(base)				Banten	509	0.897	0	*0.788*	*1.006*
Poorer	2426	0.147	0.001	*0.062*	*0.232*	Bali	413	0.864	0	*0.756*	*0.972*
Middle	2462	0.155	0	*0.068*	*0.241*	West Nusa Tenggara	395	1.006	0	*0.868*	*1.143*

Table 5.3.2 Cont

Richer	2442	0.247	0	*0.155*	*0.339*	East Nusa Tenggara	259	1.331	0	*1.191*	*1.472*
Richest	2234	0.256	0	*0.155*	*0.358*	West Kalimantan	332	0.39	0	*0.267*	*0.512*
						Central Kalimantan	265	1.056	0	*0.92*	*1.191*
						South Kalimantan	331	0.985	0	*0.86*	*1.11*
SBA PROVIDER						East Kalimantan	302	1.006	0	*0.883*	*1.129*
Home SBA	3486	(base)				North Sulawesi	304	0.625	0	*0.49*	*0.76*
Public Hospital/Clinic	1999	0.29	0	*0.205*	*0.375*	Central Sulawesi	270	0.712	0	*0.57*	*0.854*
Public Non-Hospital/Clinic	983	0.458	0	*0.354*	*0.563*	South Sulawesi	393	0.847	0	*0.73*	*0.965*
Private Hospital/Clinic	2115	0.209	0	*0.128*	*0.29*	Southeast Sulawesi	277	0.559	0	*0.419*	*0.699*
Private Non-Hospital/Clinic	3194	0.192	0	*0.117*	*0.267*	Gorontalo	271	0.877	0	*0.747*	*1.007*
Other	54	-0.009	0.962	*-0.398*	*0.38*	West Sulawesi	185	0.657	0	*0.501*	*0.814*
						Maluku	215	0.333	0	*0.19*	*0.477*
PARITY						North Maluku	223	0.616	0	*0.463*	*0.768*
1st Birth	4382	0.14	0.006	*0.04*	*0.239*	West Papua	253	0.232	0.002	*0.085*	*0.379*
2nd Birth	3737	0.167	0	*0.078*	*0.257*	Papua	127	0.464	0	*0.267*	*0.661*
3rd Birth	2047	0.104	0.028	*0.011*	*0.197*						
4+ Birth	1665	(base)									
						_constant		-1.466	0	*-1.594*	*-1.338*
TOTAL	**11831**					**R-Sqr**	**0.1693**		**Prob-F**		**0**

The results for these categories are however potentially affected by the reference categories having a low sample size - a greater explanatory ability may be gained from combining several of the categories related to age and education. As such, maternal age was re-categorised into three categories (<25, 25-34 and 35+) and education into four ("Primary or Lower" "Some Secondary", "Completed Secondary" and "Higher Education"), thus ensuring that each category contained at least 1000 observations. Figure 5.3.2 shows the results of the revised categorisation on the regression.

In this revised categorisation model the effect of maternal age almost disappears; only the 25-34 year age group shows significant difference and with a coefficient of only 0.07 the overall impact on QI scores is negligible. In contrast, the maternal education not only shows marked increases in coefficients with each increase in educational attainment, but all categories are significantly better than the base (Primary education or lower).

In terms of parity, first and second births show roughly the same coefficient size, with a slight decline for third births; all are significantly better than the 4+ category. As differences in choice of provider are accounted for in this model, these results suggest that those with fewer children have the most complete routine care while those with more than two children receive poorer standards of care, regardless of where they deliver.

As far as service delivery is concerned, it is apparent that having a facility based delivery, regardless of which facility is used, is associated with a significantly higher QI score. Public Non-Hospital care carries the largest increase, with a coefficient almost twice the size of either Private provider category, followed by Public Hospitals. From a policy perspective the fact that primary health care facilities are associated with a higher QI than any other group suggests that government efforts to promote use these services for routine care have not been associated with declines in quality, and bodes well for future efforts in this direction.

While often considered in terms of restricting access to particular forms of facilities, wealth is also known to potentially affect type of services an individual will receive at a given facility[83,107,126], particularly if fee structures are based on per-procedure payment models[19]. This was seen in the graphical analysis and also is apparent here in the regression model.

The poorest wealth quintile scores significantly lower than all other wealth quintiles in terms of QI, however the second and third lowest quintiles share similar coefficients, as do the fourth and fifth. This suggest that while there is not a stepwise increase in quality as wealth increases, there is a certain amount of variation in quality depending upon the patient’s ability to pay for what should be routine care.

By far the greatest influence on QI score however is region. Compared to the coefficients for all other variables, province produces by far the largest effect on QI scores. While the performance of North Sumatra is significantly worse than all other provinces, the magnitude of the effect ranges from 0.23 for West Papua to 1.38 for Yogyakarta with a median value of 0.78. Compared to the coefficient associated with having higher education (0.37) or delivering in a Public Non-Hospital facility (0.45) this shows the importance of regional factors in how care is delivered. This echoes what was seen in the graphical analysis – a home delivery in Yogyakarta will score higher on the QI than a facility based delivery in much of Sumatra, all other things being equal.

In fact the differences between the coefficients calculated for each variable individually and the coefficients generated by the multivariate model provide some insight into the graphical trends visible in the earlier sections. The coefficients for wealth categories more than halved, with the highest wealth quintile decreasing by almost two thirds, suggesting that much of the wealth based advantage was due to differences in other factors such as facility usage and geographic distribution of wealth.

Similarly, provinces residing in the Java and parts of the Lesser Sunda Islands also saw coefficient decreases, reflecting the adjustment for their relatively wealthier and more educated populations. On the other hand the fact that these regions maintain coefficients that are noticeably greater than outlying regions such as Sumatra, Sulawesi, Maluku and Papua does suggest that economic development in general plays a part in the quality of maternal and neonatal care.

Tests of the assumptions surrounding the regression model (Appendix 3) suggest that while the model does not meet the criteria to perform as an appropriate predictive tool, it is unlikely that the statistical limitations of the model have heavily affected its explanatory ability. In particular, the finding that region appears to have a stronger influence on QI scores than household wealth or SBA provider type is unlikely to have occurred due purely to limitations of the model.

5.4 Discussion of Variation in Quality of Care in Indonesia

Quality of routine and neonatal care, as measured using data from the Indonesia 2012 DHS, varies considerably based on a complex combination of factors including wealth, region of residence and type of health service provider.

By far the biggest influence on QI scores is geographical location, with the amount of variation between QI scores for the same types of provider across provinces reflecting the heavily decentralised nature of the Indonesian health system. Unsurprisingly less developed provinces, particularly those at a greater distance from Java, demonstrate considerably lower quality services than their more economically advantaged counterparts. This is not simply a reflection of demographic differences, as the effect of provincial residence remains even after controlling for wealth, age and educational status.

Large regional variations are known to exist with regards to coverage of maternal health services[129] in Indonesia, and given the known difficulties regarding the ability of local governments to ensure access to essential health services in the wake of decentralisation[9,109,110,124], it is unsurprising that many of the same issues around fiscal space and institutional capacity for health planning are also associated with the quality of routine maternal and neonatal care. In particular issues relating to limited coordination between stakeholders, retention and training of health staff, and appropriate engagement with local communities have been previously documented as major impediments to good quality healthcare in disadvantaged districts[130-132]. These results similarly echo the more limited findings from the IFLS with regard to both ANC and structural aspects of quality, which also noted lower standards of quality in outlying regions[108,109].

Geographical location is not the only factor affecting the quality of maternal and neonatal care in Indonesia however; in this analysis there was also a strong association between QI scores and type of SBA provider. Home based SBA care was notably lower than any form of facility based delivery, and in general public facilities provided a higher standard of care than private facilities. The highest QI scores were associated with public non-hospital providers, which, despite considerable government efforts to strengthen primary health facilities as part of a movement towards universal health care[133], are not heavily utilised for delivery services. This juxtaposition between apparent quality and low utilisation is unexpected, however it may reflect an underlying trend in patient preferences; based on evidence from qualitative studies, concerns regarding overcrowding and lack of staff in nearby primary facilities will often lead to primary care facilities being bypassed in favour of other options, including home based delivery among women who cannot afford private care[125].

Indeed, the majority of Indonesian women who utilise SBA services choose to deliver in the private system. Higher perceived quality[134] [135] has been suggested as a major factor driving this preference, however the results of this analysis suggest that private providers score worse than their public counterparts. This does accord with what little is known with regard to private provider quality in Indonesia[109] with limited regulation and training[127] , particularly of small private providers, being considered of particular concern. More generally, differences between client expectations and evidence based practice[18,19] can often result in lower standards of care within the private health systems, although evidence for this in Indonesia specifically remains scarce.

One major caveat regarding these findings regarding regional and provider based variation, is that the QI does not reflect access to, or quality of EMOC services which have considerable impact on maternal and neonatal mortality. The case of East and West Nusa Tenggara raises the possibility that even good quality routine care may be of limited use when not accompanied by lifesaving care. This is a considerable limitation of the QI, however from a health systems perspective good quality routine care is essential in ensuring better outcomes in those who are able to utilise emergency care. Prompt identification of complications and early referral are important components in maximising the chance of a positive outcome for mother and child[39]. These findings thus might be considered an important step forward in understanding the interaction between routine health services and referral level care.

While region and provider type were by far the largest determinants of quality of care, wealth, education and number of previous births were also associated with a significant level of variation. Notably, the quality of care received by the poorest households even at public facilities, is much worse than for the rest of the population. Outside of direct concerns regarding discrimination by providers[125,126,131] , it is also possible the OOP costs associated with consumables such as diagnostic tests[110] may also be contributing to wealth based variation. Lower scores are also associated with limited education and higher birth order; other studies have noted limited health knowledge among the general population as a concern in Indonesia[113,126,127,131] with those perceived as "healthy" often not considered as needing routine services[113].

If Indonesia is to achieve its goal of UHC, and see maternal and neonatal health outcomes improve among the disadvantaged, good quality care is essential. However this is unlikely unless one of the underlying barriers to implementation, the limited capacity of already struggling local health systems to provide a range of good quality health services in a decentralised context, is addressed successfully. Until then it is likely that inequities in the quality of maternal and neonatal care will continue to persist.

The next chapter will demonstrate the application of the QI methodology to explore variation in quality of care in the Philippines, a nearby country that has similarly undergone movement towards UHC in the context of a highly decentralised health system.

6 Variation in the Quality of Maternal and Neonatal care in the Philippines

The analysis of the 2012 Indonesian DHS revealed a complex relationship between assorted demographic and health system factors and the quality of routine maternal and neonatal care. While the patterns of quality of care seen in Indonesia are undoubtedly heavily affected by internal factors, the relationship between decentralisation and quality, as well as the role of primary health services in providing access to appropriate forms of care bear further looking into. The nearby country of the Philippines, which also has a highly decentralised health system and growing private sector, offers an opportunity to examine these themes within a similar context.

6.1 Country Background

With a rapidly expanding population of nearly 103milllion and a healthily growing economy, the Philippines is Southeast Asia's second largest country, spanning over seven thousand islands on the western edge of the Pacific Ocean[136]. Over half the total population resides in Luzon, the largest island group in the archipelago; the majority of these reside in and around the rapidly growing urban areas surrounding the capital Manila[137]. Despite this urbanisation, there remains a sizable population residing in rural, often isolated, parts of the country. Geographically the Philippines is heavily mountainous, and is often subject to natural disasters in the form of tropical cyclones, earthquakes and volcanic activity. The population is predominantly Catholic, although there is a sizable Muslim minority residing in the Mindanao island group to the south. Linguistically, the country is highly diverse, with the two official languages of the country (Tagalog and English) necessarily supplemented by nineteen regionally official languages[138]. Armed conflict between the Philippine government and Moro Muslim groups as well as an ongoing communist insurgency have historically affected (predominantly southern) parts of the country since the 1960s and 70s resulting in internal instability in these regions[139].

Perhaps unsurprisingly, the Philippines is heavily decentralised, with Local Government Units (LGUs) being the principal method of administration[137]. The country is divided into eighteen national government regions used only for administrative purposes, and one autonomous province, the Autonomous Region of Muslim Mindanao (ARMM), which has a separate regional government. Within each region the country is divided into, Provinces and Independent Cities with each province being further divided into Component Cities and Municipalities. The smallest LGU is the Barangay, or village, which may be administered by either city or municipal governments.

Access to health care has risen considerably in recent decades, with much of the increase attributed to the effect of the national PhilHealth Insurance scheme[63,124,140]. At the same time, rates of neonatal mortality have shown little reduction from 17 deaths per 1000 live births as estimated by the 2003 Philippines DHS to 13 per 1000 in the 2013 DHS[141]. Similarly, maternal mortality has also appeared to stagnate, sitting at just over 120 deaths per 100000 live births between 1995 and 2010, although more recent estimates suggest that that the rate had declined to 114 deaths per 1000 live births by 2015[121]. As such there has been considerable attention paid improving both the quality of and access to maternal and neonatal health services within the country. In terms of the structure of the health system Provincial governments are responsible for providing secondary hospital care and coordinating health service delivery within the province, while city and municipal governments are tasked with providing primary care through primary care centres linked to Barangay Health Centres (BHCs) and health outposts. There is also a small number of tertiary medical centres run directly by the DOH. The exception to this structure occurs in ARMM, where all health facilities are directly administered by the regional government[137].

Outside the public sector, there is a rapidly expanding, well-resourced private sector serving approximately a third of the population[137]. Despite being regulated by the national Department of Health and the Philippine Health Insurance Corporation (PhilHealth), private providers do not directly provide health information to the government for inclusion in their data. Evidence on usage patterns suggests that while the poor tend to utilise primary health care facilities (due to higher co-payments and other costs associated with both private and public hospital care), those who can afford to often bypass lower level government hospitals in favour of private or tertiary level care due to concerns regarding poor quality of care. Access to private facilities is however limited by location, with the majority of hospitals based in larger urban areas[137].

While OOP payment remains the primary form of health expenditure, an increasing number of the population are covered by the PhilHealth insurance programme either through direct payment of premiums or by being classed as indigent, whereby premiums are subsidised either by the national government or by the relevant LGUs[124,137]. Despite this, a sizable proportion of the population remains uninsured; 37% of households in the 2013 Philippines DHS were reported as not being covered by any form of health insurance, including PhilHealth[137]. While insurance coverage is associated with a higher utilisation of health facilities[140] the PhilHealth scheme remains heavily biased towards the wealthy; lack of knowledge regarding the availability of services and concerns about inappropriate reimbursement rates leading to unexpected OOP expenditure have been implicated as major factors leading to a lack of use by the poor who are enrolled in the PhilHealth[142].

In terms of quality of care, the majority of information available is typically related to the ability of higher level providers (particularly hospitals) to meet PhilHealth accreditation standards[137], with reporting being particularly sparse for primary level health care and non-accredited private facilities[143]. However, the limited data that is available suggests that there is considerable variation in quality of care within the country, particularly with regards to wealth. A preparatory study for the Quality Improvement Demonstration Study program, which utilised pay-for-performance and expanded access to insurance schemes in order to target quality of care within the hospital environment, found that facility accreditation was associated with a higher quality of care, although potentially this was affected by payments associated with the PhilHealth insurance scheme[144]. Data from the same study also showed that with regards to the treatment of childhood diarrhoea and pneumonia the care recommended by the majority of doctors was not of a high standard, often combining both insufficient care and unnecessary (and potentially harmful) treatment at the same time[20], and that the amount of care provided to children with these conditions appeared to vary based on ability to pay[142] even within the context of a public hospital setting.

With regards to the quality of maternal and neonatal health care in particular, there is evidence that practices in the initial postpartum period are suboptimal[145] and follow up care is limited by a heavy reliance on community level health workers to provide home visits, often with insufficient support[146]. The ability of this analysis to examine quality of care across multiple provider types as well as for a representative sample of the overall population thus provides a major opportunity to determine the level to which these findings are applicable to the Philippines as a whole.

6.2 Overview of the Philippines 2013 DHS

The 2013 Philippines DHS collected data from 14804 households throughout the country, with the individual Women's Questionnaire being used to collect data from 16155 women between the ages of 15 and 49. The two-stage stratified sampling design enabled the data to be representative of urban and rural populations at the regional level.

6.2.1 Sample Characteristics

Of the 16155 women interviewed, 5301 reported having had at least one live birth in the last five years, and thus were potentially eligible for inclusion in the analysis. Coverage of ANC is generally high, with 95% of women reporting at least one ANC visit with a skilled provider and 84% reporting at least four ANC visits. Overall, 61% of women delivered in a health facility and 72.8% were assisted by a SBA. In total, 3841 women reported having had both ANC and SBA services, forming the basis of the analysis.

6.2.2 Availability of Quality Indicators

As well as the Core DHS indicators outlined in previous chapters, the Philippines DHS included a number of other indicators relating to the content of pregnancy and birth related visits. In addition to the question asking about the timing of the initial ANC visit, the questionnaire also asked about the timing of the last ANC visit. Based on the IMPAC recommendations regarding the timing of ANC visits, this was used to construct an indicator reflecting "At least one ANC visit in the 3rd trimester".

In addition to the standard ANC content questions regarding Blood Pressure, Urine and Blood Testing, Tetanus Immunisation, Iron supplementation and Advice about pregnancy complications, the 2013 Philippines DHS also included questions about whether or not height and weight were measured (necessary for monitoring nutritional status and general wellbeing throughout the pregnancy), and if drugs were taken for intestinal parasites (recommended in areas with high parasite burdens in order to combat maternal anaemia and other complications).

The remaining country specific questions all pertained to the content of maternal PNC; in addition to the DHS standard question regarding maternal vitamin A supplementation questions were also asked about postpartum iron supplementation (for preventing maternal anaemia), and counselling regarding newborn care, family planning and breastfeeding (to provide appropriate health advice).

Women were also asked about physical examinations that took place during PNC; in particular whether or not they received breast, abdominal and internal exams as well as a general check of their health including blood pressure testing. As much of PNC's effectiveness in preventing maternal and neonatal mortality is due to the early identification of complications that require treatment, these indicators are potentially a very important reflection of the quality of postnatal care.

Table 6.2.1 provides an overview of the available indicators for the Philippines 2013 DHS, as well as a summary of the indicator means within the sample of the population who received both ANC and SBA services. Coverage ranges from blood pressure testing in ANC at over 99% to less than 1% for intestinal deworming during pregnancy.

Table 6.2.1 Potential Quality Indicators Identified with mean prevalence in population with both ANC and SBA services, Philippines 2013

Indicator	**Mean**	**Std. Err.**
1+ ANC visit in 1st Trimester	0.675	0.008
1+ANC visit in 3rd Trimester	0.975	0.003
Blood Pressure measured during ANC	0.991	0.002
Urine sample taken during ANC	0.711	0.007
Blood sample taken during ANC	0.640	0.008
Weight measured during ANC	0.984	0.002
Height measured during ANC	0.813	0.006
Took drugs for intestinal parasites during pregnancy	0.046	0.003
Iron supplementation during pregnancy	0.517	0.008
Fully protected from Tetanus during pregnancy	0.842	0.006
Told about pregnancy complications during ANC	0.825	0.006
Baby was weighed at birth	0.956	0.003
Baby was breastfed within 1 hr of birth	0.498	0.008
No liquids given before milk began to flow (no prelacteal feed)	0.588	0.008
Maternal postnatal check within 2 hrs of delivery	0.487	0.008
Neonatal postnatal check within 2 hrs of delivery	0.350	0.008
Mother received postpartum Vitamin A within 2 months of delivery	0.716	0.007
Mother received postpartum Iron within 2 months of delivery	0.746	0.007
Mother received counselling on newborn care within 2 months of delivery	0.858	0.006
Mother received advice about family planning within 2 months of delivery	0.679	0.008
Mother received advice about breastfeeding within 2 months of delivery	0.900	0.005
Mother received abdominal exam within 2 months of delivery	0.792	0.007
Mother received breast exam within 2 months of delivery	0.645	0.008
Mother received internal exam within 2 months of delivery	0.595	0.008
Mother received complete checkup within 2 months of delivery	0.840	0.006

6.2.3 Missing Data

Using the methods outlined in Chapter 3, binary indicators were created from each relevant variable reflecting whether or not each observation received a particular service or not. As recommended by the analyses outlined in Chapter 4, “full quality” for indicators with a quantitative component was defined as having 90+ days of iron supplementation and having the first PNC check within 2 hours of delivery – this enables comparability across analyses and minimises the likelihood that the resulting QI will reflect access to, rather than quality of services. No country-specific indicators contained a quantitative component, and as such simply reflect whether or not a particular service was provided.

Of the 3841 observations reporting both ANC and SBA use, 3611 (94% of sample) had available information on all indicators (including country specific indicators). Following the assumptions outlined in Chapter 2 regarding “don’t know” and partial responses a further 181 observations (4.7% of sample) were included in the sample; in total 49 observations (1.3% of sample) were dropped due to missing data.

Table 6.2.2 Demographic characteristics by Non-Missing, Imputed or Dropped status, Philippines 2013

Category	**Complete**		**Imputed**		**Missing**	
	#	%	#	%	#	%
Urban	1,737	*48.1%*	84	*46.4%*	27	*55.1%*
Rural	1,874	*51.9%*	97	*53.6%*	22	*44.9%*
p-value			0.656		0.330	
15-19	193	*5.3%*	6	*3.3%*	1	*2.0%*
20-24	824	*22.8%*	37	*20.4%*	10	*20.4%*
25-29	899	*24.9%*	29	*16.0%*	6	*12.2%*
30-34	812	*22.5%*	49	*27.1%*	14	*28.6%*
35-39	521	*14.4%*	30	*16.6%*	10	*20.4%*
40-44	270	*7.5%*	21	*11.6%*	6	*12.2%*
45-49	92	*2.5%*	9	*5.0%*	2	*4.1%*
p-value			0.009		0.229	
No education	14	*0.4%*	2	*1.1%*	0	*0.0%*
Incomplete primary	213	*5.9%*	12	*6.6%*	4	*8.2%*
Complete primary	296	*8.2%*	17	*9.4%*	4	*8.2%*
Incomplete secondary	528	*14.6%*	22	*12.2%*	10	*20.4%*
Complete secondary	1,302	*36.1%*	63	*34.8%*	14	*28.6%*
Higher	1,258	*34.8%*	65	*35.9%*	17	*34.7%*
p-value			0.637		0.782	
Poorest	624	*17.3%*	28	*15.5%*	7	*14.3%*
Poorer	778	*21.5%*	37	*20.4%*	9	*18.4%*
Middle	815	*22.6%*	33	*18.2%*	14	*28.6%*
Richer	777	*21.5%*	37	*20.4%*	13	*26.5%*
Richest	617	*17.1%*	46	*25.4%*	6	*12.2%*
p-value			0.066		0.649	

Table 6.2.2 Cont.

National Capital Region	559	*15.5%*	10	*5.5%*	7	*14.3%*
Cordillera Admin Region	168	*4.7%*	13	*7.2%*	3	*6.1%*
I - Ilocos Region	198	*5.5%*	13	*7.2%*	1	*2.0%*
II - Cagayan Valley	156	*4.3%*	10	*5.5%*	3	*6.1%*
III - Central Luzon	334	*9.2%*	22	*12.2%*	5	*10.2%*
IVA - CALABARZON	376	*10.4%*	34	*18.8%*	5	*10.2%*
IVB - MIMAROPA	96	*2.7%*	3	*1.7%*	1	*2.0%*
V - Bicol	190	*5.3%*	18	*9.9%*	4	*8.2%*
VI - Western Visayas	231	*6.4%*	6	*3.3%*	5	*10.2%*
VII - Central Visayas	245	*6.8%*	12	*6.6%*	1	*2.0%*
VIII - Eastern Visaya	143	*4.0%*	2	*1.1%*	1	*2.0%*
IX - Zamboanga Peninsula	169	*4.7%*	3	*1.7%*	4	*8.2%*
X - Northern Mindanao	154	*4.3%*	1	*0.6%*	2	*4.1%*
XI - Davao	195	*5.4%*	18	*9.9%*	3	*6.1%*
XII - SOCCSKSARGEN	142	*3.9%*	1	*0.6%*	0	*0.0%*
XIII - Caraga	190	*5.3%*	8	*4.4%*	2	*4.1%*
ARMM	65	*1.8%*	7	*3.9%*	2	*4.1%*
p-value			0.000		0.842	
Total	**3611**		**181**		**49**	
(% of Total)	*94.0%*		*4.7%*		*1.3%*	

Table 6.2.2 provides a breakdown of complete, imputed and dropped observations by key demographic factors. Neither the imputed or dropped observations significantly differed from the complete observations on the basis of age, urban rural status, educational attainment or wealth, however observations for which data on at least one indicator were imputed did differ significantly from the complete observations in terms of the region they were from.

Imputed observations were more likely to be from CALABARZON, Bicol and Davao; as the majority of the assumptions used for the imputed group result in observations being categorised as NOT having received the given indicator, it should be noted that regional estimates of quality are likely to be underestimated for these regions. There is no significant regional variation between the dropped and complete observations.

6.3 Construction of Quality Indices

Construction of QI for the 2013 Philippines dataset followed the methodology outlined in Chapters 3 and 4, starting with the identification of potential indicators and categorisation into different indicator sets. PCA analysis was then carried out on each set of indicators and indices based on PCA were created alongside indices based on equal weighting.

6.3.1 Indicator Sets

As previously mentioned in section 6.2.2 the Philippines 2013 DHS collected data not only the Core DHS indicators, but also a large number of additional country specific indicators. In particular, this DHS contains eight additional questions relating to the content of maternal postnatal visits, as well as four additional questions relating to the timing and content of ANC visits. Table 6.2.1 in the section above provides an overview of the mean and standard deviation of each indicator within the dataset.

Based on the assumption that indicators with a mean of greater than 90%, or a SE of less than 0.005 would be unlikely to substantially determine relative quality of care, six indicators were omitted from the complete indicator set in order to form a third “Key” indicator set. Table 6.3.1 lists the final indicators used as well as the Cronbach’s alpha calculated for each indicator set. Notably, of the three indicator sets used, only the All and Key indicator sets achieved a score above 0.7, which suggests a very low level of internal consistency between the indicators in the Core DHS indicator set. The reasons for this become apparent when examining the results of the PCA process in the section below.

Table 6.3.1 Indicator sets used for construction of QI, Philippines 2013

	All Indicators	**Key Indicators**	**Core Indicators**
1+ ANC visit in 1st Trimester	x	x	x
1+ANC visit in 3rd Trimester	x		
Blood Pressure measured during ANC	x		x
Urine sample taken during ANC	x	x	x
Blood sample taken during ANC	x	x	x
Weight measured during ANC	x		
Height measured during ANC	x	x	
Took drugs for intestinal parasites during pregnancy	x		
Iron supplementation during pregnancy	x	x	x
Fully protected from Tetanus during pregnancy	x	x	x
Told about pregnancy complications during ANC	x	x	x
Baby was weighed at birth	x		x
Baby was breastfed within 1 hr of birth	x	x	x
No liquids given before milk began to flow (no prelacteal feed)	x	x	x
Maternal postnatal check within 2 hrs of delivery	x	x	x
Neonatal postnatal check within 2 hrs of delivery	x	x	x
Mother received postpartum Vitamin A within 2 months of delivery	x	x	x
Mother received postpartum Iron within 2 months of delivery	x	x	
Mother received counselling on newborn care within 2 months of delivery	x	x	
Mother received advice about family planning within 2 months of delivery	x	x	
Mother received advice about breastfeeding within 2 months of delivery	x		
Mother received abdominal exam within 2 months of delivery	x	x	
Mother received breast exam within 2 months of delivery	x	x	
Mother received internal exam within 2 months of delivery	x	x	
Mother received complete checkup including blood pressure within 2 months of delivery	x	x	
Chronbach's Alpha	**0.7369**	**0.7132**	**0.3556**

6.3.2 Results of PCA

Table 6.3.2 shows the variable weights calculated as a result of the PCA analysis using the All, Key and Core indicator sets. There is a notable difference in the weighting patterns between the country specific and Core DHS based indicator sets: while the provision of blood and urine testing during ANC carry substantial weight in both scenarios, in the Core indicator set these two indicators overwhelmingly dominate the index while in the All and Key indicator sets these ANC based indicators carry a slightly smaller weight than the indicators relating to the content of PNC.

In fact, the Core indicator set shows an extreme bias toward ANC content as a whole, with early initiation of ANC and the receipt of at least 90 days of iron supplementation also carrying substantial weight, while the provision of postnatal vitamin A is the only non-ANC indicator to have any noticeable effect on the index. In contrast, the other indices are heavily weighted towards the content of PNC. Additionally, while timely PNC (within 2 hours of birth) is slightly negative in the Core indicator set, in the All and Key sets it has small, but not insignificant weight.

Table 6.3.2 PCA derived variable weights for primary and secondary components using different indicator sets, Philippines 2013

Indicator	**All Indicators**		**Key Indicators**		**Core Indicators**	
	Comp 1	**Comp 2**	**Comp 1**	**Comp 2**	**Comp 1**	**Comp 2**
1+ ANC visit in 1st Trimester	0.113	-0.193	0.121	-0.188	0.280	0.039
1+ANC visit in 3rd Trimester	0.015	-0.014				
Blood Pressure measured during ANC	0.013	-0.014			0.020	0.004
Urine sample taken during ANC	0.221	-0.458	0.235	-0.449	0.583	-0.001
Blood sample taken during ANC	0.238	-0.503	0.254	-0.493	0.629	-0.019
Weight measured during ANC	0.019	-0.019				
Height measured during ANC	0.130	-0.105	0.137	-0.099		
Took drugs for intestinal parasites during pregnancy	0.008	-0.009				
Iron supplementation during pregnancy	0.144	-0.211	0.153	-0.203	0.343	0.097
Fully protected from Tetanus during pregnancy	0.018	0.017	0.019	0.019	0.013	0.049

Table 6.3.2 cont.

Told about pregnancy complications during ANC	0.142	-0.068	0.148	-0.062	0.178	0.069
Baby was weighed at birth	0.054	-0.011			0.056	0.035
Baby was breastfed within 1 hr of birth	0.057	0.200	0.060	0.210	-0.037	0.318
No liquids given before milk began to flow (no prelacteal feed)	0.029	0.171	0.029	0.178	-0.057	0.242
Maternal postnatal check within 2 hrs of delivery	0.158	0.421	0.159	0.432	-0.024	0.668
Neonatal postnatal check within 2 hrs of delivery	0.110	0.388	0.110	0.398	-0.054	0.588
Mother received postpartum Vitamin A within 2 months of delivery	0.309	0.087	0.316	0.094	0.160	0.170
Mother received postpartum Iron within 2 months of delivery	0.307	0.048	0.313	0.055		
Mother received counselling on newborn care within 2 months of delivery	0.256	0.056	0.251	0.054		
Mother received advice about family planning within 2 months of delivery	0.321	0.102	0.325	0.107		
Mother received advice about breastfeeding within 2 months of delivery	0.218	0.067				
Mother received abdominal exam within 2 months of delivery	0.298	0.057	0.304	0.064		
Mother received breast exam within 2 months of delivery	0.356	0.063	0.368	0.074		
Mother received internal exam within 2 months of delivery	0.320	0.039	0.331	0.050		
Mother received complete checkup including blood pressure within 2 months of delivery	0.234	0.073	0.236	0.076		
Rho	**0.187**	**0.100**	**0.188**	**0.105**	**0.178**	**0.152**

PCA usually focuses on the primary component (or factor) identified in the data, that is, the component that explains the most variation in the correlation between variables. Usually there is a substantial difference in the Rho value for the primary and secondary components identified by PCA, however when looking at the secondary component identified in the Core based PCA we can see that not only are the Rho values fairly close, but that the pattern of weighting appears to be almost inverse to that seen in the primary component. That is, there is almost no weight on ANC indicators, while timely maternal and neonatal PNC dominate the index.

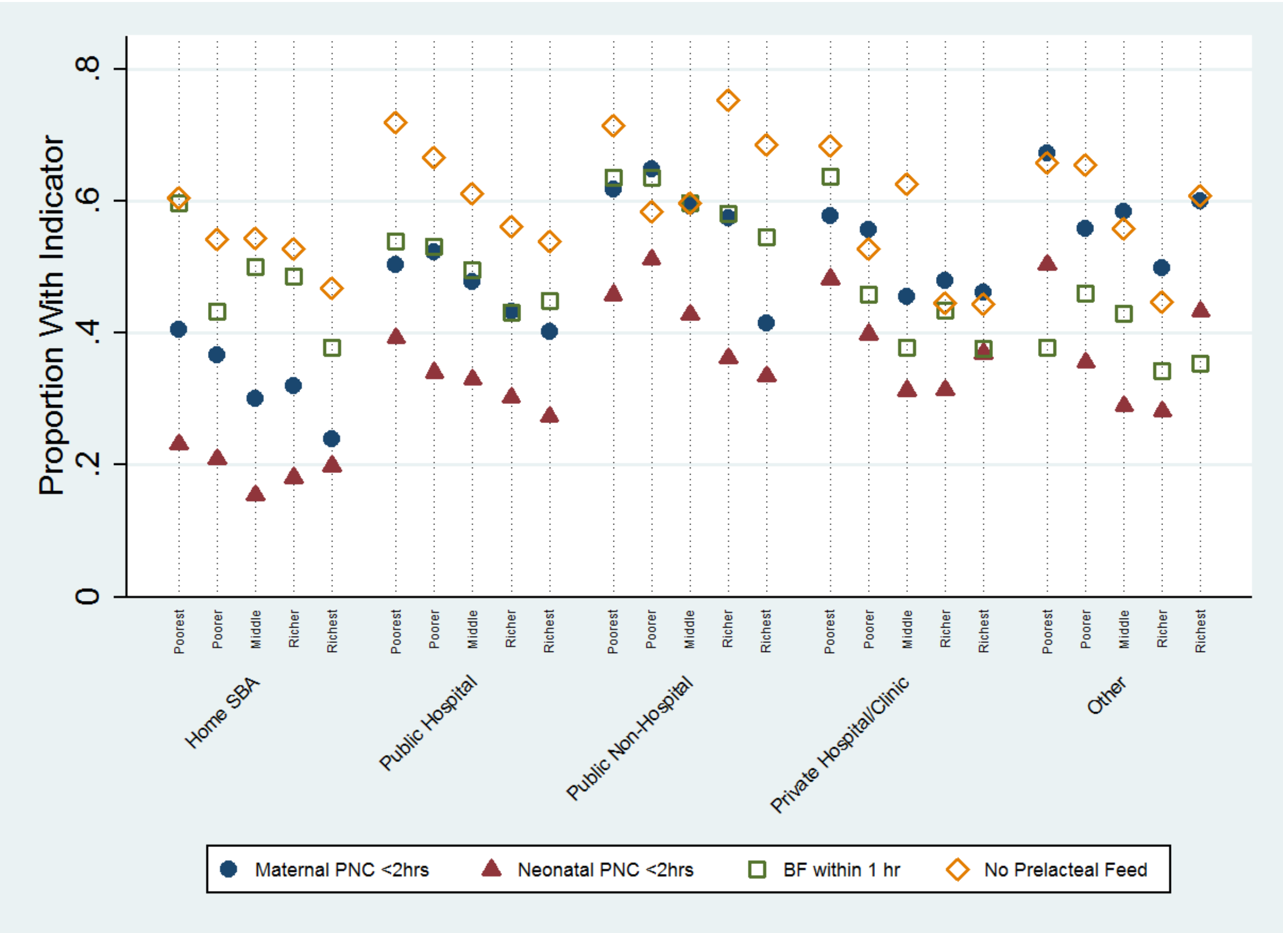
As the dataset is restricted to only women who received both ANC and SBA services, this suggests a definite split between the provision of ANC and SBA care; good quality ANC appears to be unrelated to receiving timely PNC and having optimal breastfeeding practices. Vitamin A supplementation carries similar weight in both components, suggesting it is not directly aligned with either group. In the All and Key based PCA however there is a far greater distance between the primary and secondary components, and the primary components appear to reflect primarily PNC content (with vitamin A supplementation almost doubling in weight), but also reflect ANC content and timing of PNC to a lesser extent. Early initiation of breastfeeding and lack of prelacteal feeding carry almost no weight in the primary component despite the fact that the indicator reflecting breastfeeding advice during PNC carries substantial weight; in the second component the pattern swaps.

Based on the data, those with good ANC care are not guaranteed high quality PNC content, but neither are those who receive timely PNC. At the same time those who do have high quality PNC content are more likely to also have good quality ANC or timely PNC. Notably, the fact that the second component in both indicator sets identifies a strong negative correlation between ANC content, timely PNC and Breastfeeding indicators suggests that there is a definite group of observations who received only a basic level of care during their pregnancy. While these women did receive ANC and PNC checks, they did not receive the same thorough examinations that other women received. The fact that these women were also more likely to receive a check-up within 2 hours of delivery, suggests that part of the reason for the lack of PNC content may be due to early discharge – several studies of the implementation of the PhilHealth insurance scheme have noted that uninsured, or otherwise disadvantaged individuals tend to spend less time as inpatients due to inability to pay[142].

As can be seen in Figure 6.3.3 the coverage of both breastfeeding and PNC timing indicators is higher among the poor and near poor regardless of where they deliver.

It would therefore seem to be the case that those who can afford to stay in a facility for a longer period are more likely to have delayed PNC, but the quality of the PNC care they receive is higher. These individuals are also more likely to have received appropriate ANC content and advice regarding breastfeeding as part of the PNC checkup, but are more likely to have sub-optimal breastfeeding practices. It is possible that the advice being given to new mothers is not succeeding in promoting appropriate breastfeeding practices, although there is insufficient data to determine if this is due to inappropriate advice or to external factors that are not currently addressed as part of the counselling.

Figure 6.3.3 Coverage of PNC and Breastfeeding Indicators by Wealth Quintile and SBA provider, Philippines 2013



Several studies[63,146] have noted that lack of quality postnatal care, particularly among disadvantaged communities, may be severely hindering efforts to decrease maternal and neonatal mortality rates in the country, and these results underline the importance of including indicators relating to the content of PNC in the formation of the QI. In the Core indicator set, quality is almost solely defined by ANC content, but as we can see the timing and content of PNC appears to be a major point of difference within the sample. Similarly, it also demonstrates that, contrary to conventional assumptions, the timing of PNC is not an adequate proxy for the overall quality of the PNC visit. Good PNC is assumed to be both comprehensive and timely; however, the current data suggests that in the Philippines, it appears to only be one or the other.

6.3.3 Comparison of QI

As a result of the factors mentioned in the previous section, it is apparent that there will be substantial differences in the scores produced by each indicator set. However, in order to look both at absolute and relative differences in quality, there is also a need to look at the differences between QI produced using either the equal weight (EW) or PCA based weighting systems. The inclusion of the EW based indices is particularly important given the findings of the PCA process – it is evident that in the case of the Philippines very few receive all the indicators of high quality care, and moreover, that certain indicators appear to be mutually exclusive although they should not. Table 5.3.3.1 shows the correlation between each of the six QI.

Table 6.3.4 Correlation between scores using different QI, Philippines 2013

Corr. between QI Scores	**QI1 - All Indicators PCA**	**QI2 - All Indicators EW**	**QI3 - Key Indicators PCA**	**QI4 - Key Indicators EW**	**QI5 - Core Indicators PCA**	**QI6 - Core Indicators PCA**
QI1	1					
QI2	0.955	1				
QI3	0.998	0.954	1			
QI4	0.951	0.993	0.955	1		
QI5	0.562	0.584	0.581	0.589	1	
QI6	0.68	0.837	0.69	0.845	0.668	1

Unsurprisingly, there is a great deal of correlation between the All and Key indicator sets however not only do the Core indicator based indices not correlate strongly with the other indices, but they do not even correlate strongly with each other. It is quite apparent that, at least in this context, that the Core indicator sets are insufficient to truly capture relative variation in quality of care. At the same time, the overlapping nature of the All indicator and Key indicator based QI suggests that there is no great benefit in using a reduced set of indicators in this case. Again, this is somewhat expected, as the majority of indicators are neither ubiquitous (with coverage over 90%) nor scarce enough to be concentrated in only a small segment of the population (have a SE of less than 0.005). As a result, for the remaining sections examining patterns of quality, only the All indicators based QI will be considered.

6.4 QI score by Key Equity Markers

The following sections will examine variation in QI scores across a number of potential equity markers. It should be noted that all scores (regardless of the type of weighting applied) have been standardised, in order to better demonstrate group based variation.

6.4.1 Variation by Wealth and Urban Rural Status

As can be seen in Figure 6.4.1, urban women have distinctively higher scores than their rural counterparts across both the EW and PCA based QI. This is not particularly surprising given the known issues of access in the Philippines particularly with regards to areas accessible only via air or sea[137]. Similarly, the distinct wealth gradient that can be seen in Figure 6.4.2 is also alluded to in existing literature surrounding the nature of care provided to the economically disadvantaged[142,147].

Figure 6.4.1 Mean QI scores for Urban and Rural populations using PCA and EW based QI with All Indicators, Philippines 2013

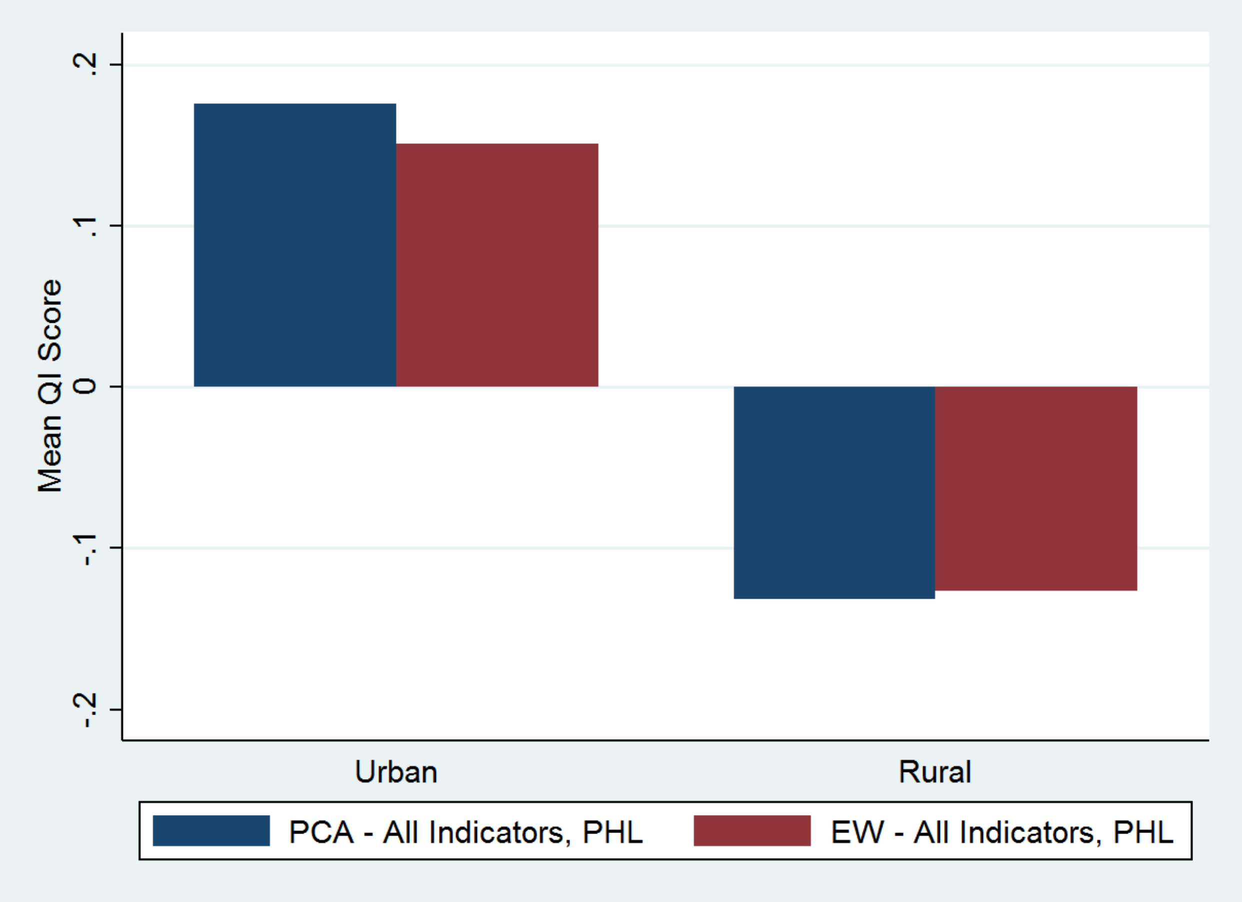
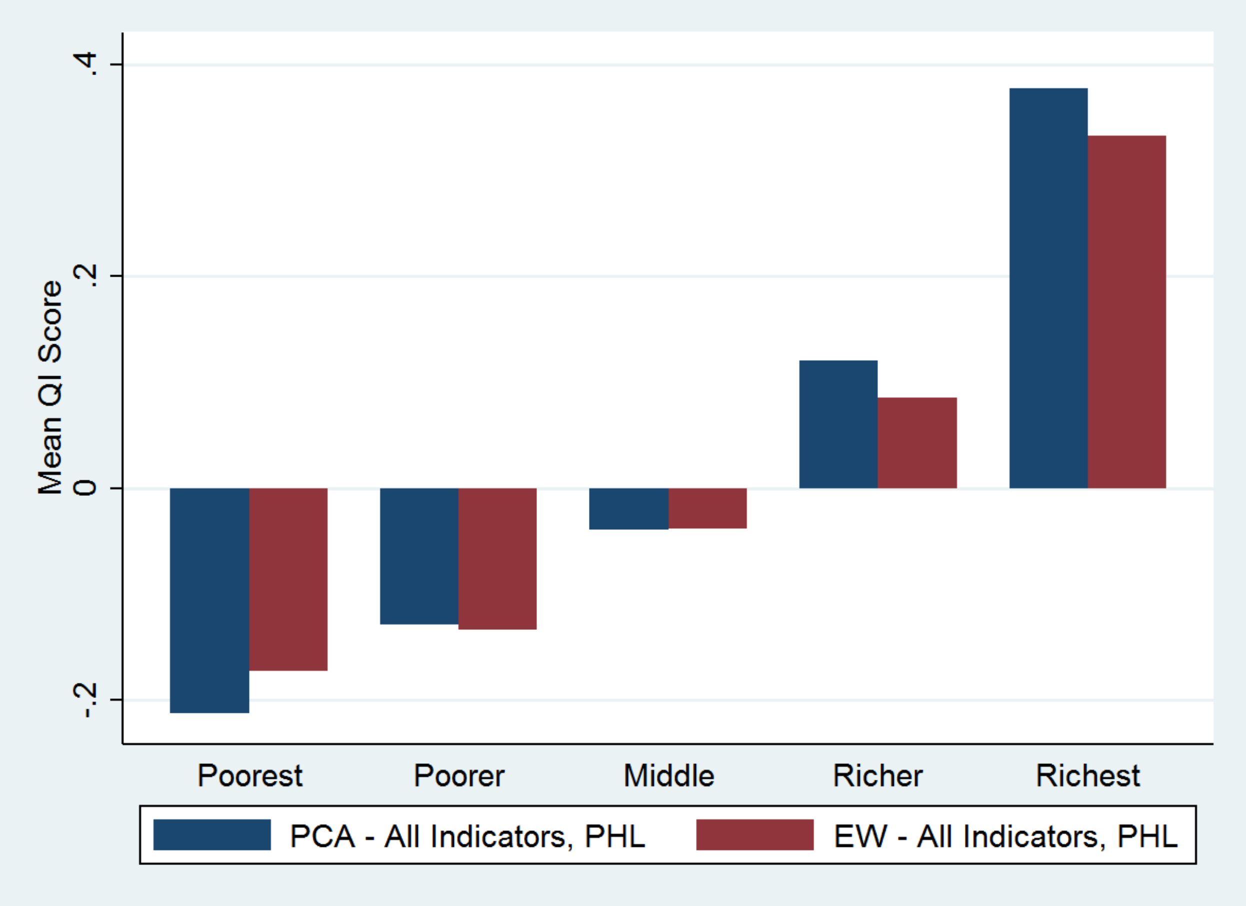


Figure 6.4.2 Mean QI scores by Wealth Quintile using PCA and EW based QI with All Indicators, Philippines 2013

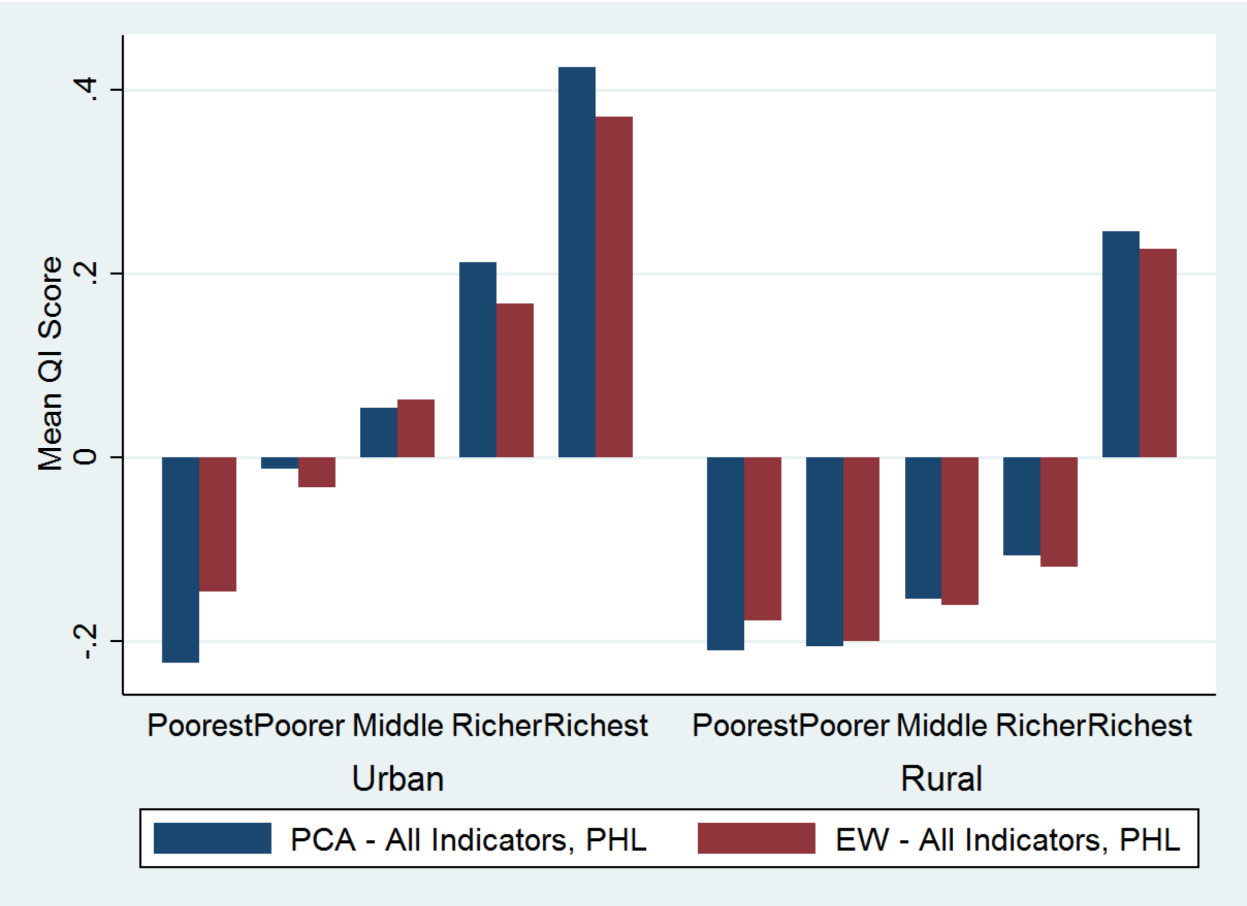


It is however interesting that the pattern of wealth based variation does appear to differ between the PCA and EW based QI. While the EW based scores show a certain level of similarity between the poorest and poorer wealth quintiles the PCA based scores clearly differentiate between all wealth quintiles. Across both QI there are large increases in mean scores occurring between the middle and richer, and richer and richest wealth quintiles. This appears to further illustrate the issues identified during the PCA analysis with regards to the timing versus content of PNC; the relatively higher scores seen in the EW index are indicative of the higher prevalence of breastfeeding and timely PNC indicators among the poor, which offset the fact that these groups are less likely to receive the recommended content of ANC and PNC visits.

As shown in Figure 6.4.3, wealth based patterns of inequality differ between urban and rural areas. While the mean scores for the poorest quintiles are similar, scores for the poorer, middle and richer wealth quintiles are much lower in rural areas, and show far less of a gradient than in urban areas. While not as high scoring as the richest urban quintile, the dramatic difference between the richest rural quintile and the rest of the rural population suggests that with sufficient resources it is possible to receive good quality care in rural areas, however those with limited wealth are generally worse off compared to their urban counterparts.

While wealth appears to be a major determinant of good quality care, it is also apparent that location, and particularly urban residence, is also potentially important. Given the decentralised nature of the Philippine health system, and the reliance on local funding sources, it is very possible that less densely populated rural areas may experience limitations in the types of care available within the public sector, resulting in the large gap between those who can afford to seek care elsewhere and those who cannot.

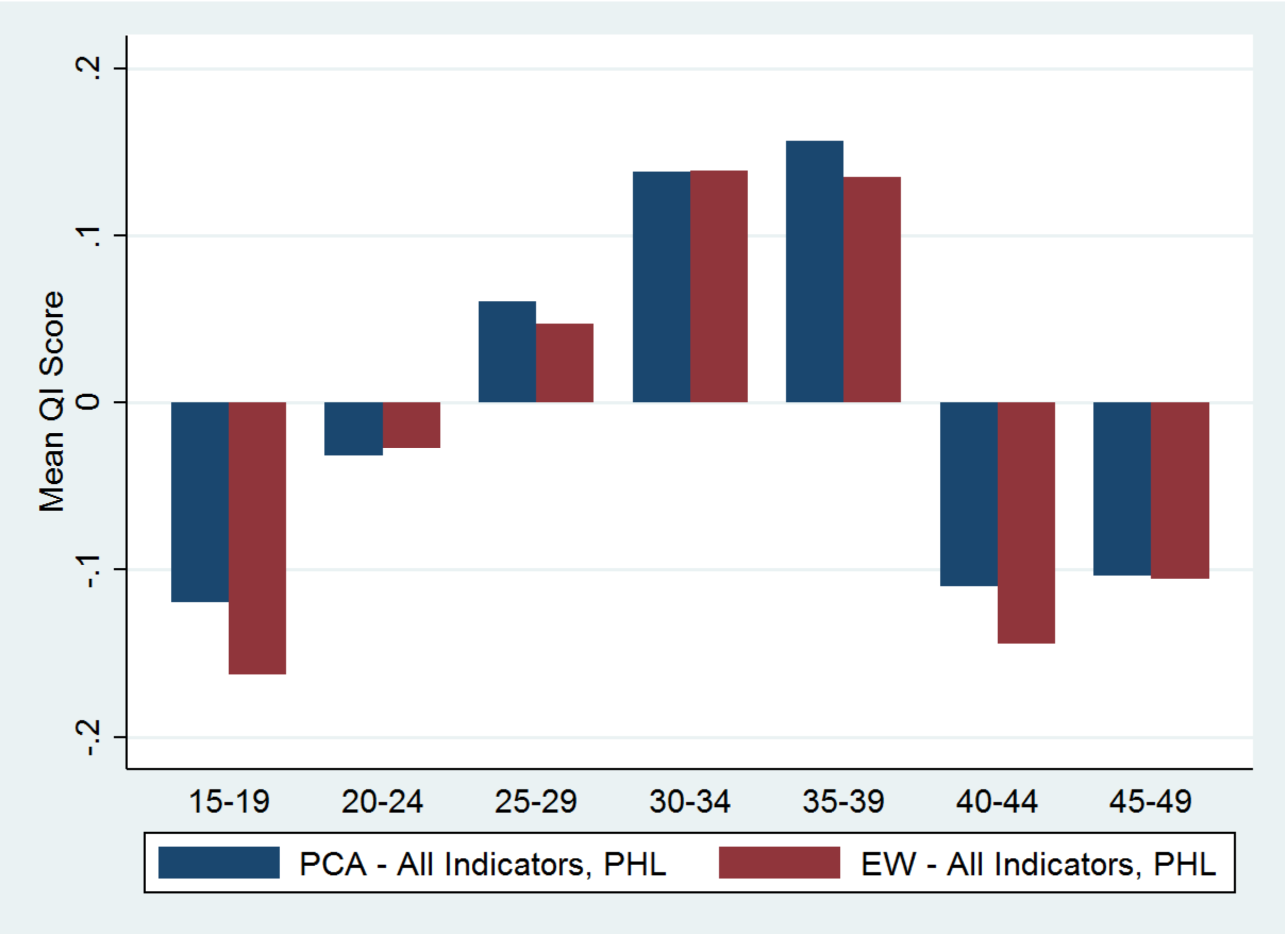
Figure 6.4.3 Mean QI scores by Wealth Quintile for Urban and Rural population, using PCA and EW based QI with All Indicators, Philippines 2013



6.4.2 *Variation by Maternal Age and Education Level*

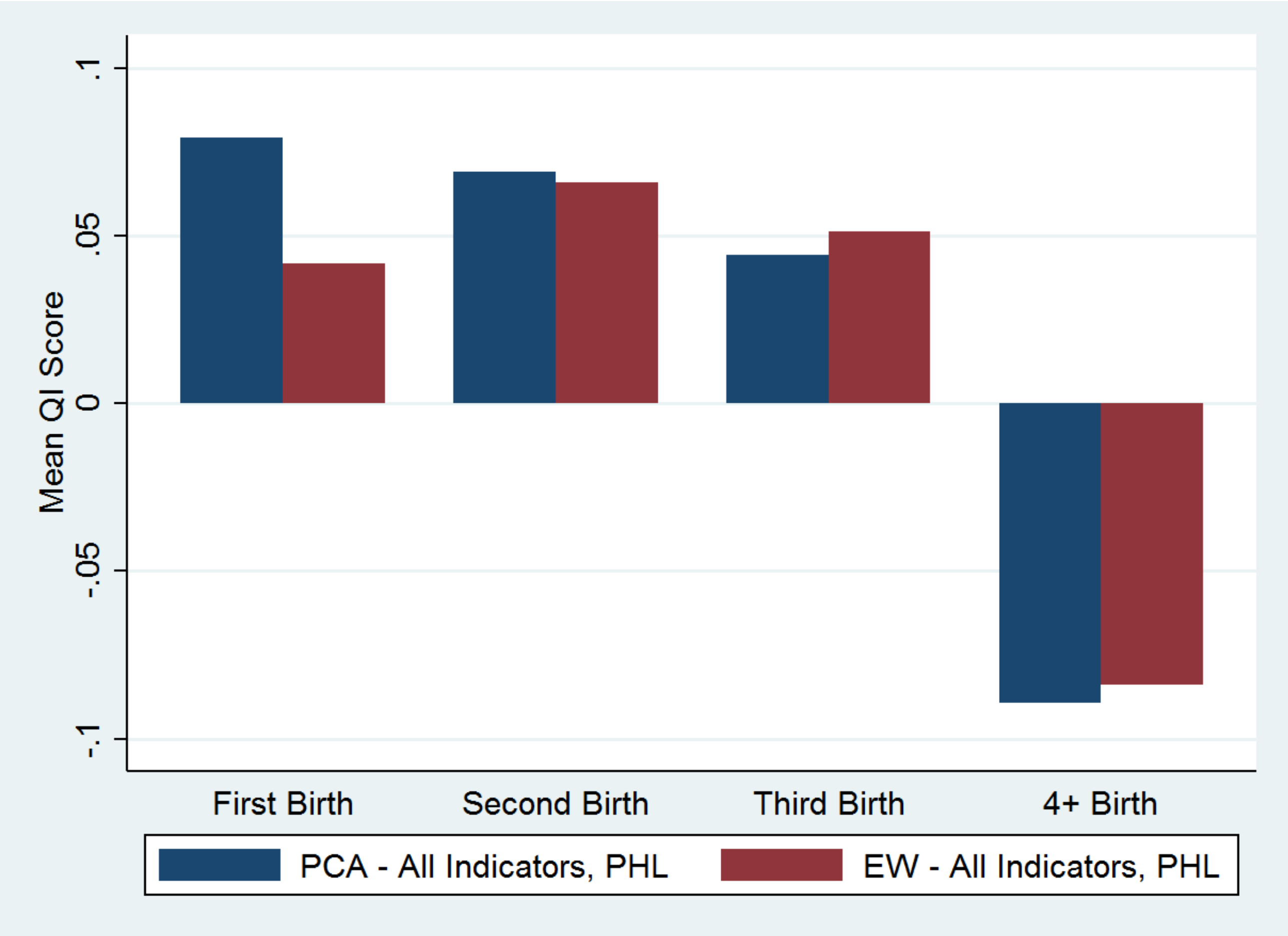
The Philippines has one the highest adolescent fertility rates in Asia, with one in ten women aged 15-19 having started childbearing; the DHS also estimates that for women over the age of 25 over a fifth gave birth by the age of 20. Overall fertility rates are also much higher than many other countries in the region, often attributed to the influence of the Catholic Church on contraceptive patterns and other reproductive behaviours. As such the Philippines has a larger proportion of the population that falls into high risk groups relating to maternal age and parity. Figure 6.4.4 shows that younger women score much lower in terms of the QI compared to their counterparts, with teenage pregnancies showing particularly low levels of quality.

Figure 6.4.4 Mean QI scores by Maternal Age at Birth using PCA and EW based QI with All Indicators, Philippines 2013



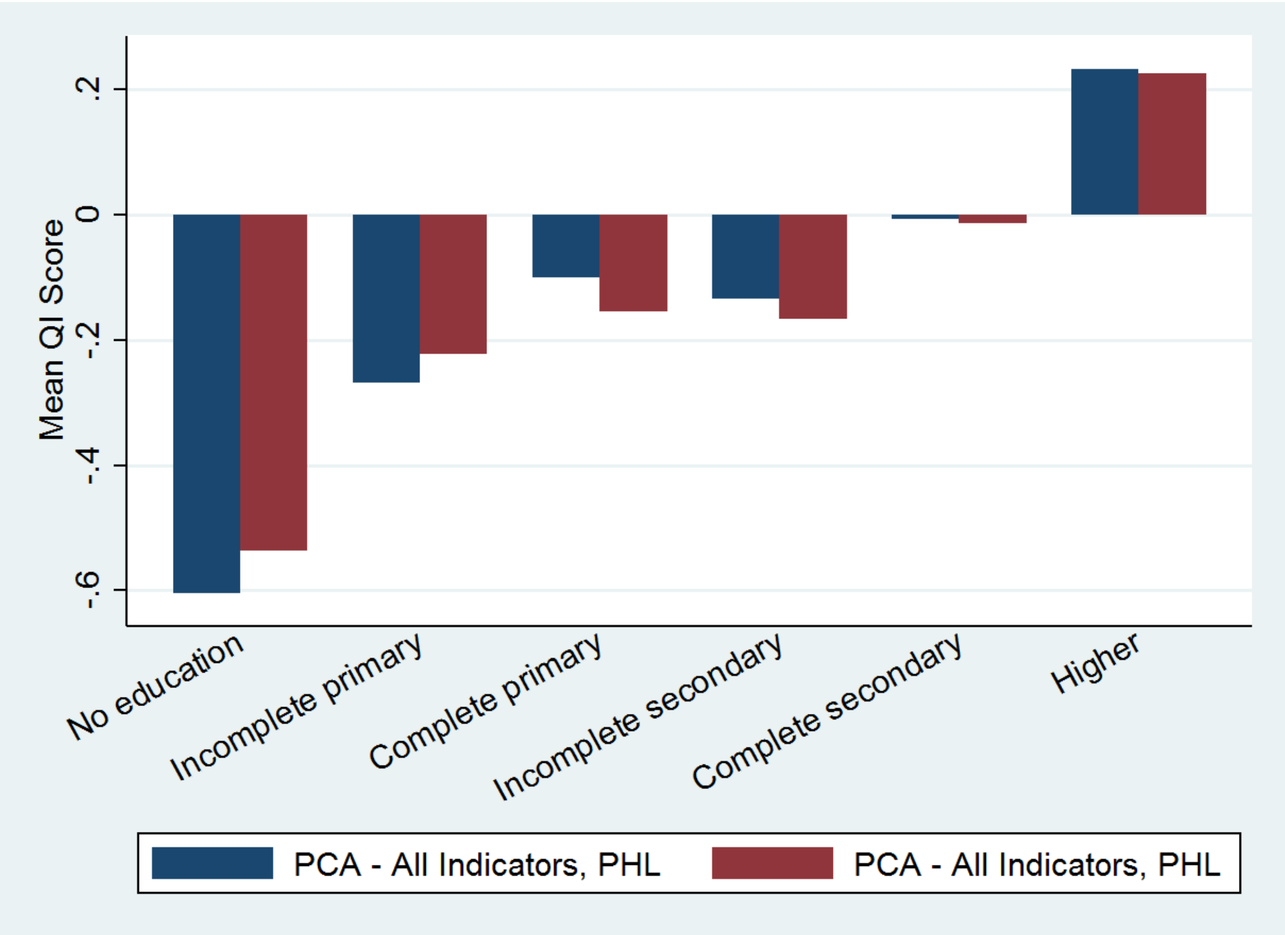
Older mothers also appear to have a lower quality of care, although it is possible that this is the result of higher parity births; Figure 6.4.5 shows that while there is little difference in QI scores for first, second and third births, fourth births and above appear to have a much lower quality of care. Interestingly, this graph also shows a marked difference between PCA and EW score for first births. As the majority of difference between these indices is related to breastfeeding behaviours, this suggests that first-time mothers may not be receiving appropriate counselling in this regard.

Figure 6.4.5 Mean QI scores by Birth Order, using PCA and EW based QI with All Indicators, Philippines 2013



In terms of maternal education, those with post-secondary education score well above average. According to the DHS estimates approximately one third of women aged 15-49 have a tertiary education, with another 30% having completed secondary schooling. Secondary completion rates vary considerably however by wealth, with only 27% of those in the poorest wealth quintiles having completed high school compared to 86% in the wealthiest quintile. It is possible that the lower QI scores seen for those who did not complete secondary schooling is due to this overlap between wealth and education, however the strongly positive scores among the tertiary educated segment of the population still suggest that education may affect routine quality of care.

Figure 6.4.6 Mean QI scores by Educational Attainment, using PCA and EW based QI with All Indicators, Philippines 2013



6.4.3 Variation by Region

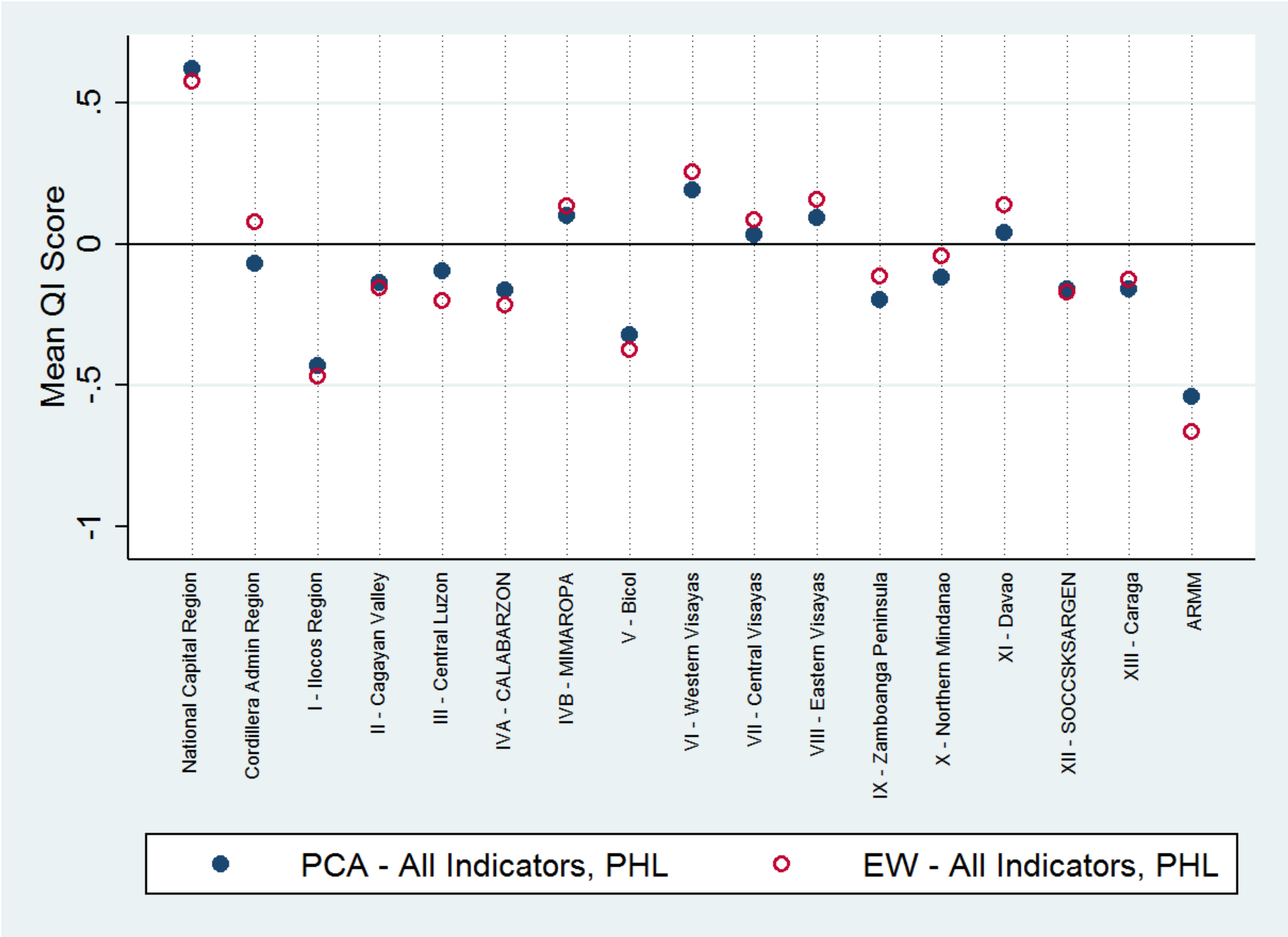
The effect of location on quality of care seen at the national level is echoed in the vastly differing scores seen in Figure 6.4.7, which shows the mean QI scores across the seventeen administrative regions of the Philippines[xvii] . Across both PCA and EW QI the National Capital Region (NCR - Manila) has by far the highest mean score while the Autonomous Region in Muslim Mindanao (ARMM) has the lowest. These extremes are not completely unexpected based on known demographic factors; the population of Manila is not only far larger than any other region but it is also comparatively wealthier with over two thirds of households falling into the Richest and Richer wealth quintiles. In contrast in the ARMM over seventy percent of the population falls into the Poorest wealth quintile.

Similarly, while the NCR has the lowest infant mortality rate (IMR) in the country (at 16 deaths per 1000 live births) and SBA coverage of over 90%, infant mortality in the ARMM is relatively high (at 36 deaths per 1000 live births compared to a national average of 23[xviii]) and the overwhelming majority of women deliver at home without a SBA. It is thus rather understandable that the NCR performs similarly well in terms of QI scores, and that, given the difficulties in delivering care in the region, the ARMM falls well behind other regions.

[xvii] At the time of 2013 DHS survey the Philippines had seventeen administrative regions. As of 2015, an eighteenth region (Negros Island Region) has been created from parts of the Western and Central Visayas Regions. Due to sampling restrictions, this analysis will exclusively use the 2013 regional definitions.

[xviii] Mortality rates are as reported in the 2013 Philippines DHS final report

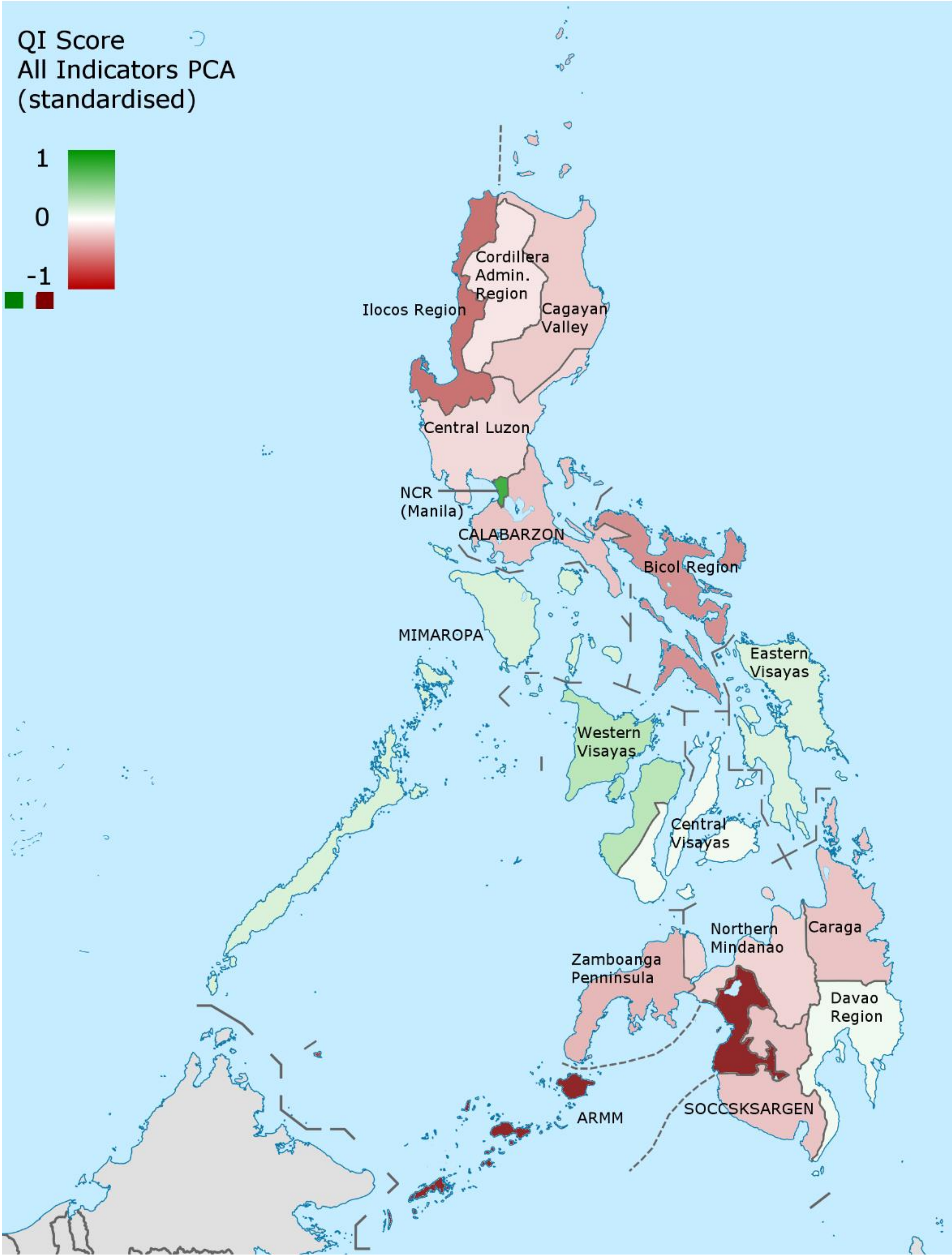
Figure 6.4.7 Mean QI scores by Region, using PCA and EW based QI with All Indicators, Philippines 2013



There are however several regions which are surprising given what is known about their demographics and general performance with regards to child health. MIMAROPA for example has a high IMR (36 deaths per 1000 live births), but scores highly on both PCA and EW based QI. The coverage of SBA in MIMAROPA is however very low, at 41%. Given the restriction of the QI to women with both ANC and SBA care, this seems to reflect a situation where access to care is limited but for those who can access care, the quality of service provided is high. In contrast, the two regions that border the NCR, Central Luzon and CALABARZON, do not score highly at all despite being relatively wealthy regions with high SBA coverage (above 85%). Here, despite access to care clearly not being a major issue, the quality of care provided is below what might be expected given the high scores seen in the capital.

Indeed, unlike the pattern seen in Indonesia, Figures 6.4.8 shows that in general, proximity to the NCR does not appear to predict high QI scores. Regions that score highly across both QI include the Western, Eastern and Central Visayas (with the Western Visayas having the highest QI score after the NCR) and to a lesser extent, Davao. These patterns are observable in both the EW and PCA based QI, however it is notable that the PCA based QI creates a greater level of discrimination between regions despite both types of scores being standardised; in particular the distance between the NCR and all other regions appears to be exacerbated by PCA weighting.

Figure 6.4.8 Map of mean QI scores by Region using PCA with All Indicators, Philippines 2013



To explore the possibility that the higher performance of the NCR is due to its status as a major urban centre, Figure 6.4.9 shows the mean scores for each region by urban/rural status. In general, there does not appear to be a clear pattern of urban areas significantly outperforming their rural counterparts, with the exception of the ARMM and the Zamboanga Peninsula. Indeed, in the Western Visayas rural populations perform markedly better than urban residents. This does however suggest that much of the urban rural variation seen across the sample as a whole is more likely to be driven by the fact that poor performing regions tend to be predominantly rural rather than by explicit differences between urban and rural populations as a whole.

Similarly, it is possible that while household wealth does appear to be a considerable factor in determining relative quality of care, overall regional wealth and economic health may also affect wealth based quality patterns. The NCR is by far the most prosperous region in the Philippines, and only ten percent of its households fall into the two lowest wealth quintiles. As the primary source of government revenue is through provincial level taxation it is possible that this prosperity has resulted in a greater amount of resources being available for government health spending, which benefits poorer residents.

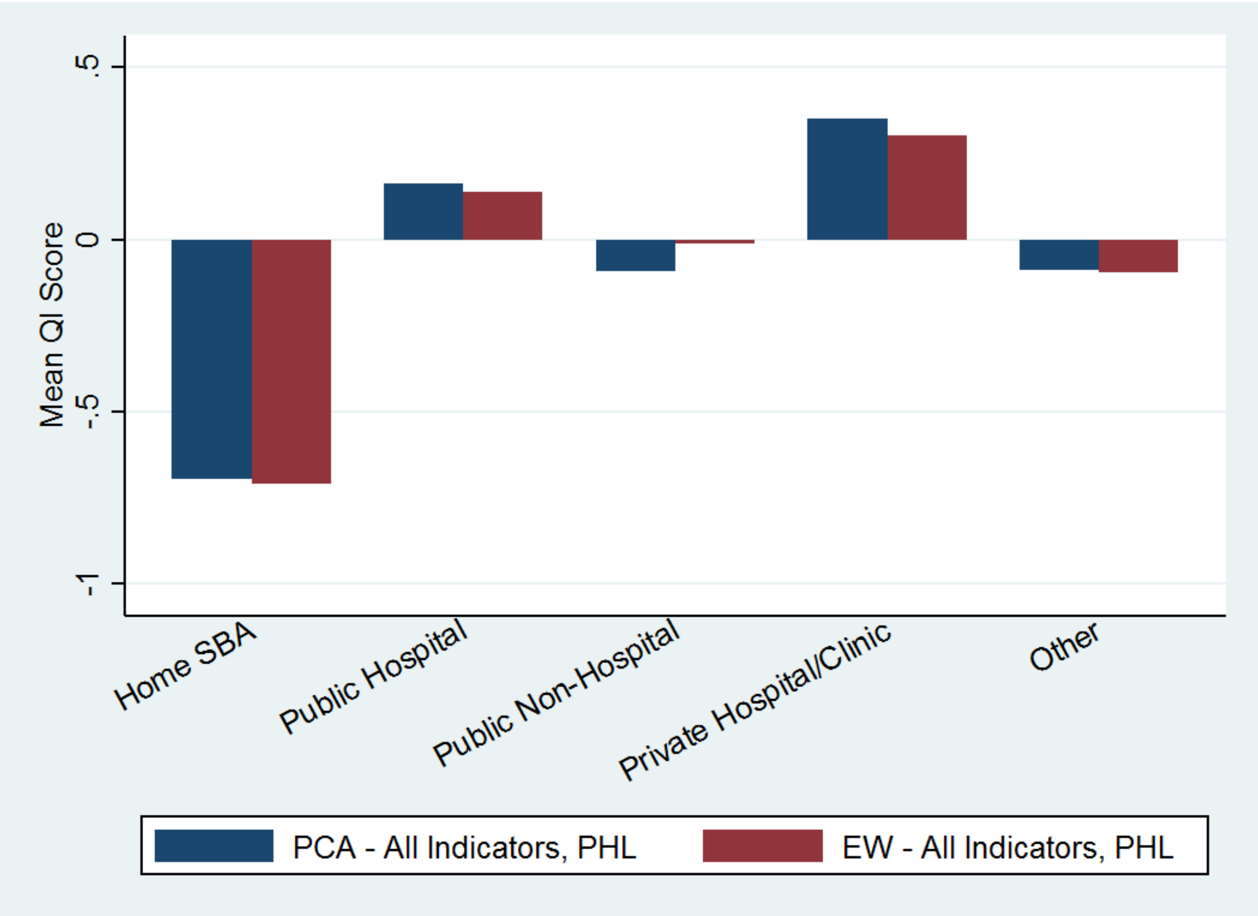
Given the relative size of metropolitan Manila compared to other urban centres, it is likely that these results are largely driving the wealth patterns seen for urban populations at the national level. Outside the capital region however, government facilities may face issues arising from lower level resourcing, and thus access to high quality services may depend on who can afford to access higher level facilities. To examine the role of service availability the following section will examine how quality differs not only across regions but also across health care providers. .

Figure 6.4.9 Mean QI scores by Province and Urban Rural Status, using PCA and EW based QI with All Indicators, Philippines 2013

6.4.4 *Variation by Provider Type*

In the Philippines the potential impact of provider type is an important consideration when discussing quality of care, as issues with perceptions of poor quality been cited as affecting the decision for individuals to seek private over public hospital care. As can be seen in Figure 6.4.10, which shows the mean QI scores based on the place of delivery, these perceptions are not without merit.

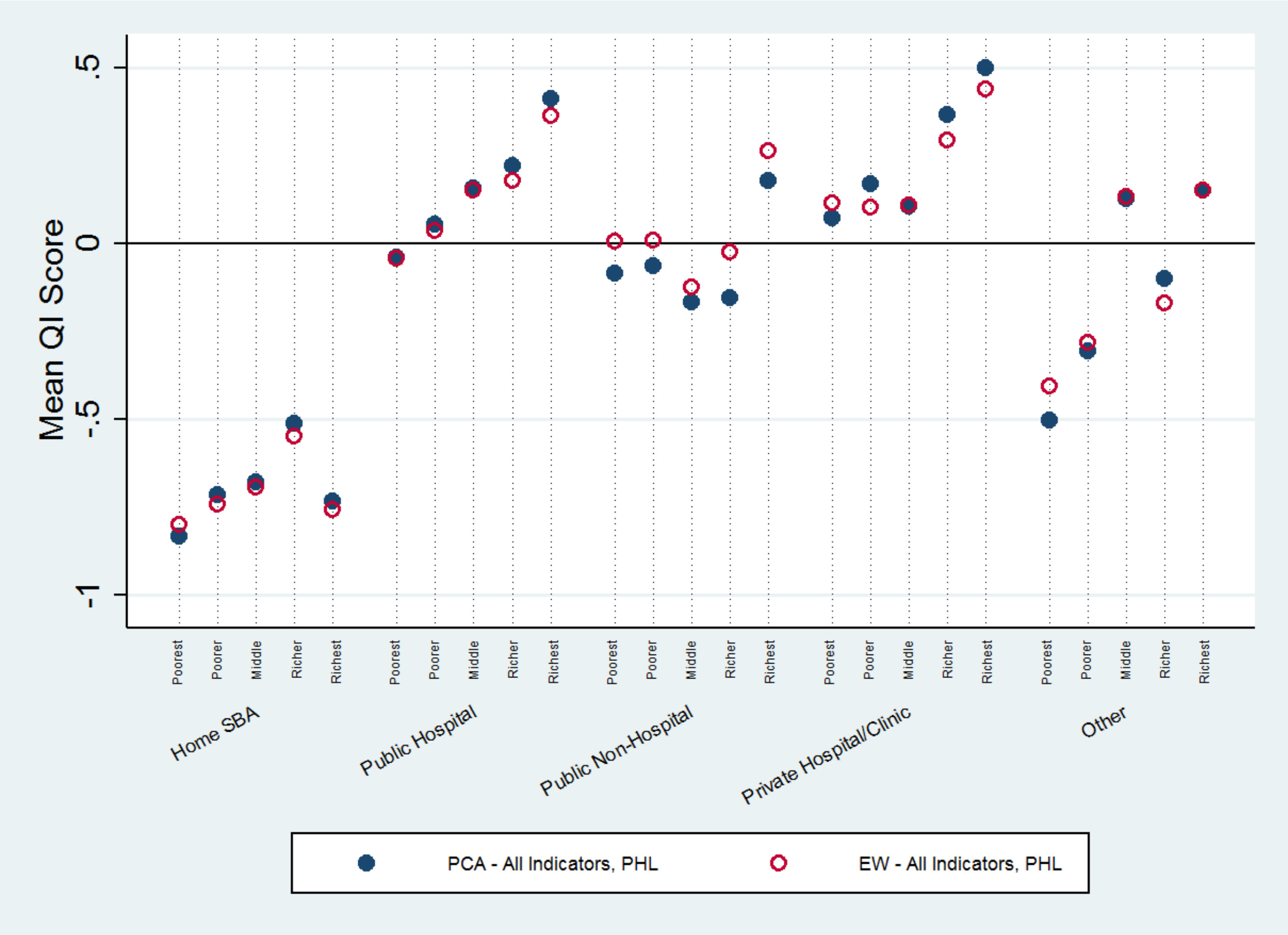
Figure 6.4.10 Mean QI scores by Delivery Provider Type, using PCA and EW based QI with All Indicators, Philippines 2013



It should be noted that the categories used for provider types are slightly different to those used in Indonesia. Unlike in Indonesia, Private Facility Deliveries includes all deliveries in private clinic or hospital facilities – the DHS does not distinguish between different types of private providers, however the majority of private facilities used for maternity services in the Philippines are hospitals.

As noted above, and suggested by the literature, private facilities do appear to score more highly than either type of government facility. The gap between private and public hospitals overall however is not immense - indeed the greatest difference in QI scores is most definitely between home deliveries and facility based deliveries of any type. The relatively lower scores for Public Non-Hospital facilities does however suggest that there may be elements affecting the capacity to provide good quality care at lower levels.

Figure 6.4.11 Mean QI scores by SBA provider and wealth quintile using PCA and EW based QI with All Indicators, Philippines 2013



Given the strong trends seen with regards to household wealth in earlier sections, it is possible that the higher levels of quality seen in private facilities may reflect their relatively richer clientele rather than provider level factors. Figure 6.4.11 therefore shows the mean QI score for each provider type broken down by wealth quintile. Here it is apparent that wealth plays a large role in the type of care received even within provider types. Home based SBA scores extremely low across the board, which may reflect the limitation in the resources and time available to SBAs providing in-home services. In contrast, there are notable wealth gradients visible for both private and public hospital deliveries.

In Public Hospitals the mean score of both PCA and EW indices increases with each increase in wealth quintile. In private facilities there is a distinct gap between the scores of the lowest three wealth quintiles and the richer and richest. It is most noticeable in the PCA based score, where the higher rates of breastfeeding do not offset lower rates of ANC and PNC content in the poor. The difference between the EW and PCA indices can also be seen when looking at Public Non-Hospital deliveries; interestingly it appears that with the exception of the richest wealth quintile it is the poor who score better in these facilities.

There is still, however, the question about the potential effects of differing wealth patterns across regions, especially given the large quality differential between Home SBA, which is often utilised by poorer women, and all other provider types. The relative size and wealth of the NCR compared to other regions of the country also makes it possible that the higher scores seen for wealthier quintiles and private providers may be distorted by their higher prevalence in the well performing NCR. To explore this possibility Figure 6.4.12 shows the mean QI score by provider for each region.

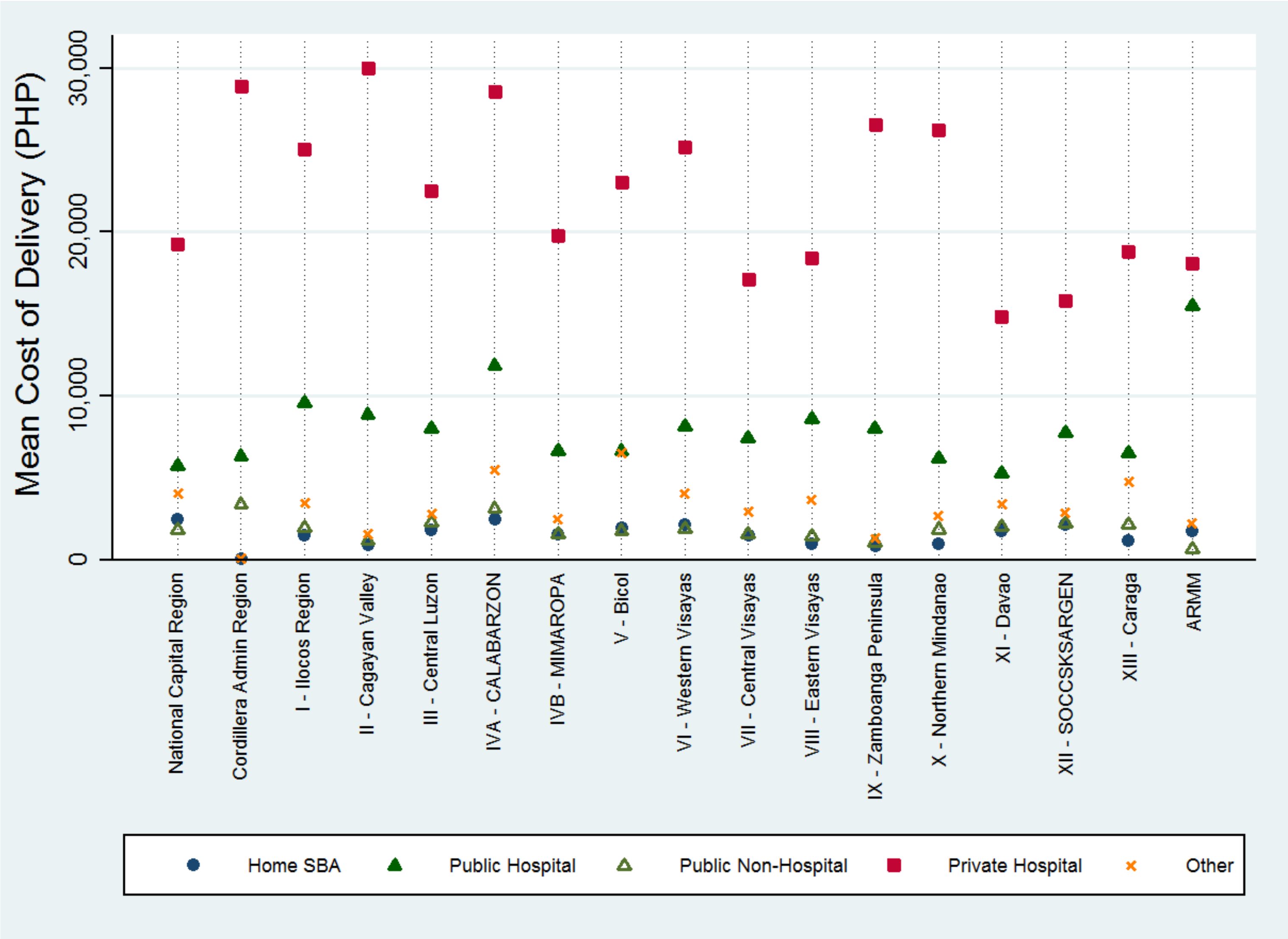
Figure 6.4.12 Mean QI scores by Province and Provider Type, using PCA based QI with All Indicators, Philippines 2013

As expected the scores are highest in the NCR for all provider types, with public and private facility deliveries tightly clustered together above home deliveries. Even home based SBA deliveries are higher than facility based care in some other regions. Ilocos and Bicol in particular have low scores for all types of facility; these are, with the exception of the ARMM, the worst performing regions overall, a status that appears to be driven by poor quality facility based care rather than by a higher prevalence of home based SBA. Indeed, while generally lower than facility based SBA, the relative QI scores for home based SBA are highly variable; they are lowest in the Cordillera Admin region and nearly as high as in the NCR in the Western Visayas (and are in fact on par with government health centres in that region).

Across all regions, private providers generally score higher than government facilities (with the exception of the Cordillera Administration region and Ilocos) however the magnitude of difference is not constant. In the Zamboanga Peninsular and the ARMM there is a considerable gap between Private Facilities and Public Hospitals, whereas in the Eastern and Central Visayas, all facilities, including Public Non Hospital care, are clustered together - although not as tightly as in the NCR. QI scores at these lower level public facilities are highly variable across regions; as good as or better than hospitals in some regions while barely better than home deliveries in others.

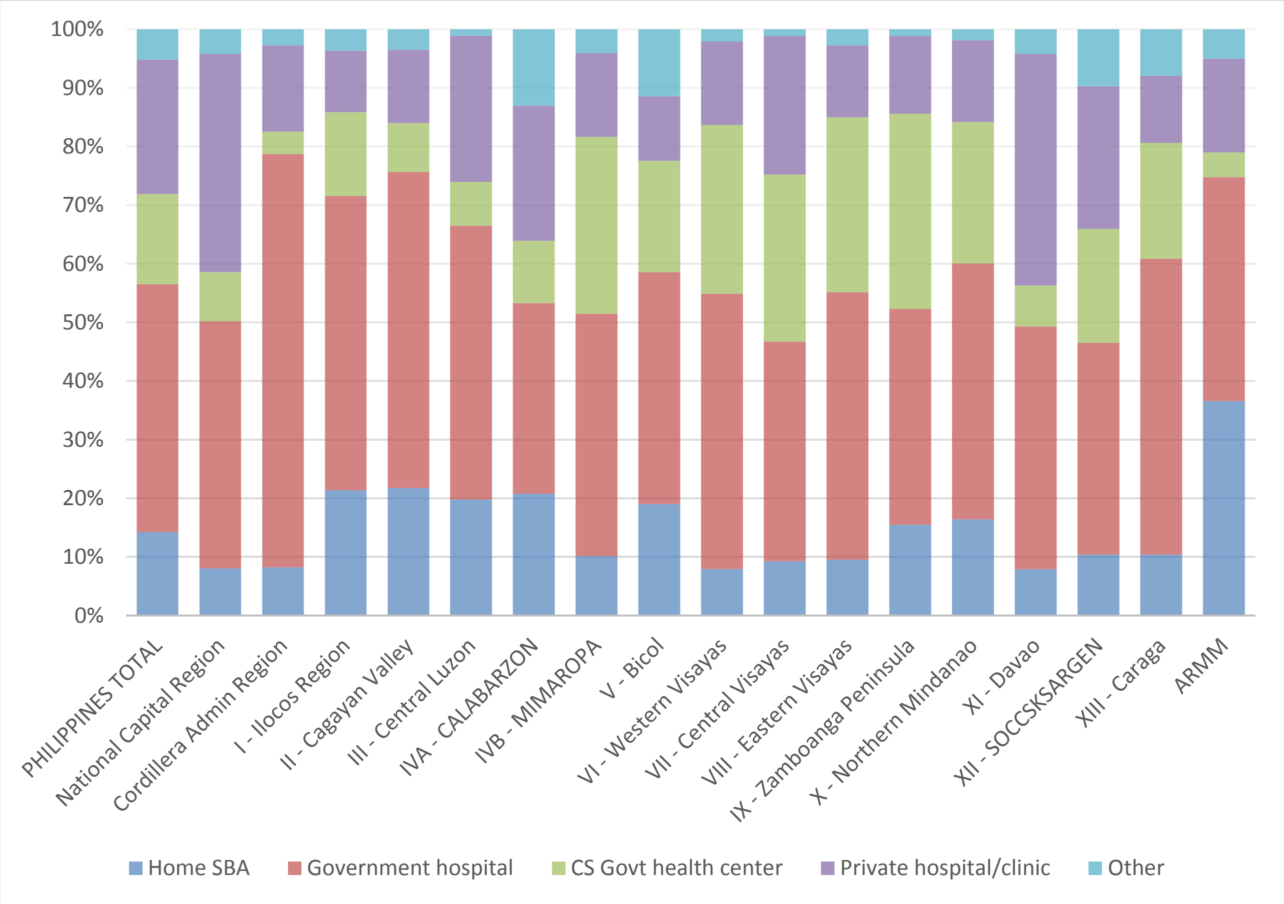
Overall it is apparent that the variation in QI scores seen between provider types nationally does not resemble the patterns seen regionally; within the NCR there is little difference between FBD providers, while outside the capital relative quality within provider types is far from consistent, particularly with regards to Home SBA and Public Non-Hospital deliveries.

Figure 6.4.13 Mean cost of delivery by SBA provider and region (in PHP), Philippines 2013



The importance of ensuring lower levels of care are of sufficient quality is emphasised by the marked way in which financial factors appear to influence choice of provider. As shown in Figure 6.4.13 the cost of private deliveries is considerable across all regions, although it is notably higher in less urbanised regions. Similarly, the cost of government hospital deliveries can be much more expensive in regional areas. Given the literature noting that choice of provider in the Philippines is heavily affected by financial barriers to access[142,147] and the fact that these higher-level facilities tend have higher QI scores, it is possible that some overall regional trends may be driven by service usage patterns.

Figure 6.4.14 Proportion of women using SBA provider type by Region - Philippines 2013



However as can be seen in figure 6.4.14, which outlines the proportion within each region utilising different types of provider, regions with similar profiles in terms of provider usage, such as the NCR and Davao, do not always exhibit similar patterns in terms of quality of care. The Visayas in particular demonstrate the potential impact of good quality public providers on regional average as a whole; compared to nearby regions with similar usage patterns they have noticeably higher QI scores for public providers, and non-hospital care in particular, which appears to have resulted in generally higher scores for the region overall. The Western Visayas, which is the second highest scoring region after the NCR, also appears to be benefiting from the much higher scores for home based SBA.

Taking all of this into account, it is still evident that there is a distinct difference between the NCR and all other regions that may not be explainable purely based on demographic differences. This stark difference raises the possibility that the pattern of correlation between quality indicators used to create the PCA based index may be very different between these populations. As such, Table 6.4.15 shows the results of PCA carried out for the NCR and All Other Regions separately using the full PHL dataset.

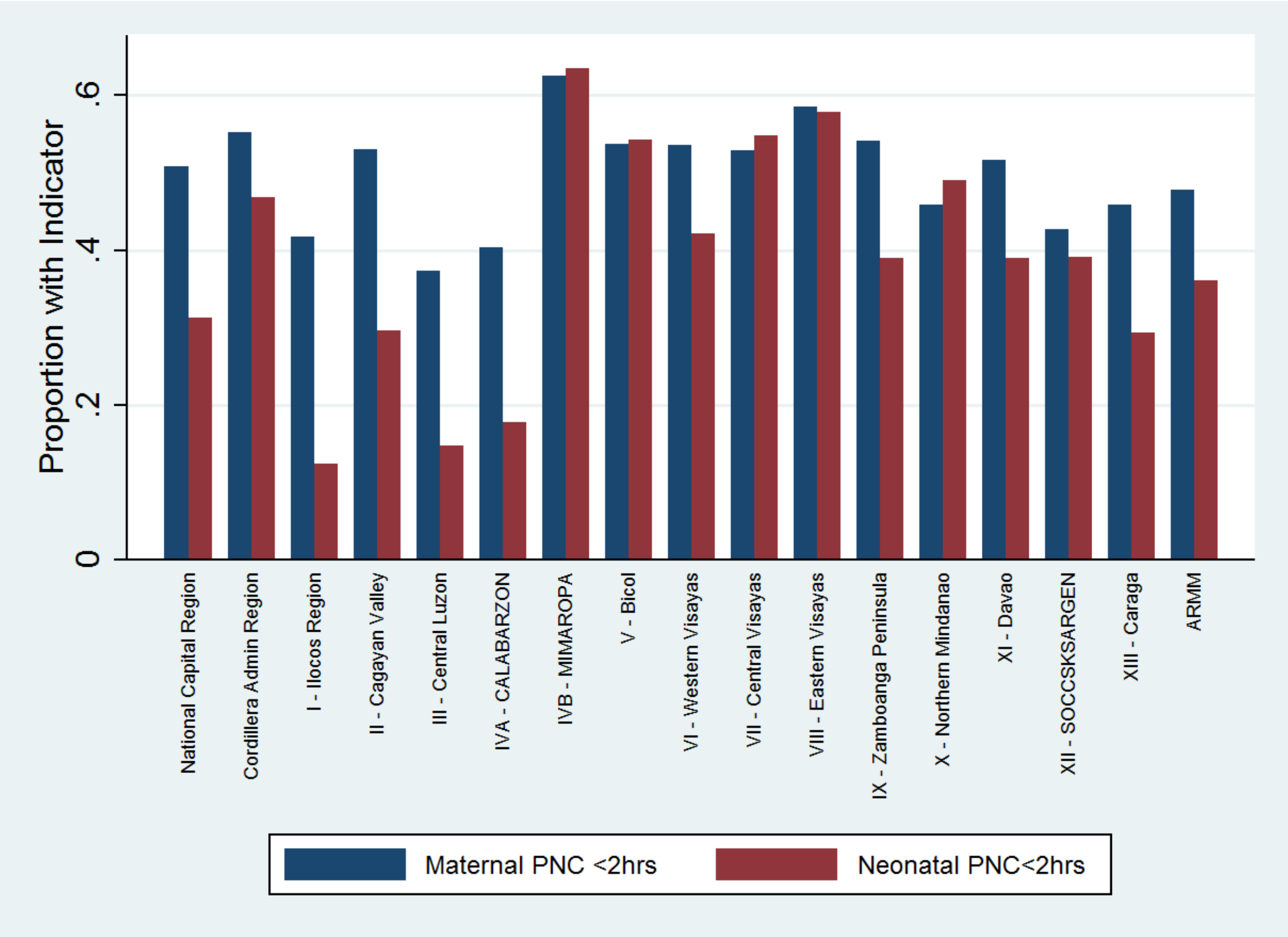
One clear difference between the weights seen in the NCR and All Other Regions is the role of ANC content; outside the capital, blood and urine testing are heavily weighed while 90+ days of iron supplementation and early initiation of ANC appear to be the points of difference within the NCR. The other noticeable change in the weighting pattern is with regards to immediate PNC. In contrast to regional areas, which show a pattern not unlike the whole population results, the NCR based weights have large weights applied to both breastfeeding indicators as well as prompt maternal and neonatal PNC.

Table 6.4.15 PCA derived variable weights for primary and secondary components for NCR and All Other Regions, Philippines 2013

Indicator	**National Capital Region**		**All Other Regions**	
	Comp 1	**Comp2**	**Comp1**	**Comp2**
1+ ANC visit in 1st Trimester	0.156	0.169	0.101	0.194
1+ANC visit in 3rd Trimester	0.013	0.006	0.015	0.015
Blood Pressure measured during ANC	0.024	0.005	0.011	0.017
Urine sample taken during ANC	0.058	0.050	0.198	0.521
Blood sample taken during ANC	0.062	0.077	0.207	0.560
Weight measured during ANC	0.020	0.007	0.018	0.022
Height measured during ANC	0.121	0.018	0.117	0.117
Took drugs for intestinal parasites during pregnancy	0.034	0.093	0.005	0.005
Iron supplementation during pregnancy	0.279	0.361	0.129	0.214
Fully protected from Tetanus during pregnancy	0.068	0.101	0.026	-0.010
Told about pregnancy complications during ANC	0.123	0.044	0.142	0.078
Baby was weighed at birth	0.027	-0.001	0.055	0.017
Baby was breastfed within 1 hr of birth	0.240	-0.106	0.059	-0.168
No liquids given before milk began to flow (no prelacteal feed)	0.255	0.202	0.015	-0.179
Maternal postnatal check within 2 hrs of delivery	0.335	-0.617	0.172	-0.330
Neonatal postnatal check within 2 hrs of delivery	0.251	-0.549	0.129	-0.312
Mother received postpartum Vitamin A within 2 months of delivery	0.332	0.168	0.315	-0.084
Mother received postpartum Iron within 2 months of delivery	0.308	0.164	0.312	-0.048
Mother received counselling on newborn care within 2 months of delivery	0.147	0.026	0.270	-0.059
Mother received advice about family planning within 2 months of delivery	0.344	0.062	0.323	-0.106
Mother received advice about breastfeeding within 2 months of delivery	0.137	0.024	0.233	-0.064
Mother received abdominal exam within 2 months of delivery	0.202	0.058	0.308	-0.060
Mother received breast exam within 2 months of delivery	0.274	0.108	0.352	-0.077
Mother received internal exam within 2 months of delivery	0.222	-0.008	0.307	-0.057
Mother received complete checkup including blood pressure within 2 months of delivery	0.162	-0.053	0.250	-0.056
Rho	**0.1407**	**0.1257**	**0.1842**	**0.101**

While some PNC content indicators such as contraceptive advice and vitamin supplementation remain highly weighted, indicators relating to physical examinations, breastfeeding advice and advice about neonatal care are more lowly weighted than in the full sample. Timing of PNC definitely appears to be a major point of differentiation in the NCR, as can be seen with regards to the secondary component, which appears to represent a situation where PNC is delayed but some components such as vitamin A supplementation and lack of prelacteal feeding still occur. This is in contrast to the results from All Other Regions, where the secondary component appears to reflect a group that received ANC but little to no PNC.

Figure 6.4.15 Coverage of PNC indicators by region, Philippines 2013



Looking at coverage of timely PNC across all regions (Figure 6.4.15) it is apparent that despite having higher rates of facility based delivery mothers and neonates in the NCR are less likely to have a check-up within 2hrs of delivery compared to those in other regions. Interestingly several other regions in close proximity to the capital (Cordillera Admin Region, Ilocos, Cagayan Valley, Central Luzon, CALABARZON) also show lower than average coverage of timely PNC, particularly with regards to neonatal PNC. Unlike the NCR, these regions did not perform particularly well based on the PCA derived QI used in the earlier analysis (see Figure 5.4.2.3 in previous section).

Additionally it is now evident why the magnitude of difference between regions is much lower in the EW based index – while the NCR still scores highly, the lower levels of timely PNC and breastfeeding indicators lowers the mean score while in outlying regions high coverage of prompt PNC helps offset lower coverage of PNC content. Thus three distinct patterns of quality appear to emerge from the Philippines; in the capital region coverage of some PNC content indicators is high, but PNC tends to be delayed and breastfeeding is suboptimal. In inner regions not only is timing of PNC an issue, but PNC content is also problematic. In outlying regions PNC tends to be prompt, and breastfeeding is closer to recommended guidelines, but the content of both ANC and PNC is in need of attention.

This also casts some light on the odd patterns seen with regards to PNC and breastfeeding indicators in the sample as a whole; the hypothesis that some women were receiving a "basic" level of care in which early discharge following delivery led to PNC content not being delivered appears to reflect the situation seen in non-capital regions, where despite timely PNC having high coverage the content of PNC remains a major determinant of quality. Whether due to wealth or cultural reasons, these regions are also more likely to have higher coverage of appropriate breastfeeding regardless of whether or not they received advice about breastfeeding during PNC. However in the NCR women who receive prompt PNC are more likely to have appropriate breastfeeding, and breastfeeding advice still carries a certain amount of weight, suggesting that PNC may be having an effect on breastfeeding behaviours.

The differences between regional patterns of quality further demonstrate the benefits in using both relative (PCA based) and absolute (EW based) indices for measuring quality of care; solely relying on the PCA based QI suggests that the

NCR is performing well compared to all other regions, but the EW QI reveals that there are still most definitely areas of concern.

6.5 Regression Analysis

Following the example set out in Chapter 4, multivariate regression techniques were used to further explore the factors affecting QI scores, and in particular help disentangle the effect of underlying differences in wealth, education, urban residence and region on overall scores.

Weighted regression was carried out using the QI score based on All indicators and PCA based weighting using the lowest score category within each variable as the reference category. With the exception of maternal age and education where the very low number of observations made these categories unreliable standards; the next lowest scoring group was used instead.

The results of the individual variable regressions as well as the initial multivariate model can be seen in Table 6.5.1. Rural-Urban status, Maternal age, Parity, Maternal Education, SBA provider, Wealth and Region all individually produce models that are significant at the p=0.05 level, however the proportion of variance explained by the models is very different; maternal age and parity appear to have a near negligible effect on QI, while Region and SBA provider are associated with a much stronger effect. This accords with the findings from the graphical analysis, which implied that underlying differences in the demographics of different regions, as well as the effect of wealth on choice of provider type, may explain many of the overall trends seen in other equity markers.

Table 6.5.1 Results of Linear Regression of Individual variables against PCA based QI score with All Indicators, Philippines 2013

		Individual Regression						**Multiple Regression**			
CATEGORY	**N**	**Coef**	**P>t**	**(95%CI)**		***R-Sqr***	***Prob-F***	**Coef**	**P>t**	**(95%CI)**	
RURAL-URBAN											
Urban	1821	0.307	0	0.242	0.372			0.307	0.385	-0.120	0.035
Rural	1971	(base)				*0.024*	*0*	(base)			
AGE											
15-19	431	(base)				*0.009*	*0*	(base)			
20-24	1006	0.088	0.162	-0.035	0.21			0.088	0.291	-0.023	0.2
25-29	923	0.18	0.004	0.058	0.302			0.18	0.04	0.059	0.29
30-34	764	0.258	0	0.134	0.382			0.258	0.034	0.103	0.356
35-39	444	0.276	0	0.14	0.412			0.276	0.094	0.194	0.483
40-44	195	0.01	0.922	-0.184	0.203			0.01	0.018	-0.060	0.327
45-49	29	0.016	0.946	-0.453	0.486			0.016	0.53	-0.201	0.638
EDUCATION											
No education	16	-0.335	0.332	-1.014	0.343			-0.335	0.701	-0.803	0.407
Incomplete primary	225	(base)				*0.027*	*0*	(base)		0.000	0
Complete primary	313	0.169	0.089	-0.026	0.364			0.169	0.035	-0.045	0.312
Incomplete secondary	550	0.135	0.143	-0.046	0.315			0.135	0.004	-0.085	0.247
Complete secondary	1365	0.262	0.002	0.098	0.427			0.262	0	-0.040	0.273
Higher Education	1323	0.502	0	0.34	0.664			0.502	0	0.028	0.348

Table 6.5.1 Cont.

WEALTH											
Poorest	652	(base)				*0.04*	*0*	(base)			
Poorer	815	0.083	0.147	-0.029	0.196			0.083	0.002	-0.108	0.111
Middle	848	0.173	0.002	0.063	0.282			0.173	0.002	-0.140	0.082
Richer	814	0.332	0	0.223	0.44			0.332	0	-0.099	0.145
Richest	663	0.589	0	0.484	0.694			0.589	0	0.048	0.306
REGION											
National Capital Region	569	1.165	0	0.936	1.393			1.165	0	0.667	1.148
Cordillera Admin Region	181	0.474	0	0.208	0.74			0.474		-0.078	0.45
I - Ilocos Region	211	0.112	0.398	-0.148	0.373			0.112	0	-0.308	0.207
II - Cagayan Valley	166	0.407	0.003	0.135	0.679			0.407	0	-0.011	0.52
III - Central Luzon	356	0.446	0	0.200	0.692			0.446	0	0.014	0.51
IVA - CALABARZON	410	0.379	0.002	0.135	0.623			0.379	0	-0.034	0.461
IVB - MIMAROPA	99	0.642	0	0.366	0.919			0.642	0	0.178	0.725
V - Bicol	208	0.219	0.098	-0.04	0.478			0.219	0	-0.169	0.345
VI - Western Visayas	237	0.733	0	0.482	0.985			0.733	0	0.271	0.77
VII - Central Visayas	257	0.577	0	0.323	0.83			0.577	0	0.126	0.637
VIII - Eastern Visaya	145	0.634	0	0.365	0.904			0.634	0	0.154	0.692
IX - Zamboanga Peninsula	172	0.345	0.011	0.079	0.611			0.345	0	-0.064	0.46
X - Northern Mindanao	155	0.425	0.003	0.148	0.702			0.425	0	0.028	0.573

Table 6.5.1 Cont.

XI - Davao	213	0.583	0	0.331	0.835			0.583	0	0.094	0.604
XII - SOCCSKSARGEN	143	0.382	0.006	0.11	0.653			0.382	0	-0.040	0.502
XIII - Caraga	198	0.383	0.004	0.12	0.645			0.383	0	-0.051	0.471
ARMM	72	(base)				*0.103*	*0*	(base)			
SBA PROVIDER											
Home SBA	531	(base)				*0.108*	*0*	(base)			
Public Hospital/Clinic	1658	0.857	0	0.737	0.977			0.857	0	0.607	0.845
Public Non-Hospital/Clinic	607	0.601	0	0.461	0.742			0.601	0	0.398	0.677
Private Hospital/Clinic	808	1.044	0	0.918	1.17			1.044	0	0.617	0.881
Other	188	0.605	0	0.421	0.789			0.605	0	0.371	0.73
PARITY											
1st Birth	1279	0.168	0	0.076	0.261			0.168	0.007	-0.043	0.177
2nd Birth	982	0.158	0.001	0.061	0.256			0.158	0.001	-0.020	0.188
3rd Birth	660	0.133	0.014	0.027	0.24			0.133	0.037	-0.080	0.13
4+ Birth	871	(base)				*0.004*	*0.003*	(base)			
_cons								-1.291	0	-1.571	-1.01
TOTAL	**3792**							**R-Sqr**	0.1993		0

In terms of the multivariate regression, as with the case of Indonesia, not only does urban residence fall from significance as a predictive variable, but the direction of the coefficient changes, suggesting that almost all urban-rural variation can in fact be explained by the other variables in the model. It is likely that as the NCR contributes heavily to the overall urban population, many of the urban-rural effects seen in the graphical analysis should more accurately be considered regional effects. Parity (which is often associated with maternal age) also appears to have no significant effect in this model with those who are delivering their fourth or greater child not scoring substantially worse than the rest of the sample.

For maternal age, only the categories of 25-29yrs and 40-44yrs are significantly different to the 15-19yr reference category. This is similar to the patterns seen in Indonesia, although there is more variation in the magnitude of coefficients. In contrast, only higher education was found to be statistically better than incomplete primary education. Table 6.5.2 shows the results of a regression using the same re-categorisation of these variables that was used in Indonesia (maternal age into <25, 25-34 and 35+ and education into “Primary or Lower” “Some Secondary”, “Completed Secondary” and “Higher Education”).

Broadly, QI scores appear to increase with maternal age, although the difference between the 25-35 year age group and the 35+ year group is not large. It is unlikely that this is due to differences in education, as only having post-secondary education appears to significantly increase QI scores above reference category. Another category for which only the extreme end of the scale shows significant difference in QI is Wealth, with only the richest wealth quintile associated with substantially higher scores than the poorest. This appears counterintuitive given the results of earlier analyses, however it should be noted that as the type of provider was also included in the model as an explanatory variable, this appears to suggest that household wealth has only a limited impact on QI scores once financial access to particular types of care are accounted for. That is, with the exception of those in the richest wealth quintile, there appears to be little wealth based variation within providers of the same type.

Table 6.5.2 Results of Linear regression of multiple variables with revised categorisation against PCA based QI score with All Indicators, Philippines 2013

CATEGORY	**N**	**Coef**	**P>t**	**(95%CI)**		**CATEGORY**	**N**	**Coef**	**P>t**	**(95%CI)**	
RURAL-URBAN											
Urban	1821	-0.041	0.308	-0.119	0.037	REGION					
Rural	1971	(base)				National Capital Region	569	0.912	0	0.673	1.151
						Cordillera Admin Region	181	0.182	0.173	-0.08	0.445
AGE						I - Ilocos Region	211	-0.038	0.769	-0.294	0.217
<25 years	1437	(base)				II - Cagayan Valley	166	0.258	0.057	-0.007	0.522
25-35 years	1687	0.127	0.001	0.055	0.2	III - Central Luzon	356	0.27	0.031	0.025	0.516
35+ years	668	0.201	0	0.093	0.309	IVA - CALABARZON	410	0.216	0.085	-0.03	0.463
						IVB - MIMAROPA	99	0.457	0.001	0.186	0.728
EDUCATION						V - Bicol	208	0.096	0.462	-0.159	0.351
Primary or Lower	554	(base)				VI - Western Visayas	237	0.519	0	0.271	0.768
Incomplete secondary	550	0.012	0.838	-0.107	0.132	VII - Central Visayas	257	0.378	0.003	0.125	0.631
Complete secondary	1365	0.055	0.298	-0.048	0.158	VIII - Eastern Visayas	145	0.429	0.002	0.162	0.696
Higher Education	1323	0.135	0.014	0.027	0.242	IX - Zamboanga Peninsula	172	0.199	0.135	-0.062	0.46
						X - Northern Mindanao	155	0.295	0.033	0.024	0.566
WEALTH						XI - Davao	213	0.345	0.008	0.091	0.598
Poorest	652	(base)				XII - SOCCSKSARGEN	143	0.223	0.107	-0.048	0.493
Poorer	815	0.008	0.882	-0.101	0.118	XIII - Caraga	198	0.219	0.098	-0.04	0.478
Middle	848	-0.021	0.708	-0.133	0.09	ARMM	72	(base)			
Richer	814	0.028	0.648	-0.094	0.15						
Richest	663	0.181	0.006	0.052	0.31						

Table 6.5.2 Cont.

SBA PROVIDER						PARITY					
Home SBA	531	(base)				1st Birth	1279	0.044	0.054	0.82	0.413
Public Hospital/Clinic	1658	0.735	0	0.616	0.854	2nd Birth	982	0.081	0.052	1.55	0.121
Public Non-Hospital/Clinic	607	0.547	0	0.407	0.686	3rd Birth	660	0.027	0.053	0.52	0.604
Private Hospital/Clinic	808	0.757	0	0.625	0.889	4+ Birth	871	0	(base)	0	0
Other	188	0.555	0	0.374	0.735						
						_constant	0	-1.169	0.126	-9.25	0
TOTAL	**3792**							**R-Sqr**	0.1993	**Prob-F**	0

The financial ability to access higher quality facilities is however emphasised by the large coefficient increases seen in terms of SBA provider. Having a facility based delivery alone appears to carry a 0.55-point increase in QI scores compared to 0.18 for being in the richest wealth quintile or 0.13 for having higher education. One noticeable difference between the results of the individual variable regression and this model is that the advantage in having a Private Hospital/Clinic delivery compared to a Government Hospital delivery appears to almost disappear. It is possible that the initial private advantage reflects both the underlying clustering of private providers within major urban centres such as Manila, as well as the high usage of private facilities by those in the richest wealth quintile. This is an important finding, as it suggests that efforts to improve economic access to private health facilities may not necessarily result in greater quality than similar efforts increasing access to higher level government facilities. It does however suggest that both types of provider appear to be associated with higher quality care than the primary level government facilities. This indicates that further investigation into how to improve primary care has the potential to achieve substantial gains in overall quality of care.

Residence in the NCR still carries a significant benefit in terms of QI scores, however the difference between the coefficients for it and other high performing regions such as the Visayas is less than might otherwise be expected given the graphical analysis. The underlying wealth distribution and related patterns of facility usage may have been somewhat inflating the estimates for the capital region compared to less wealthy regions with fewer private facilities. On the other hand, it is apparent that outside the NCR region still carries substantial weight in terms of quality of care; those in the Ilocos and Bicol regions are not significantly better than those in the ARMM despite the vast differences in how they are administered. Regional variation is however still most apparent in terms of Capital versus Non-Capital residence.

6.6 Discussion of Variation in Quality of Care in the Philippines

As with Indonesia, the historical focus on increasing coverage of ANC and SBA services in the Philippines has masked substantial variation in the type of care received, with the effects of wealth, geographic location and type of health. The patterns of quality care are however markedly different despite both countries having a heavily decentralised health system. In the Philippines the effect of wealth, at both the household and regional level, is far more pronounced, as is the difference between the capital and all other regions. In addition, the availability of information regarding the type of care received during the postnatal period has also raised potential issues regarding trade-offs between the timely and comprehensive care.

The Philippines 2013 DHS contains a comparatively wide range of indicators, including several relating to the content of PNC services and the provision of appropriate health advice. In general, coverage of quality indicators is far from ideal. While most women who receive ANC will have at least four visits, and blood pressure testing is near universal, testing of blood and urine samples is far less common and coverage of iron supplementation and tetanus immunisation is far below recommended levels[138]. Similarly while almost all SBA deliveries will involve weighing the newborn, less than half will incorporate a maternal or neonatal check within the first two hours and coverage of individual aspects of PNC content, such as maternal vitamin A supplementation, advice about breastfeeding and physical examinations are higher, but still far from universal.

This is an important finding in the context of what is currently known about the nature of maternal and neonatal care in the Philippines; while coverage of ANC and SBA services has increased following major health reforms[140,147] , relative inequality in coverage has remained high despite the despite increases in facility based delivery as a result of pro-poor financing intitiatives[140,148]. Notably, access to higher levels of care continues to heavily favour the rich[149], suggesting differences in the type of care available to women depends on their socioeconomic status.

The patterns emerging from the PCA analysis, support the notion of there being two prominent, but quite different experiences of care. While ANC and PNC content appear to be strongly associated in one component, timely PNC and optimal breastfeeding form a second line of correlation that is negatively associated with the first. In an apparent paradox, breastfeeding advice was not associated with early initiation of breastfeeding or lack of prelacteal feeding, and having a PNC check-up within two hours of birth was negatively correlated with receiving indicators relating to PNC content. This is a startling, but perhaps not completely unexpected result. Studies from higher level facilities have noted that overprovision of care is relatively common[20,145], and that the level of attentiveness and provision of additional services may vary based on ability to pay[150]. Those who can afford to utilise these services might thus be expected to receive more interventions, regardless of their appropriateness.

This is supported by known trends regarding breastfeeding practices in the Philippines. The influence of factors such as formula marketing[151] and social perceptions around public breastfeeding have led to it being far less common among the rich[138]. Additionally, there is some suggestion that medical intervention by health professionals may be delaying the initiation of breastfeeding for women delivering in referral facilities[145]. At the same time, poorer women, who are more likely to breastfeed, are also less likely to deliver in these type of facilities[149] and instead rely on lower levels of care.

However while PNC care for women utilising lower levels of care is more likely to be prompt, it is less likely to be complete. Home based delivery is often the cheapest delivery option in the Philippines and, despite the heavy promotion of facility based delivery by government health departments, is still frequently used by the poor[137,147]. The pressures of limited time and physical resources may be resulting to a situation where the SBA leaves shortly after delivery without performing in depth PNC. Similarly, for those utilising facility based services the duration of inpatient stay is dependent upon a patient's ability to pay[142,152], making it likely that poorer women are discharged earlier than their wealthier counterparts. Further check-ups thus become reliant upon community based postnatal care, which is often left to overworked health volunteers, who do not always have the appropriate support to provide the necessary care[146] which may limit the quality of services available.

This complex relationship between wealth and provider type is integral to understanding quality of care in the Philippines context. Private providers, while associated with substantial OOP costs also were associated with higher QI scores than any other group, although the gap between them and Public Hospitals narrowed considerably once regional variation was taken into account. At the same time, quality in lower level government facilities was highly variable, and in some regions was just as bad as Home SBA. As patient preference in terms of delivery place largely echoes these rankings[137] it appears that in the Philippines it truly is a case of "you get what you pay for" in terms of quality.

The generally poor standard of care in government health centres is particularly concerning. Not only does the lack of quality exacerbate existing inequalities, but as the primary health care system is by its nature intended to lessen the load on higher level care, it plays an important role in controlling the costs of social insurance programs, such as Philhealth[137,153]. If however, as appears to be the case in the Philippines, primary services are not of sufficient quality, patients will continue to bypass these facilities in favour of more expensive care provided at public referral facilities, or if accessible, private facilities. This may, in the long term, exacerbate existing issues with financing and resourcing of the Philippine health system[2].

This is not to say that there are not regions where primary health care facilities appear to offer the same standard of quality as higher level hospital care; while the NCR is a notable standout, Davao and the Cordillera Admin Region also demonstrate comparable quality of care across all public facilities. Conversely, even private providers have lower QI scores in Ilocos and Bicol than public health centres in most other regions. Thus while wealth and provider type contribute heavily to patterns of quality of care, regional variation must not be disregarded.

While this is the first study to comment on regional difference in quality of care in the Philippines, coverage of key maternal and neonatal services, as well as health outcomes, are known to vary considerably between regions[149,154]. As with Indonesia, the pattern of QI scores did not always mirror these trends, with low coverage regions such as MIMAROPA scoring relatively well once access to care was accounted for. However, unlike Indonesia, where quality gradually decreased with distance from the central island, in the Philippines the starkest difference occurs between the NCR and everywhere else.

As previously noted, financing for government health services in the Philippines is heavily reliant upon local economic activity both through taxation and user fees at the point of service[137,155]. For less populous and economically disadvantaged regions this may limit the functionality of local systems, and with much of the country's economic activity concentrated around the capital[137], it is perhaps unsurprising that the QI scores reflect this geographic divide. Even the private sector appears to be affected by these economic factors, as despite being higher than other facility types, QI scores still appear to follow regional trends. It is possible that this may reflect underlying socioeconomic factors within each region; the health of a regional economy may not only affect the amount of government revenue available through taxation but also the proportion of the population who can utilise, and thus fund[137], services provided by private facilities.

Here lies perhaps one of the greatest issues with regards to improving maternal and neonatal health in the Philippines. As the government pushes forward with the expansion of PhilHealth to cover greater segments of the population there is an assumption that improved financial access to facility based services will lead to improved health outcomes. However, as demonstrated here, if the quality of care provided by these the available services is poor due to limited regional resources it is unlikely even complete insurance coverage will result in better outcomes. There is also the issue of primary versus higher level care; while hospital based deliveries, both public and private, are associated with a higher quality care, it is not sustainable for all women to utilise these services.

If all women are to receive an appropriate standard of maternal and neonatal care then it is necessary to involve all elements of the health system in quality improvement efforts. These results, with their new insights into quality of care at lower levels of the health system and in more remote parts of the country demonstrate the potential limitations of relying predominantly on accreditation of higher level facilities to improve quality of care. These results also provide, in the form of the results of the NCR, an example of what may be possible in terms of ensuring facility based delivery services of similar quality across the range of providers. While issues remain even in these areas with regards some aspects of quality care, particularly to breastfeeding, these findings represent a positive step forward in ensuring better outcomes for women and children in the Philippines.

The role of health system reforms, particularly decentralisation, in affecting patterns of quality of care in Indonesia and the Philippines is apparent. Both countries were however early adopters of such policies, and it is possible their experiences may not be universal. As such the following chapter will examine variation in quality of care in Cambodia, a country which has just started the process of moving towards UHC through large scale health reforms.

7 Variation in the Quality of Maternal and Neonatal care in Cambodia

As shown with regards to Indonesia and the Philippines, variation in quality of care appears to be largely influenced by the context of the health system in which it is provided. However, both of these countries represent examples of systems with well-established private sectors and a lengthy history of decentralisation of public health services. In contrast Cambodia, situated in the nearby Gulf of Thailand, is a historically impoverished country only recently beginning to transition from a predominantly donor assisted model of care. Recent reforms have included the gradual decentralisation of health services and the introduction of measures designed to strengthen primary health care and reduce health inequalities in poor and rural populations. Cambodia thus represents an opportunity to examine variation in quality of maternal and neonatal care in the context of an evolving rather than established health system.

7.1 Country Background

Following decades of conflict and political instability, the Kingdom of Cambodia was established as a constitutional monarchy in 1991, allowing the country to begin the lengthy process of reconstruction[156]. With a predominantly rural population of a little over 15 million, agriculture is the country's primary economic activity and per capita GDP is estimated at under 1200 USD. While Cambodia lags behind other countries in the region in terms of GDP, a high rate of economic growth since the mid 2000's has seen a large improvement in standards of living, particularly among the poor[157].

In addition to being predominantly rural, Cambodia's population is also relatively young with over half the population aged below 25 years[158]. There has been a dramatic fall in maternal mortality ratio in recent decades, from an estimated 1020 deaths per 100000 live births in 1990 to 161 deaths per 100000 in 2015[121], and neonatal mortality has also decreased (from 40 per 1000 live births to 15 per 1000 over the same period[119]) however mortality still remains higher than neighbouring countries. Combined with a relatively high fertility rate (at 2.7 children per woman) and a historical HIV epidemic[xix] [159], maternal and child health has emerged as one of Cambodia's key health priorities.

The general population is relatively homogenous, with 90% of the population belonging to the Khmer ethnic group; there are however notable minorities of Khmer Loeu ("upland Khmer"), a term used to refer to a number of indigenous ethnic groups in the highland provinces of Ratanakiri, Stung Treng, and Mondol Kiri who demonstrate cultural and linguistic differences to the majority Khmer population. Similarly, the vast majority (>95%) of Cambodians are Buddhist, although small Islamic and Christian minorities exist. Khmer is Cambodia's official language and is spoken near universally within the country[160].

Much of the country consists of tropical lowland surrounding the Tonle Sap basin and Mekong River systems. Due to the rich alluvial soil provided by the major river systems, the majority of the population resides in and around this central basin region. The capital Phnom Penh lies at the junction of these river systems, and contains over half the total urban population, much of the country's overall wealth and the majority of political power[160]. The low-lying central plains are bordered by mountain ranges to the north and south-west and highlands in the east – the very south of Cambodia is coastal, bordering the Gulf of Thailand. Access to these more remote regions can be limited, and health outcomes in the North-Eastern provinces are notably worse than the rest of the country.

Cambodia has 24 provinces and one special administrative unit (Phnom Penh) which operates as a de facto provincial unit. Each province consists of multiple districts (163 in total, including 12 in Phnom Penh that use slightly different terminology) which are further divided into communes representing a number of individual villages. It should be noted that in 2013 the current province of Tboung Khmum was created by splitting Kampong Cham; all land west of the Mekong river remained as Kampong Cham while the eastern section went on to form the new Province. Both the 2010 and 2014 Cambodian DHS utilised the pre-2013 Kampong Cham borders when determining their sampling frame. As

[xix] The HIV epidemic in Cambodia peaked in 1998 with an estimated prevalence of 1.6% of the general population aged 15-49. Thanks to concerted control programs this has reduced to an estimated 0.6% in 2015, although the prevalence in some segments of the population it remains substantially higher.

a result this analysis can only present results as being representative for the region as a whole rather than by modern provincial lines.

Despite its limited resources, Cambodia has steadily been rebuilding and expanding health infrastructure to provide basic health services to the predominantly rural population. While the bulk of primary and preventative health care in Cambodia is provided through the public health sector, a poorly regulated private health sector dominates the provision of outpatient curative care[134,160]. The public health sector is primarily administered by the Ministry of Health staff at central, provincial and operational district (OD) level. Each OD is designed to cover a population of 100 000-200 000, with at least one referral hospital and sufficient Health Centres (providing basic curative and preventative health services) to cover 10 000 – 20 000 people. In remote areas, located a minimum of 15km from the nearest Health Centre, Health Posts may be available to provide a limited range of services. Every Provincial Health Department is responsible for operating a provincial hospital (providing comprehensive emergency and specialised care) as well as supervising between 1 and 10 OD. In addition, there are eight National Hospitals in Phnom Penh that are directly administered by the central MOH.

There has been considerable NGO involvement in the health sector[156], and recent pushes towards a more responsive, decentralised system have been based on earlier programs entailing the contracting of service provision to non-MOH providers[160,161]. The current model involves the conversion of ODs and Provincial Hospitals into Special Operating Agencies (SOA) that utilise internal contracting arrangements and community monitoring. SOAs have greater control over budget allocation and receive additional discretionary funds that may be utilised in a number of ways, including staff incentives.

While the provision of basic service coverage has been largely successful, user fees, transport costs and limitations in the range of services offered by health centres present a major barrier to accessing care, and there are concerns about poor quality of care in public facilities. In particular, low remuneration of staff has led to the understaffing of primary health care and large numbers of public health staff dual-practicing within the private sector[12]. In addition to the introduction of Health Equity Funds to provide financial access for the poor, Cambodia introduced the Government Midwifery Incentive Scheme (GMIS) in

2007, which provided incentives for health workers of 15 USD for each live birth in a health centre and USD 10 for each live birth in a referral hospital[162,163].

In general there is very little available information on quality of care in Cambodia, particularly for periods covering the more recent reforms[160]. An observational study of SBAs at several facilities in a single province in early 2010[84] found substandard care across all facility types and levels of training. In particular, the study noted poor hygiene practices, incorrect management of the third stage of labour, and very poor postnatal care. Only 12% of women were left alone in the first two hours of delivery and breastfeeding was delayed in 95% of cases – the study noted that a lack of monitoring for both mothers and newborns was a particular concern when complications arose. Focus group interviews with SBAs noted that many did not feel competent in managing obstetric complications and even hospital based staff would often refer patients to national level facilities for treatment[164]. Poor treatment of patients from low socioeconomic backgrounds and the performance of unnecessary procedures such as episiotomy were raised as issues linked to the need for greater remuneration of SBAs. Similarly, financial incentives were implicated in the lack of ongoing monitoring – SBAs who performed post-birth activities received fewer payments than those who performed the delivery, and when care was provided it was usually for women who could afford to pay additional incentives. SBAs also reported high levels of dual practice and the use of commissions for referrals to private facilities.

A study investigating the perceptions of the parents of infants hospitalised within the first month of life at several Southeast Asian hospitals, including a private referral hospital in Siem Reap, did however find low parental satisfaction. Neonatal care, infant outcomes, cost of care and staff demeanour were cited as the most common issues in the Cambodian site[165]. With regards to the public sector, while not directly analysing quality of care, an analysis of performance based financing linked to the contracting of health services between 2000 and 2010 noted that while institutional deliveries increased, concerns remained about the quality of care in such facilities due to lack of equipment and trained staff[166]. It should be noted that this study, which incorporates data from the 2014 Cambodian DHS thus represents one of the first explorations of quality of care in more recent years.

7.2 Overview of the Cambodia 2010 and 2014 DHS

The 2010 Cambodian DHS collected data from 15,667 households throughout the country, with the individual Women's Questionnaire being used to collect data from 18,754 women between the ages of 15 and 49. The 2014 Cambodian DHS included 15,825 households, with data from 17,579 women of reproductive age. Both surveys used a sampling method designed to produce representative estimates for urban and rural populations in fourteen provinces (Banteay Mean Chey, Kampong Cham, Kampong Chhnang, Kampong Speu, Kampong Thom, Kandal, Kratie, Phnom Penh, Prey Veng, Pursat, Siem Reap, Svay Rieng, Takeo, and Otdar Mean Chey) and five pairs of provinces (Battambang & Pailin, Kampot & Kep, Preah Sihanouk & Kaoh Kong, Preah Vihear& Steung Treng, and Mondol Kiri & Rattanak Kiri).

7.2.1 Sample Characteristics

Of the 18,754 women interviewed in 2010, 6472 reported having had at least one live birth in the last five years, and thus were potentially eligible for inclusion in the analysis. Coverage of ANC is reasonably high, with 89% of women reporting at least one ANC visit with a skilled provider, however only 59% report having at least four ANC visits. Overall, 54% of women delivered in a health facility and 71% were assisted by a skilled birth attendant (SBA). In total, 4428 women reported having had both ANC and SBA services.

In the 2014 DHS 7253 women reported having at least one live birth in the past five years, and coverage of at least one ANC visit had risen to 95% and coverage of at least four visits to 76%. Delivery care coverage also improved substantially, with 89% of deliveries attended by a SBA and 83% of deliveries taking place within a facility. Overall, 5117 women had both ANC and SBA care.

7.2.2 Availability of Quality Indicators

In addition to the standard DHS indicators outlined in previous chapters, both Cambodian DHSs included a number of additional indicators relating to the content of pregnancy and birth related visits. In addition to the standard ANC content questions regarding Blood Pressure, Urine and Blood Testing, Tetanus

Immunisation, Iron supplementation and Advice about pregnancy complications, the Cambodian DHSs also included questions about whether or not height and weight were measured (necessary for monitoring nutritional status and general wellbeing throughout the pregnancy), and if drugs were taken for intestinal parasites (recommended in areas with high parasite burdens in order to combat maternal anaemia and other complications). Women were also asked if they had received nutritional advice during ANC (in order to promote optimal maternal health).

The remaining country specific questions pertained to the content and nature of maternal postnatal care; here there were differences between the questions asked in the 2010 Cambodian DHS and the 2014 Cambodian DHS. While the DHS standard question regarding maternal vitamin A supplementation questions was asked in the 2010 DHS, it was not asked in the 2014 DHS – as a result the 2014 Cambodian DHS does not have the full set of standard DHS indicators. The 2014 DHS did however ask about the total number of maternal and neonatal checkups each woman received; IMPAC guidelines recommend at least three PNC visits during the postpartum period in order to check the general health of mother and baby and identify potential issues that may require further intervention, and as such this was used to create appropriate indicators. Both the 2010 and 2014 DHS included additional questions about the content of PNC, including postpartum iron supplementation and maternal deworming (for preventing maternal anaemia), and counselling regarding newborn care and family planning (to provide appropriate health advice).

Due to the history of HIV in Cambodia both the 2010 and 2014 DHS asked questions regarding HIV counselling and testing during ANC; namely if they were given advice relating to maternal to child transmission, how to prevent the spread of HIV, and the need for HIV testing, and if they were offered a HIV test by the ANC provider. While these are important aspects of HIV control programs, and ideally would be included in the quality index, such questions were only asked of women who had delivered within the two years prior to the survey. In contrast, all other indicators were available for women who delivered in the previous five years.

As a result the effective sample size if these questions were included in the analysis would drop from 11681 to 6393 observations, increasing the risk that the sample is no longer representative of the underlying population – particularly with regards to population subgroups. It would also render the dataset no longer comparable to the Indonesian and Philippines analyses, which also utilise births in the last five years. As such these questions were omitted from the analysis. Future surveys may potentially consider the value of including HIV related questions as part of the general ANC module in countries with high prevalence.

Similarly both the 2010 and 2014 DHS included questions about the prevention of malaria during pregnancy; in particular the type and source of drug taken. However while malaria is endemic in Cambodia, its prevalence varies considerably between regions, with the highlands in the north-east and the Thai-Cambodian border being at high risk while Phnom Penh and its surrounding regions is virtually free of the parasite. For this reason the need for preventative treatment of malaria, as well as the most appropriate drug choice, varies considerably based on geographic location.

This presents a problem from the point of view of the quality index, as the population for areas with minimal malaria risk (and thus justifiably should not be receiving treatment) is substantial, and these regions would have artificially low scores as a result of this difference in need. For this reason questions related to malaria prevention were omitted from the indicator sets; for countries with more homogenous risk levels these questions might be considered for inclusion. It should be noted that in areas with a high prevalence of HIV and Malaria, the generalised indicator regarding blood testing during ANC becomes even more important when considering quality of care, as its absence suggests potential limitation not only with regards to MNCH care, but also HIV and Malaria control programs.

Table 7.2.1 provides an overview of the final indicators for the 2010 and 2014 Cambodian DHS used in the analysis, as well as a summary of the indicator means within the sample of the population who received both ANC and SBA services. The coverage of quality indicators is generally higher in 2010 compared to 2014; urine testing during ANC and deworming during PNC were only found in roughly a third of observations in 2010 compared to over half in 2014. Even indicators that were present in over 90% of the sample, such as blood pressure measurement during ANC and measurement of birth weight, saw minor increases in coverage. The only exceptions to this trend were the breastfeeding related indicators, which saw small decreases in prevalence between surveys.

Table 7.2.1 Potential Quality Indicators Identified with mean prevalence in population with both ANC and SBA services, Cambodia 2010 & 2014

Indicator	**2010 Mean**	**2010 Std. Err.**	**2014 Mean**	**2014 Std. Err.**
1+ ANC visit in 1st Trimester	0.714	0.007	0.841	0.005
Blood Pressure measured during ANC	0.922	0.004	0.965	0.003
Urine sample taken during ANC	0.386	0.007	0.508	0.007
Blood sample taken during ANC	0.513	0.008	0.775	0.006
Weight measured during ANC	0.934	0.004	0.965	0.003
Height measured during ANC	0.828	0.006	0.877	0.005
Took drugs for intestinal parasites during pregnancy	0.552	0.008	0.772	0.006
Iron supplementation during pregnancy	0.668	0.007	0.802	0.006
Fully protected from Tetanus during pregnancy	0.884	0.005	0.907	0.004
Told about pregnancy complications during ANC	0.812	0.006	0.842	0.005
Given Nutrition counselling during ANC	0.845	0.005	0.877	0.005
Baby was weighed at birth	0.918	0.004	0.978	0.002
Baby was breastfed within 1 hr of birth	0.682	0.007	0.629	0.007
No liquids given before milk began to flow (no prelacteal feed)	0.790	0.006	0.736	0.006
Maternal postnatal check within 2 hrs of delivery	0.589	0.007	0.774	0.006
Neonatal postnatal check within 2 hrs of delivery	0.260	0.007	0.689	0.006
Mother had at least 3 postnatal checks	-	-	0.529	0.007
Baby had at least 3 postnatal checks	-	-	0.428	0.007
Mother received postpartum Vitamin A within 2 months of delivery	0.510	0.008	-	-
Given iron tablet in first six weeks after delivery	0.539	0.008	0.779	0.006
Given deworming tablet in first six weeks after delivery	0.353	0.007	0.540	0.007
Received counselling on newborn care	0.516	0.008	0.676	0.007
Received Family planning advice within 6 weeks post birth	0.367	0.007	0.560	0.007

7.2.3 *Missing Data*

Using the methods outlined in Chapter 3, binary indicators were created from each relevant variable reflecting whether or not each observation received a particular service or not. As recommended by the analyses outlined in Chapter 4, “full quality” for indicators with a quantitative component was defined as having 90+ days of iron supplementation and having the first PNC check within 2 hours of delivery. The only country-specific indicators to contain a quantitative component were the number of maternal and neonatal PNC checks – as outlined in the previous section a total of three visits was considered an appropriate measure of quality.

Of the 4428 observations reporting both ANC and SBA use in 2010, 4127 (93% of sample) had available information on all indicators (including country specific indicators). Following the assumptions outlined in Chapter 2 regarding “don’t know” and partial responses a further 222 observations (5% of sample) were also included; in total 79 observations (1.8% of sample) were dropped due to missing data. In 2014, 4628 (90% of sample) of the 5117 observations with both ANC and SBA use had available information on all indicators. Another 469 (9.2% of sample) were included following the application of assumptions, leaving 20 (0.4% of sample) to be excluded from the analysis due to missing data.

Tables 7.2.2 and 7.2.3 provide a breakdown of complete, imputed and dropped observations by key demographic factors for the 2010 and 2014 datasets respectively. Neither the imputed nor dropped observations significantly differed from the complete observations on the basis of age, urban rural status, or wealth in either DHS, however the imputed observations in 2014 were statistically more likely to have either no education or an incomplete primary education than their non-missing counterparts. Care should thus be taken when examining educational based inequality for the 2014 dataset, as the assumptions used for groups containing at least one imputed indicator may result in an underestimation of quality for the affected indicators.

Table 7.2.2 Demographic characteristics by Non-Missing, Imputed or Dropped status, Cambodia 2010

Category	**Complete**		**Imputed**		**Missing**	
	#	**%**	**#**	**%**	**#**	**%**
Urban	1,451	*35.2%*	86	*38.7%*	31	*39.2%*
Rural	2,676	*64.8%*	136	*61.3%*	48	*60.8%*
p-value			0.277		0.452	
15-19	139	*3.4%*	6	*2.7%*	4	*5.1%*
20-24	986	*23.9%*	52	*23.4%*	18	*22.8%*
25-29	1,434	*34.7%*	77	*34.7%*	27	*34.2%*
30-34	800	*19.4%*	41	*18.5%*	15	*19.0%*
35-39	453	*11.0%*	28	*12.6%*	8	*10.1%*
40-44	257	*6.2%*	11	*5.0%*	5	*6.3%*
45-49	58	*1.4%*	7	*3.2%*	2	*2.5%*
p-value			0.451		0.963	
No education	501	*12.1%*	21	*9.5%*	8	*10.1%*
Incomplete primary	1,731	*41.9%*	93	*41.9%*	36	*45.6%*
Complete primary	412	*10.0%*	19	*8.6%*	8	*10.1%*
Incomplete secondary	1,212	*29.4%*	73	*32.9%*	24	*30.4%*
Complete secondary	159	*3.9%*	10	*4.5%*	2	*2.5%*
Higher Education	112	*2.7%*	6	*2.7%*	1	*1.3%*
p-value			0.730		0.914	
Poorest	621	*15.0%*	33	*14.9%*	14	*17.7%*
Poorer	642	*15.6%*	34	*15.3%*	13	*16.5%*
Middle	713	*17.3%*	36	*16.2%*	12	*15.2%*
Richer	895	*21.7%*	50	*22.5%*	13	*16.5%*
Richest	1,256	*30.4%*	69	*31.1%*	27	*34.2%*
p-value			0.993		0.746	

Table 7.2.2 Cont.

Banteay Mean Chey	212	*5.1%*	3	*1.4%*	6	*7.6%*
Kampong Cham	195	*4.7%*	23	*10.4%*	3	*3.8%*
Kampong Chhnang	272	*6.6%*	2	*0.9%*	3	*3.8%*
Kampong Speu	235	*5.7%*	8	*3.6%*	0	*0.0%*
Kampong Thom	183	*4.4%*	2	*0.9%*	0	*0.0%*
Kandal	247	*6.0%*	10	*4.5%*	2	*2.5%*
Kratie	162	*3.9%*	5	*2.3%*	3	*3.8%*
Phnom Penh	320	*7.8%*	18	*8.1%*	2	*2.5%*
Prey Veng	199	*4.8%*	0	*0.0%*	0	*0.0%*
Pursat	181	*4.4%*	7	*3.2%*	48	*60.8%*
Siem Reap	263	*6.4%*	8	*3.6%*	2	*2.5%*
SvayRieng	262	*6.3%*	7	*3.2%*	0	*0.0%*
Takeo	247	*6.0%*	15	*6.8%*	0	*0.0%*
Otdar Mean Chey	209	*5.1%*	13	*5.9%*	1	*1.3%*
Battambang & Pailin	183	*4.4%*	31	*14.0%*	1	*1.3%*
Kampot & Kep	158	*3.8%*	25	*11.3%*	3	*3.8%*
Preah Sihanouk & Kaoh Kong	270	*6.5%*	13	*5.9%*	1	*1.3%*
Preah Vihear & Steung Treng	129	*3.1%*	23	*10.4%*	1	*1.3%*
Mondol Kiri & Rattanak Kiri	200	*4.8%*	9	*4.1%*	3	*3.8%*
p-value			0.000		0.000	
Total	4,127		222		79	
(% of Total)	*93.2%*		*5.0%*		*1.8%*	

Both imputed and dropped groups did however differ significantly from the complete observations in terms of the region they were from in both the 2010 and 2014 DHS. In the 2010 DHS higher proportions of the imputed group were from Kampong Cham, Battambang & Pailin, Kampot & Kep, and Preah Vihear & Steung Treng. In 2014 imputed observations were more likely to be from Siem Reap, Battambang & Pailin, and Mondol Kiri & Rattanak Kiri. As the majority of the assumptions used for the imputed group result in observations being categorised as not having received the given indicator, it should be noted that regional estimates of quality are likely to be underestimated for the regions that are more prevalent in the imputed observation group.

More concerning is the fact that in 2010, 60% of all dropped observations (48 in total) were from the Pursat region – meaning that 20% of the 236 observations for this region were dropped from the analysis. The majority of these missing observations were excluded due to lack of data surrounding neonatal PNC, indicating a potential systemic issue in the way the survey was conducted in the province. As such, great caution should be taken when looking at the results for this region in the 2010 analysis as we cannot extrapolate the potential shape this bias might have in terms of the regional results. While there was significant regional variation between the dropped and complete observations in 2014, the very small number of observations involved makes it unlikely that this will have an impact on regional results.

Table 7.2.3 Demographic characteristics by Non-Missing, Imputed or Dropped status, Cambodia 2014

Category	**Complete**		**Imputed**		**Missing**	
	#	%	#	%	#	%
Urban	1,404	*30.3%*	143	*30.5%*	5	*25.0%*
Rural	3,224	*69.7%*	326	*69.5%*	15	*75.0%*
p-value			0.945		0.604	
15-19	177	*3.8%*	16	*3.4%*	3	*15.0%*
20-24	1,105	*23.9%*	112	*23.9%*	6	*30.0%*
25-29	1,444	*31.2%*	143	*30.5%*	7	*35.0%*
30-34	1,230	*26.6%*	118	*25.2%*	1	*5.0%*
35-39	432	*9.3%*	47	*10.0%*	2	*10.0%*
40-44	182	*3.9%*	27	*5.8%*	1	*5.0%*
45-49	58	*1.3%*	6	*1.3%*	0	*0.0%*
p-value			0.642		0.100	
No education	473	*10.2%*	64	*13.6%*	0	*0.0%*
Incomplete primary	1,748	*37.8%*	200	*42.6%*	8	*40.0%*
Complete primary	475	*10.3%*	41	*8.7%*	3	*15.0%*
Incomplete secondary	1,488	*32.2%*	139	*29.6%*	6	*30.0%*
Complete secondary	241	*5.2%*	13	*2.8%*	2	*10.0%*
Higher Education	203	*4.4%*	12	*2.6%*	1	*5.0%*
p-value			0.003		0.635	
Poorest	824	*17.8%*	82	*17.5%*	4	*20.0%*
Poorer	824	*17.8%*	90	*19.2%*	1	*5.0%*
Middle	780	*16.9%*	68	*14.5%*	5	*25.0%*
Richer	899	*19.4%*	101	*21.5%*	4	*20.0%*
Richest	1,301	*28.1%*	128	*27.3%*	6	*30.0%*
p-value			0.563		0.608	

Table 7.2.3 Cont.

Banteay Mean Chey	213	*4.6%*	35	*7.5%*	3	*15.0%*
Kampong Cham	264	*5.7%*	33	*7.0%*	1	*5.0%*
Kampong Chhnang	259	*5.6%*	5	*1.1%*	1	*5.0%*
Kampong Speu	271	*5.9%*	29	*6.2%*	1	*5.0%*
Kampong Thom	234	*5.1%*	0	*0.0%*	0	*0.0%*
Kandal	222	*4.8%*	22	*4.7%*	0	*0.0%*
Kratie	238	*5.1%*	1	*0.2%*	0	*0.0%*
Phnom Penh	330	*7.1%*	27	*5.8%*	0	*0.0%*
Prey Veng	252	*5.4%*	5	*1.1%*	0	*0.0%*
Pursat	269	*5.8%*	12	*2.6%*	2	*10.0%*
Siem Reap	235	*5.1%*	43	*9.2%*	4	*20.0%*
SvayRieng	240	*5.2%*	25	*5.3%*	0	*0.0%*
Takeo	228	*4.9%*	10	*2.1%*	1	*5.0%*
Otdar Mean Chey	267	*5.8%*	19	*4.1%*	0	*0.0%*
Battambang & Pailin	204	*4.4%*	53	*11.3%*	1	*5.0%*
Kampot & Kep	192	*4.1%*	30	*6.4%*	0	*0.0%*
Preah Sihanouk & Kaoh Kong	286	*6.2%*	24	*5.1%*	3	*15.0%*
Preah Vihear & Steung Treng	227	*4.9%*	29	*6.2%*	3	*15.0%*
Mondol Kiri & Rattanak Kiri	197	*4.3%*	67	*14.3%*	0	*0.0%*
p-value			0.000		0.038	
Total	**4,628**		**469**		**20**	
(% of Total)	*90.4%*		*9.2%*		*0.4%*	

7.3 Construction of Quality Indices

Construction of QI for the 2010 and 2014 Cambodian datasets followed the methodology outlined in Chapters 2 and 3, starting with the identification of potential indicators and categorisation into different indicator sets. PCA analysis was then carried out individually for both datasets on each set of indicators and indices based on PCA derived were created alongside indices based on equal weighting. As a result of the analysis performed in Chapter 3 regarding the effect of including partial levels of quality, as well as controlling for access to services, a decision was made to omit partial levels of quality (resulting in all indicators becoming binary variables reflecting whether or not an individual received a full quality care only) and to restrict the dataset of to only those observations that received at least one ANC visit and delivered with a SBA (thus omitting individuals who were unable to access either of these services due to non-quality related factors).
In addition to the calculation of PCA and EW based QI specific to each dataset, additional QI were created based on a pooled dataset using indicator sets common to both DHS. For the purposes of the combined PCA, weights were used to adjust for variation in sample size between the two datasets[xx].

7.3.1 Indicator Sets

As previously mentioned in section 7.2.2 the Cambodian DHS collected data for not only the core set of DHS indicators, but also a large number of additional country specific indicators. Table 7.2.1 in the section above provides an overview of the mean and standard deviation of each indicator within the dataset. Based on the assumption that indicators with a mean of greater than 90% or a SE of less than 0.005 would be unlikely to substantially determine relative quality of care, four indicators were omitted from the complete indicator set in order to form a third “Key” indicator set.

Table 7.3.1 lists the final indicators used as well as the Cronbach’s alpha calculated for each indicator set. Because the 2014 dataset does not contain all of the indicators necessary for the Core DHS indicator set, only All indicator and Key

[xx] Weights for each dataset were calculated as 1/N where N was to total number of observations from each dataset used in the analysis.

indicator sets were created for the 2014 and pooled dataset analyses. However it should be noted that the results from 2010 suggest a very low level of internal consistency between the indicators in the Core indicator set compared to the KHM based sets which have a Cronbach's Alpha score above 0.7, and as such inclusion of the DHS indicator set may not have been particularly beneficial to the analysis.

Table 7.3.1 Indicator sets used for construction of QI, Cambodia 2010 & 2014

Indicators	**All Indicators**		**Key Indicators**		**Core Indicators**	**All Combined Indicators**	**Key Combined Indicators**
	2010	**2014**	**2010**	**2014**	**2010 only**	**2010-2014**	**2010-2014**
1+ ANC visit in 1st Trimester	x	x	x	x	x	x	x
Blood Pressure measured during ANC	x	x			x	x	
Urine sample taken during ANC	x	x	x	x	x	x	x
Blood sample taken during ANC	x	x	x	x	x	x	x
Weight measured during ANC	x	x				x	
Height measured during ANC	x	x	x	x		x	x
Took drugs for intestinal parasites during pregnancy	x	x	x	x		x	x
Iron supplementation during pregnancy	x	x	x	x	x	x	x
Fully protected from Tetanus during pregnancy	x	x			x	x	
Told about pregnancy complications during ANC	x	x	x	x	x	x	x
Given Nutrition counselling during ANC	x	x	x	x		x	x

Table 7.3.1 Cont.

Baby was weighed at birth	x	x			x	x	
Baby was breastfed within 1 hr of birth	x	x	x	x	x	x	x
No liquids given before milk began to flow (no prelacteal feed)	x	x	x	x	x	x	x
Maternal postnatal check within 2 hrs of delivery	x	x	x	x	x	x	x
Neonatal postnatal check within 2 hrs of delivery	x	x	x	x	x	x	x
Mother had at least 3 postnatal checks		x		x			
Baby had at least 3 postnatal checks		x		x			
Mother received postpartum Vitamin A within 2 months of delivery	x		x		x		
Given iron tablet in first six weeks after delivery	x	x	x	x		x	x
Given deworming tablet in first six weeks after delivery	x	x	x	x		x	x
Received counseling on newborn care	x	x	x	x		x	x
Received Family planning advice within 6 weeks post birth	x	x	x	x		x	x
Cronbach's Alpha	**0.7406**	**0.7195**	**0.722**	**0.7276**	**0.5251**	**0.7455**	**0.7276**

7.3.2 *Results of PCA*

Table 7.3.2 shows the variable weights calculated as a result of the PCA analysis using the All, Key and Core DHS indicator sets for the 2010 sample. As expected there are notable differences between the indicator sets; the All and Key indicator sets are heavily weighted towards PNC content while the Core set is more heavily weighted towards ANC content. Interestingly, the secondary components for the All and Key sets are also dominated by PNC content, with negative weights for breastfeeding and PNC content related indicators, while the secondary component for the Core set has PNC timing and Vitamin A supplementation weighted highly and ANC content indicators negatively weighted.

As PCA is based on underlying patterns in correlations between indicators, these results do seem to suggest two distinct trends within the dataset; those who are more likely to receive PNC content but not particularly likely to receive ANC content, and those who are likely to receive ANC content but are less likely to receive PNC content. PNC timing appears to carry similar weights between both components, suggesting that it is not simply a case of a lack of relation between ANC and SBA care indicators, but more likely differences in the type of care different populations receive. It is possible, for example, that those who are more likely to receive ANC content do not use SBA providers that are more likely to provide PNC content – variation in provider practices might be expected for a range of reasons relating to health policy and resourcing, which will be explored in later sections.

Table 7.3.3 shows the variable weights calculated as a result of the PCA analysis using the All and Key indicator sets for the 2014 sample. Here, unlike the 2010 sample, the primary component places relatively heavy weights on urine testing during ANC and prompt PNC as well as the PNC content indicators. The indicators relating to having at least 3 PNC visits also score highly, suggesting correlation between the timing, content and frequency of PNC. Overall this pattern of correlation seems more “balanced” across the continuum of care compared to the primary components in the 2010 dataset.

Table 7.3.2 PCA derived variable weights for primary and secondary components using different indicator sets, Cambodia 2010

Indicator	**All Indicators**		**Key Indicators**		**Core Indicators**	
	Comp 1	**Comp 2**	**Comp 1**	**Comp 2**	**Comp 1**	**Comp 2**
1+ ANC visit in 1st Trimester	0.072	0.254	0.0688	0.257	0.261	-0.182
Blood Pressure measured during ANC	0.066	0.121			0.120	-0.039
Urine sample taken during ANC	0.123	0.489	0.117	0.512	0.478	-0.345
Blood sample taken during ANC	0.108	0.517	0.101	0.534	0.472	-0.430
Weight measured during ANC	0.052	0.128				
Height measured during ANC	0.083	0.227	0.076	0.208		
Took drugs for intestinal parasites during pregnancy	0.252	0.057	0.252	0.059		
Iron supplementation during pregnancy	0.126	0.246	0.122	0.249	0.303	-0.107
Fully protected from Tetanus during pregnancy	0.059	0.054			0.091	0.004
Told about pregnancy complications during ANC	0.133	0.160	0.130	0.161	0.218	0.058
Given Nutrition counselling during ANC	0.13	0.200	0.126	0.200		
Baby was weighed at birth	0.048	0.072			0.101	0.001
Baby was breastfed within 1 hr of birth	0.068	-0.027	0.068	-0.030	0.053	0.058
No liquids given before milk began to flow (no prelacteal feed)	0.064	-0.012	0.064	-0.014	0.065	0.075
Maternal postnatal check within 2 hrs of delivery	0.153	0.172	0.153	0.200	0.399	0.511
Neonatal postnatal check within 2 hrs of delivery	0.131	0.124	0.131	0.145	0.306	0.415
Mother received postpartum Vitamin A within 2 months of delivery	0.406	-0.266	0.412	-0.26	0.223	0.451
Given iron tablet in first six weeks after delivery	0.408	-0.237	0.414	-0.229		
Given deworming tablet in first six weeks after delivery	0.397	-0.173	0.402	-0.163		
Received counselling on newborn care	0.420	-0.076	0.424	-0.056		
Received Family planning advice within 6 weeks post birth	0.347	-0.006	0.350	0.016		
Rho	**0.2106**	**0.1047**	**0.2262**	**0.1102**	**0.1739**	**0.1268**

Table 7.3.3 PCA derived variable weights for primary and secondary components using different indicator sets, Cambodia 2014

Indicator	All Indicators		Key Indicators	
	Comp 1	**Comp2**	**Comp1**	**Comp2**
1+ ANC visit in 1st Trimester	0.066	-0.025	0.063	-0.026
Blood Pressure measured during ANC	0.048	0.003		
Urine sample taken during ANC	0.226	-0.063	0.224	-0.063
Blood sample taken during ANC	0.149	-0.044	0.145	-0.044
Weight measured during ANC	0.048	0.003		
Height measured during ANC	0.097	0.008	0.093	0.007
Took drugs for intestinal parasites during pregnancy	0.178	0.158	0.177	0.158
Iron supplementation during pregnancy	0.124	0.044	0.121	0.044
Fully protected from Tetanus during pregnancy	0.068	0.018		
Told about pregnancy complications during ANC	0.167	0.031	0.166	0.031
Given Nutrition counselling during ANC	0.142	-0.007	0.140	-0.007
Baby was weighed at birth	0.024	-0.004		
Baby was breastfed within 1 hr of birth	0.087	0.175	0.088	0.176
No liquids given before milk began to flow (no prelacteal feed)	0.117	0.283	0.118	0.284
Maternal postnatal check within 2 hrs of delivery	0.230	-0.063	0.234	-0.061
Neonatal postnatal check within 2 hrs of delivery	0.315	-0.119	0.320	-0.116
Mother had at least 3 postnatal checks	0.240	-0.584	0.243	-0.583
Baby had at least 3 postnatal checks	0.280	-0.551	0.283	-0.550
Given iron tablet in first six weeks after delivery	0.227	0.209	0.228	0.210
Given deworming tablet in first six weeks after delivery	0.355	0.318	0.357	0.320
Received counselling on newborn care	0.395	0.112	0.398	0.114
Received Family planning advice within 6 weeks post birth	0.407	0.186	0.409	0.187
Rho	**0.1830**	**0.1232**	**0.1905**	**0.1294**

The secondary component is also interesting, with the pattern of weights suggesting a sub-optimal number of PNC visits accompanied by an increased likelihood of appropriate breastfeeding and postnatal iron supplementation and deworming. The difference in patterns between the 2010 and 2014 PCA results could indicate fundamental changes in the way services are delivered, with a greater level of service integration since 2010 resulting in a greater chance that those with ANC will also receive PNC content; as such, the greatest point of variation may be in the manner in which PNC is received rather than its content. It is also possible, however, that the inclusion of the number of PNC visits (which was not available for 2010) is also driving this difference in patterns.

To further this analysis, the PCA results for the pooled dataset are shown in Table 7.3.4. Even with the absence of the indicators relating to the number of PNC visits, the overall pattern of weights seen in the primary component is far more reminiscent of the 2014 PCA results than the 2010. On the other hand, the secondary component shows the strong ANC content bias seen in the 2010 results, teamed with weights for PNC content and breastfeeding that are inverse to those seen in the secondary component for 2014. These combined results do suggest that there is an underlying sense of “quality service provision” that is shared between the two periods, and that PNC in particular is a key point of variation within the sample.

Table 7.3.4 weighted and unweighted PCA derived variable weights for primary and secondary components using pooled indicator sets, Cambodia2010 & 2014

	Unweighted				**Weighted (1/N)**			
Indicator	**All Indicators**		**Key Indicators**		**All Indicators**		**Key Indicators**	
	Comp 1	**Comp 2**	**Comp 1**	**Comp 2**	**Comp 1**	**Comp 2**	**Comp 1**	**Comp 2**
1+ ANC visit in 1st Trimester	0.106	0.191	0.103	0.182	0.107	0.195	0.104	0.187
Blood Pressure measured during ANC	0.067	0.079			0.068	0.080		
Urine sample taken during ANC	0.209	0.498	0.207	0.494	0.208	0.494	0.206	0.492
Blood sample taken during ANC	0.206	0.480	0.202	0.474	0.207	0.485	0.203	0.480
Weight measured during ANC	0.059	0.086			0.059	0.088		
Height measured during ANC	0.104	0.166	0.099	0.145	0.105	0.169	0.099	0.148
Took drugs for intestinal parasites during pregnancy	0.266	-0.039	0.266	-0.046	0.268	-0.040	0.269	-0.047
Iron supplementation during pregnancy	0.163	0.141	0.161	0.129	0.164	0.145	0.162	0.134
Fully protected from Tetanus during pregnancy	0.066	0.032			0.066	0.032		
Told about pregnancy complications during ANC	0.152	0.076	0.151	0.070	0.152	0.078	0.150	0.071
Given Nutrition counselling during ANC	0.142	0.131	0.139	0.121	0.142	0.130	0.140	0.120
Baby was weighed at birth	0.050	0.040			0.052	0.041		
Baby was breastfed within 1 hr of birth	0.057		0.059	-0.185	0.056	-0.167	0.057	-0.178
No liquids given before milk began to flow (no prelacteal feed)	0.082	-0.210	0.084	-0.219	0.079	-0.197	0.080	-0.206
Maternal postnatal check within 2 hrs of delivery	0.235	0.180	0.238	0.228	0.234	0.180	0.237	0.227
Neonatal postnatal check within 2 hrs of delivery	0.309	0.196	0.314	0.250	0.305	0.194	0.309	0.246
Given iron tablet in first six weeks after delivery	0.333	-0.256	0.338	-0.253	0.337	-0.261	0.342	-0.257
Given deworming tablet in first six weeks after delivery	0.387	-0.311	0.393	-0.308	0.386	-0.310	0.392	-0.306
Received counselling on newborn care	0.401	-0.224	0.406	-0.217	0.402	-0.229	0.407	-0.221
Received Family planning advice within 6 weeks post birth	0.393	-0.198	0.399	-0.190	0.392	-0.197	0.397	-0.188
Rho	**0.2165**	**0.0963**	**0.2292**	**0.1020**	**0.2163**	**0.0966**	**0.2292**	**0.1024**

As can also be seen, the weighting of observations according to the relative size of the datasets also produces little effect on either the magnitude or the overall pattern of weights. QI will be produced based upon the weighted PCA results, however as can be seen this decision is unlikely to have an impact on resulting scores.

7.3.3 Comparison of QI

Given the differences in indicator sets, both within and between years, it is unsurprising that there is potential for scores to differ considerably depending on the QI chosen for the analysis. As one of the benefits of having data from two different surveys is the ability to compare mean scores across a time period, it makes sense that the analysis be conducted using one of the pooled indicator sets. Table 7.3.5 shows the correlation between QI scores based on the all indicator sets for 2010 and 2014 and those produced using the pooled all indicator set.

As can be seen, there is a high level of correlation regardless of the weighting type used. This is not particularly surprising, as the variables that differ between datasets (Vitamin A supplementation and Number of PNC visits) appear to be strongly correlated with variables that are in both datasets (such as the PNC content indicators). This suggests that it is unlikely that the results produced using the pooled indicator QI will be substantially different from year-specific QI.

Table 7.3.5 Correlation between scores using different QI, Cambodia 2010 & 2014

Correlation between QI scores	**QI**			
	1)	**2)**	**3)**	**4)**
2010 QI comparison				
1) 2010 EW All indicators	1			
2) 2010 PCA All indicators	0.9083	1		
3) Combined PCA indicators	0.9512	0.9612	1	
4) Combined EW indicators	0.9924	0.8665	0.9396	1
2014 QI Comparison				
1) 2014 EW All indicators	1			
2) 2014 PCA All indicators	0.9548	1		
3) Combined PCA indicators	0.9215	0.9517	1	
4) Combined EW indicators	0.9635	0.9034	0.9506	1

As outlined in previous analyses, both EW and PCA derived QI were used in order to provide insight into differences between relative and absolute measures of quality of care. There is still the question however of whether the all indicator set or the key indicator set should be utilised for the equity analysis. Based on the precedent set by the analyses for Indonesia and the Philippines, the all indicator set will be used, due its more comprehensive nature and the limited likelihood of the additional indicators affecting results.

7.4 QI score by Key Equity Markers

The following sections will examine variation in QI scores across a number of potential equity markers. It should be noted that all scores (regardless of the type of weighting applied) have been standardised, in order to better demonstrate group based variation. In order to examine time based differences in QI scores all results will utilise QI formed from the pooled dataset using the All indicator set.

7.4.1 Variation by Year, Wealth and Urban Rural Status

As shown in Figure 7.4.1, the most immediately obvious point of variation within the pooled dataset is the large increase in mean QI score between the 2010 and 2014 DHS. While this is somewhat expected given the known increases in coverage of ANC and SBA Services, it is notable that this improvement exists both in the PCA and EW based scores, suggesting that there is a general increase in coverage across all indicators, rather than an increase in a more limited scope of indicators that score highly in the PCA process.

Figure 7.4.1 Mean QI scores by year, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014

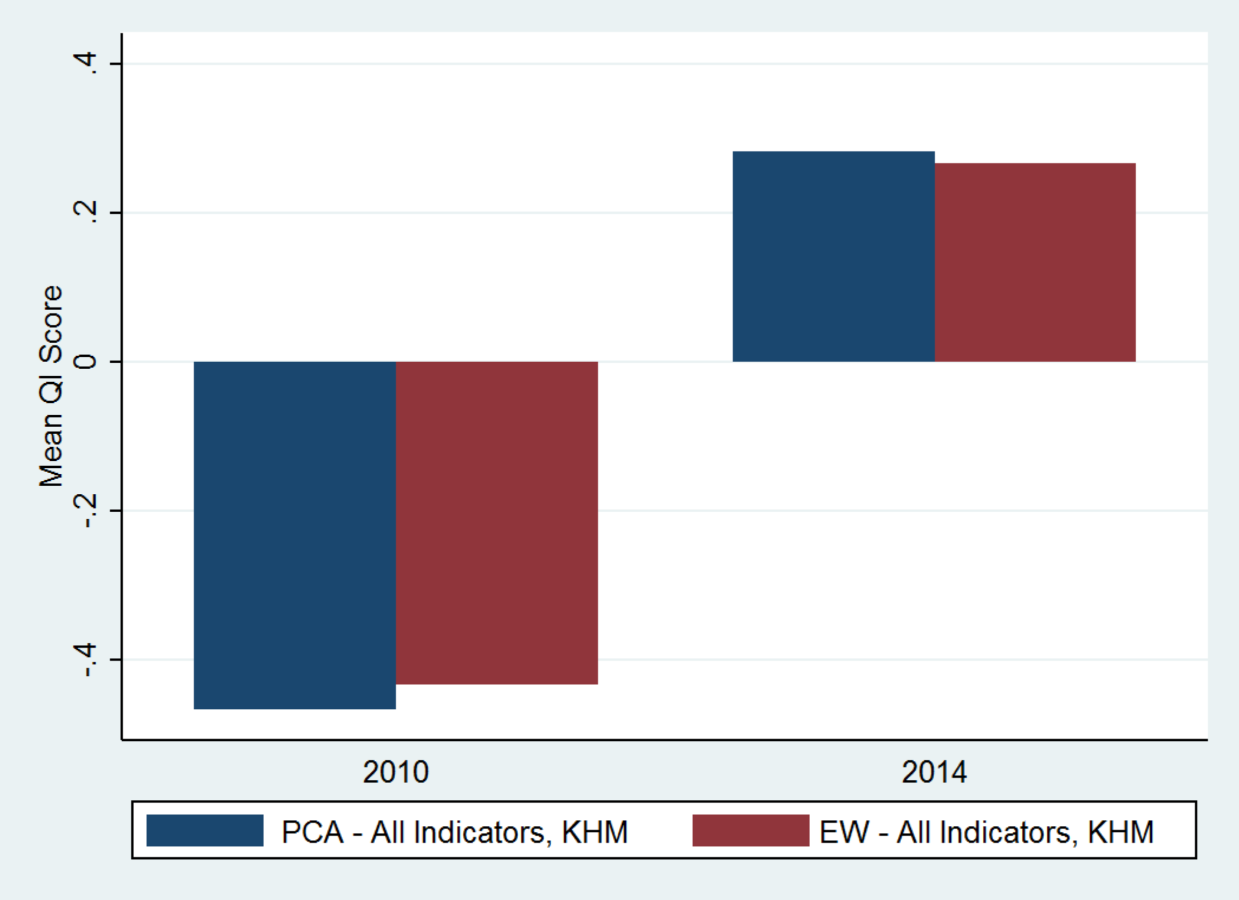
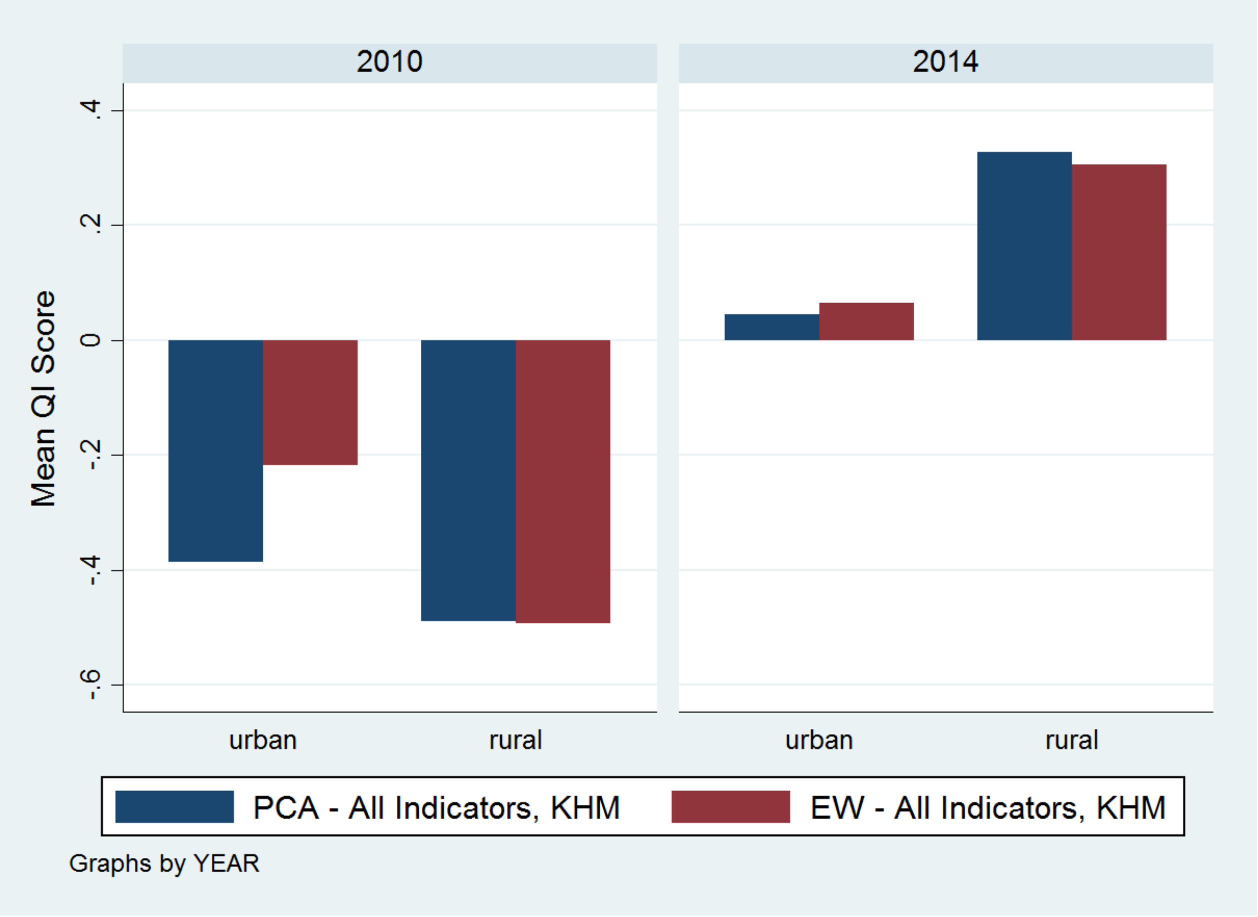


Figure 7.4.2 shows mean QI scores by year for urban and rural populations. Here it becomes apparent that while urban areas have seen increases in QI scores between 2010 and 2014, they have been well and truly outperformed by rural areas which now score markedly higher than their urban counterparts. Again, this reversal in urban rural trends exists for both PCA and EW based QI, suggesting a truly impressive change in the services received by rural women. It is also interesting to note the substantial difference between PCA and EW derived scores for urban women in 2010. In particular, the fact that urban women score more highly in the EW based QI suggests that a large number are missing indicators highly weighed as a result of the PCA process.

Given that the secondary component for the 2010 dataset produced a high weight on ANC content indicators but negative weight for PNC content, as well as the generally higher prevalence of indicators such as Blood and Urine testing in urban regions (particularly Phnom Penh), it is likely that in 2010 urban women had difficulties receiving key PNC content indicators. By 2014 however this discrepancy had mostly disappeared; while EW scores are still slightly larger than PCA base scores the overall effect on urban-rural differences is minor.

Figure 7.4.2 Mean QI scores for Urban and Rural populations, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014



A similar reversal in urban advantage is evident when looking at QI score by wealth quintile (Figure 7.4.3). In 2010 QI scores were similarly low for the poorest and poorer wealth quintiles, increased slightly for the middle and richer quintiles, and were highest for the richest wealth quintile. In contrast, scores were quite similar across the bottom four wealth quintiles in 2014 but the richest quintile had markedly lower mean QI scores – it appears that by 2014 being in the richest wealth quintile was actually disadvantageous in receiving quality maternal and neonatal care.

The difference between PCA and EW based scores seen in urban population in the 2010 sample are similarly evident when looking at the richest wealth quintile for the same year. It appears that it was the richest women in 2010 (who also happened to be primarily urban) who were not receiving PNC content indicators as expected. At the same time both years show a higher PCA score than EW score for the poorest two quintiles, suggesting that these groups were comparatively more likely to receive PNC content than ANC content indicators. It is possible that these variations reflect differences in perceived need for care; the PNC content indicators in question revolve around iron supplementation, deworming, neonatal and contraceptive advice. It is possible that providers may consider such interventions unnecessary for wealthier women who they presume to be better nourished or more highly educated than their poorer counterparts, and thus are less likely to offer such services (or indeed, such women may themselves see such interventions as being unnecessary).

Figure 7.4.3 Mean QI scores by Wealth Quintile, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014

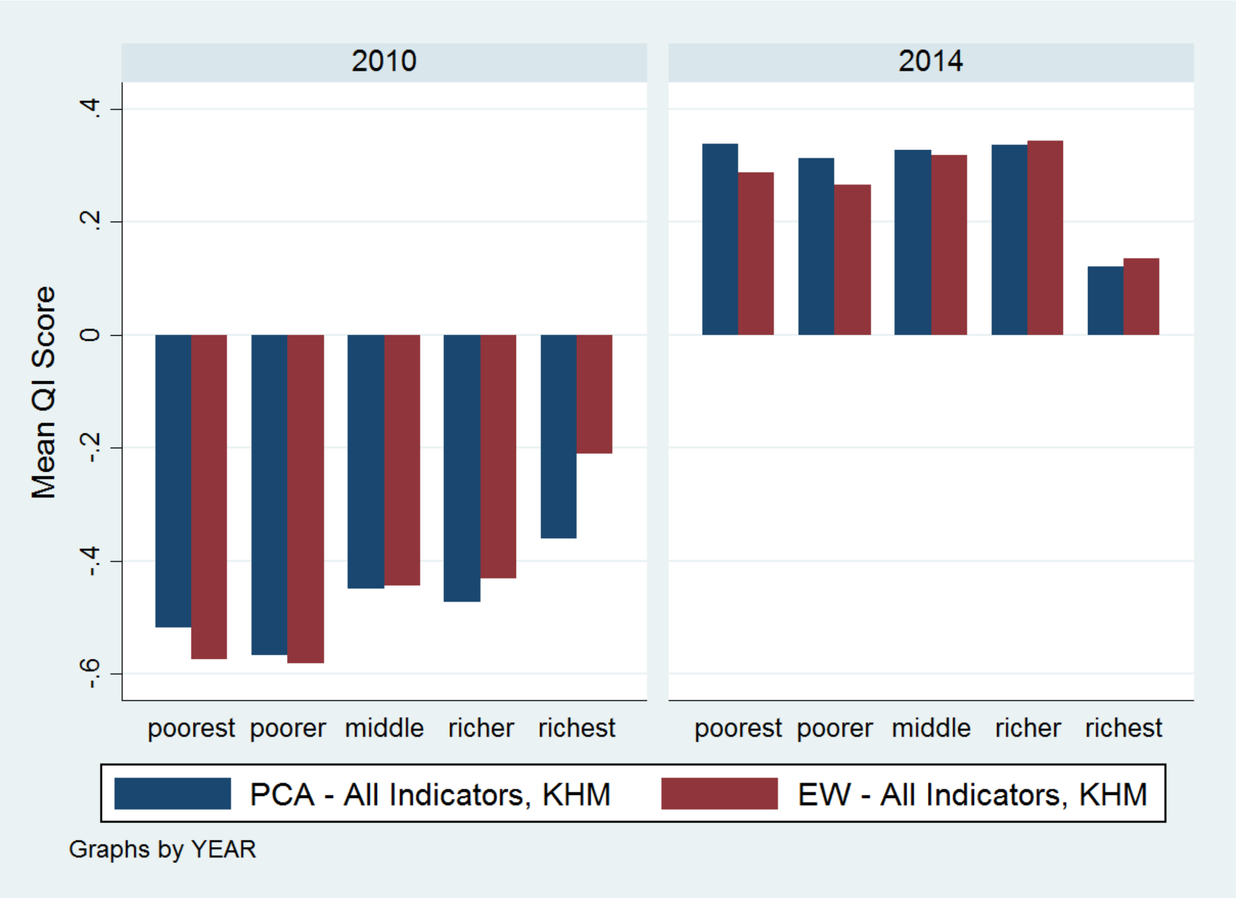
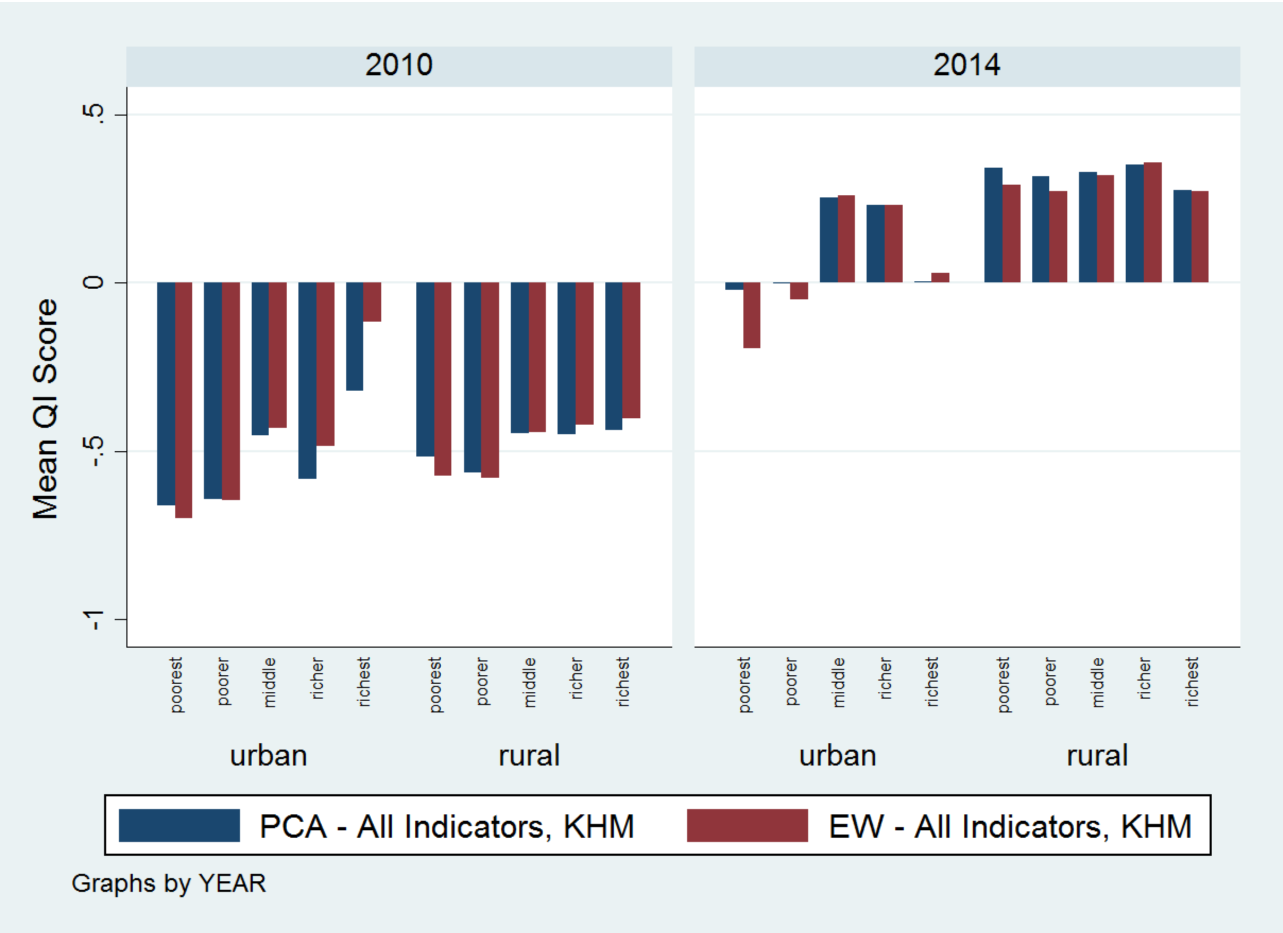


Figure 7.4.4 shows QI scores by both urban rural status and wealth quintile. While there is still an overall increase across all wealth quintiles between years, it is

evident that the increase in scores seen in rural areas is only matched by the middle and richer quintiles in urban areas. While the richest in both urban and rural areas have lower scores than the middle and richer quintiles, the difference is much greater in urban areas. The urban poor still have a distinct disadvantage in both PCA and EW derived QI, but the difference between the two weighting methods for these groups is strongly marked.

Figure 7.4.4 Mean QI scores by Wealth Quintile for Urban and Rural population, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014

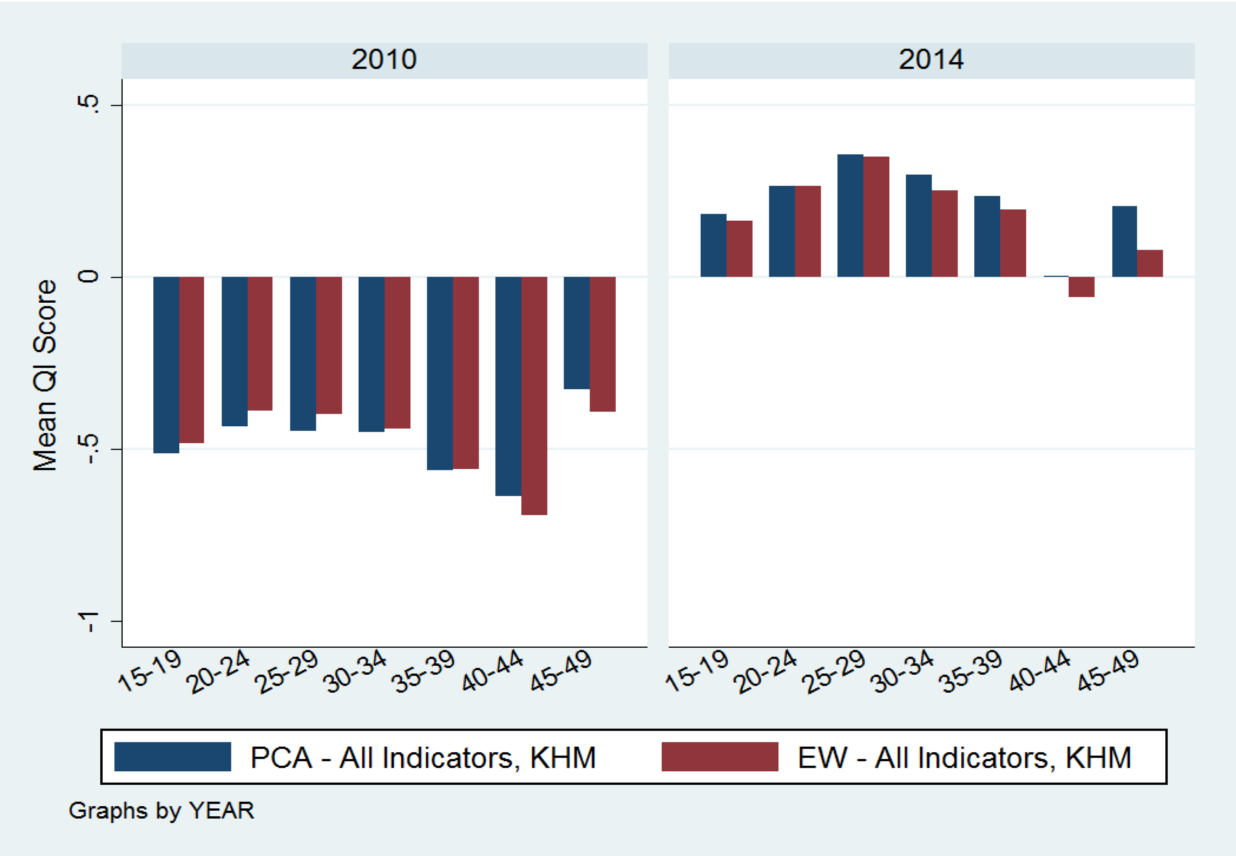


This does support that idea that variations in perceived need for services may be affecting delivery of PNC content, however it is also possible that these differences arise from variations in the type of provider utilised for maternal health care – as the PNC content indicators are not strongly time dependent women utilising community based PNC services may be more likely to receive these indicators than those whose PNC occurs almost entirely at the place of delivery. This will be considered when examining variation in QI score by provider type, in section 7.4.4.

7.4.2 Variation by Maternal Age and Education Level

Having a particularly young and fertile population, maternal age and parity are important factors to consider when looking at maternal health in Cambodia. As can be seen in Figure 7.4.5 both the 2010 sample and the 2014 sample show similar age based patterns of QI, where QI is lower for women at both older and younger ends of the spectrum (note that the 45+ age group had a total of 33 observations across both years, making it an unreliable estimate). While not strongly marked, this trend bears investigation, as these groups tend to carry a higher risk of pregnancy complications compared to those aged between 20 and 30 years.

Figure 7.4.5 Mean QI scores by Maternal Age at Birth, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014



In terms of parity, Figure 7.4.6 shows that while in 2010 QI scores were highest for first births, and decreased with each birth thereafter, by 2014 first births had a lower score than second or third births, although the high parity births (4+) were still notably lower than any other group. In fact, that 2014 trend roughly mirrors the age-related pattern – it is possible that similar underlying factors are affecting both sets of results.

Figure 7.4.6 Mean QI scores by Birth Order, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014

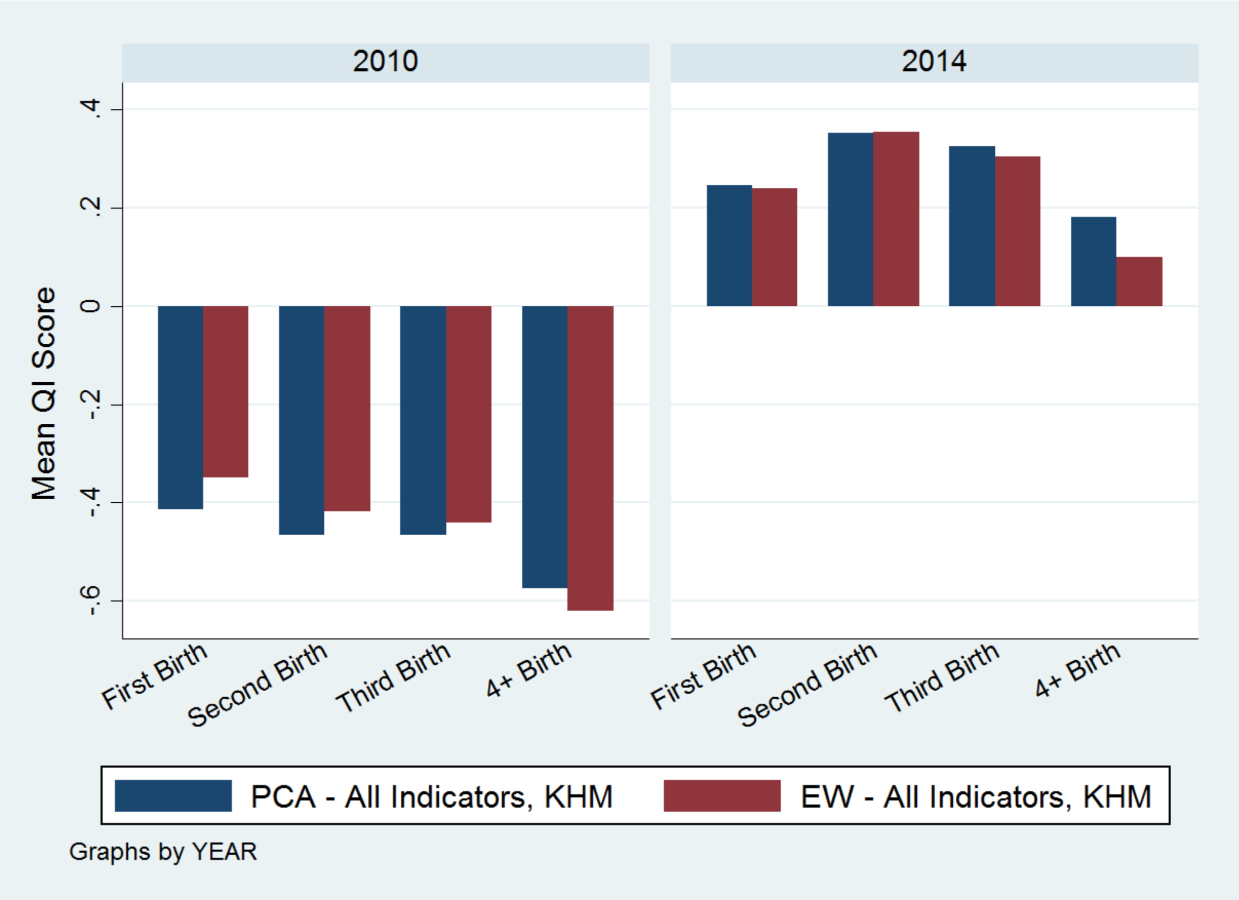
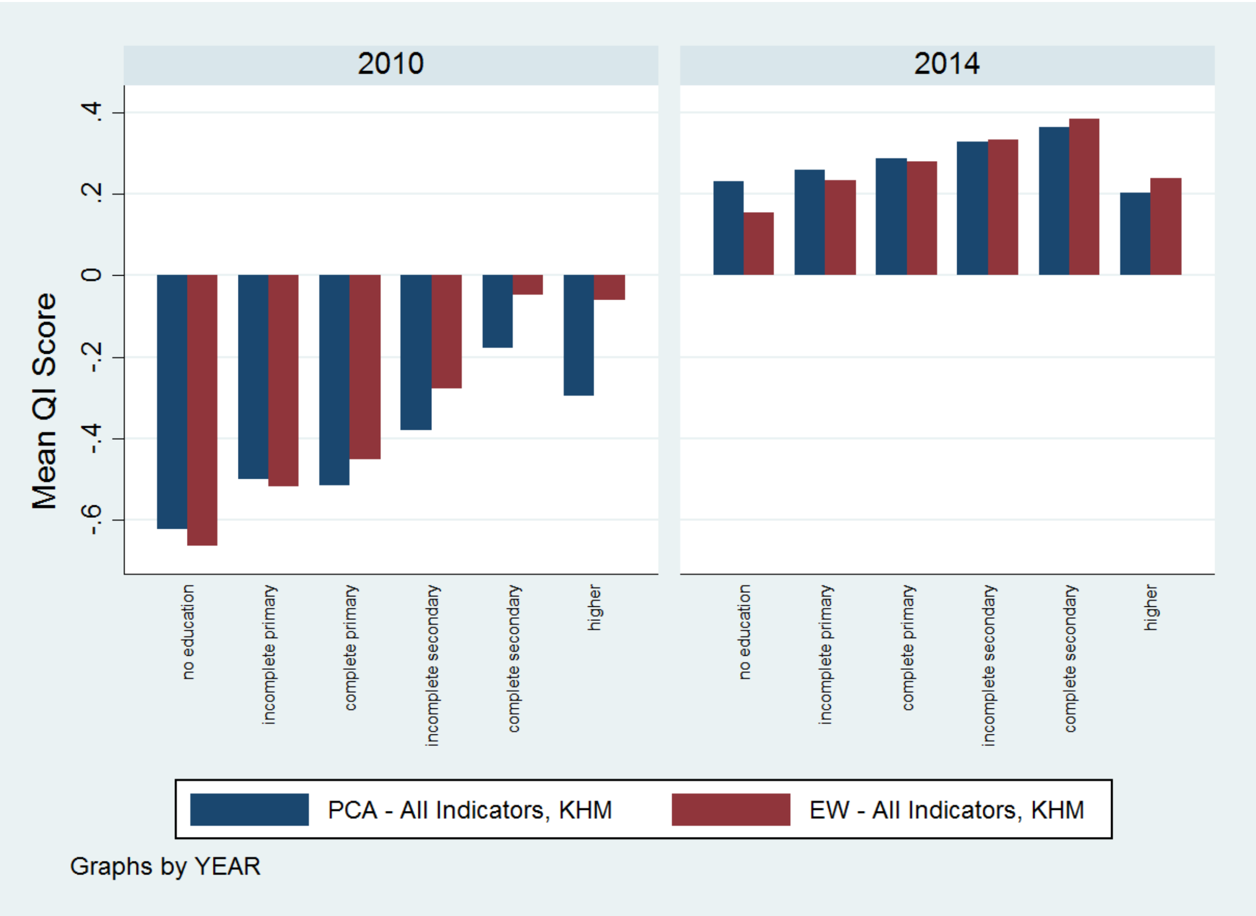


Figure 7.4.7 shows QI scores by educational attainment. Very interestingly the large difference between EW and PCA scores noted with relation to wealthier women in 2010 are also visible in terms of education; in particular those with complete secondary or higher education have higher scores on average, but score much lower in terms of PCA based QI than EW. This suggests that it is rich, urban, education women who were comparatively unlikely to receive PNC content indicators – a fact which strongly suggests an element of perceived lack of need for services may have been involved. By 2014 however the difference in EW and PCA based scores has almost disappeared, and while those with complete secondary education are still scoring the highest, those with higher education have lower scores than those with less than a primary education on both QI.

This is an unexpected result – while the higher education group is the smallest of the educational categories in terms of number of observations, it is by no means small enough that this result can be attributed to sampling error, and it does appear to correspond with the lower scores seen in terms of wealth for the 2014 sample. Again, it will be important to see if differences in the type of provider used by wealthy, educated women can explain the observed patterns.

Figure 7.4.7 Mean QI scores by Educational Attainment, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014



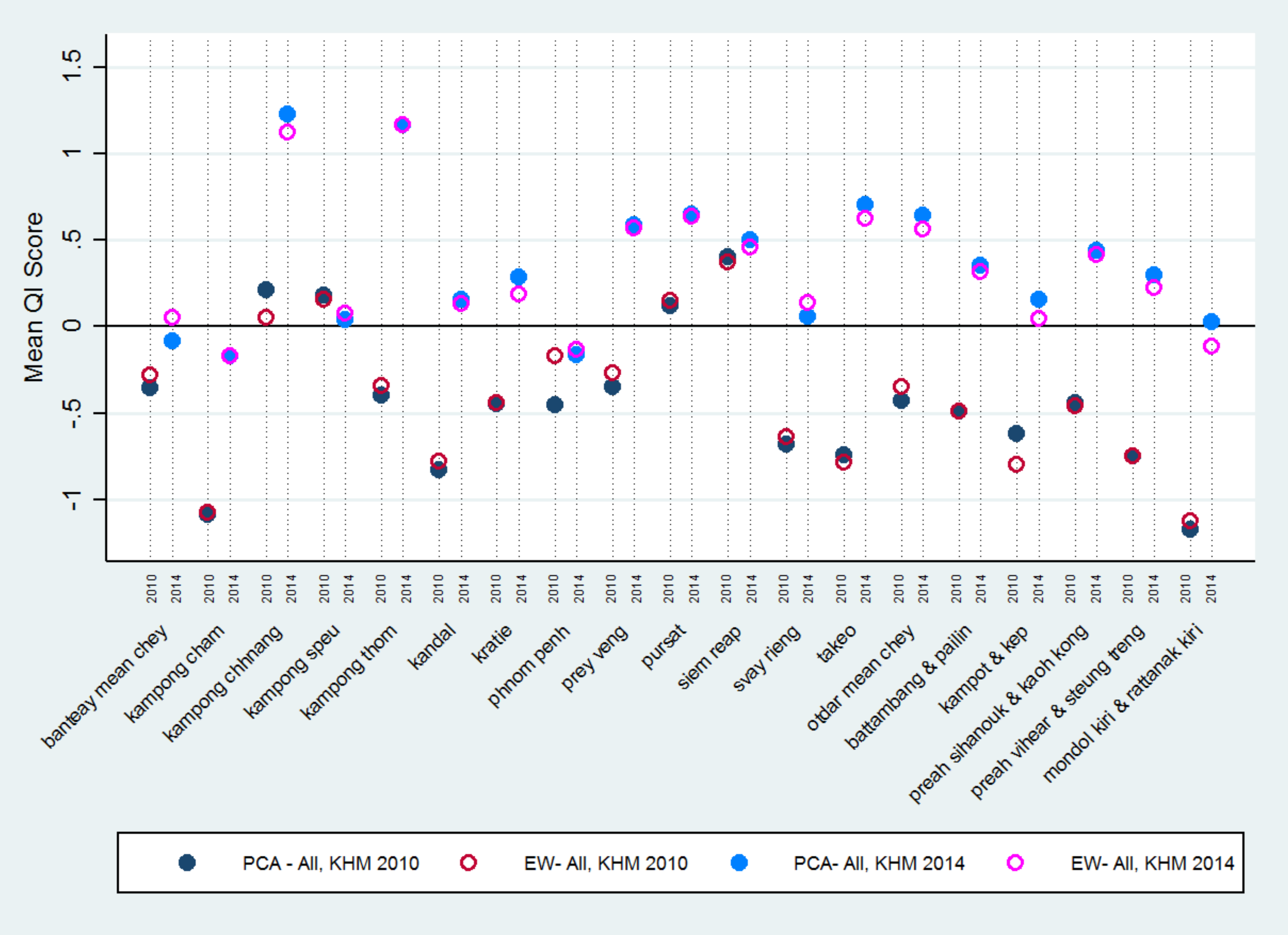
7.4.3 *Variation by Region*

It is possible that some of marked reversal of wealth and urban-rural trends seen at the national level may in fact be due variation in regions which are disproportionately poor or rural, as was the case in the Philippines and Indonesia. Similarly, given the previously demonstrated relationships between decentralisation and quality of health services in these countries, it is important to see if Cambodia also demonstrates substantial regional variation. Accordingly, Figure 7.4.8 shows the mean QI score by region and year.

In both time periods it is apparent that there are substantial differences in QI across regions, although the pattern of scores is very different between periods. Most regions have shown improvements in QI score between 2010 and 2014, however extent of the improvement within differing region is highly variable. For example, in 2010 Siem Reap, Kampong Speu, Kampong Chhnang and Pursat all scored relatively highly, but by 2014 only Kampong Chhnang remained as a top scoring region; indeed, the mean QI scores for Kampong Speu appear to have actually decreased between survey rounds. In contrast, Kampong Thom was an average scoring region in 2010 but was one of the best performers alongside Kampong Chhnang in 2014.

Similarly the poor performing regions of Kampong Cham and Mondol Kiri & Rattanak Kiri saw increases in scores large enough to place them at a higher score than Phnom Penh. The relatively poor performance of Phnom Penh in both survey rounds is in itself an remarkable finding – indeed, in terms of the 2014 QI scores Phnom Penh is the lowest scoring province. While the earlier analyses of QI by wealth and education suggest that there are some aspects of the QI indicators that richer and more educated women are less likely to receive – and Phnom Penh is considerably richer and more educated than the rest of the country - this still represents a remarkable shift from the expected dynamics within the country.

Figure 7.4.8 Mean QI scores by Region and Year, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014



Indeed, as we can see in Figures 7.4.9 and 7.4.10 which provide a visual overview of QI scores by region, there have been large increases across many of the regions that are most distant from the capital region surrounding Phnom Penh. As these regions are predominantly rural is difficult at this point to determine if the increases in rural QI score are due to these regions improving service delivery as a result of increasing decentralisation, or if more general policies targeting rural areas as a whole are leading to more rural regions experiencing greater benefits than their urban counterparts.

Figure 7.4.9 Map of mean QI scores by Region using PCA with All Pooled Indicators, Cambodia 2010

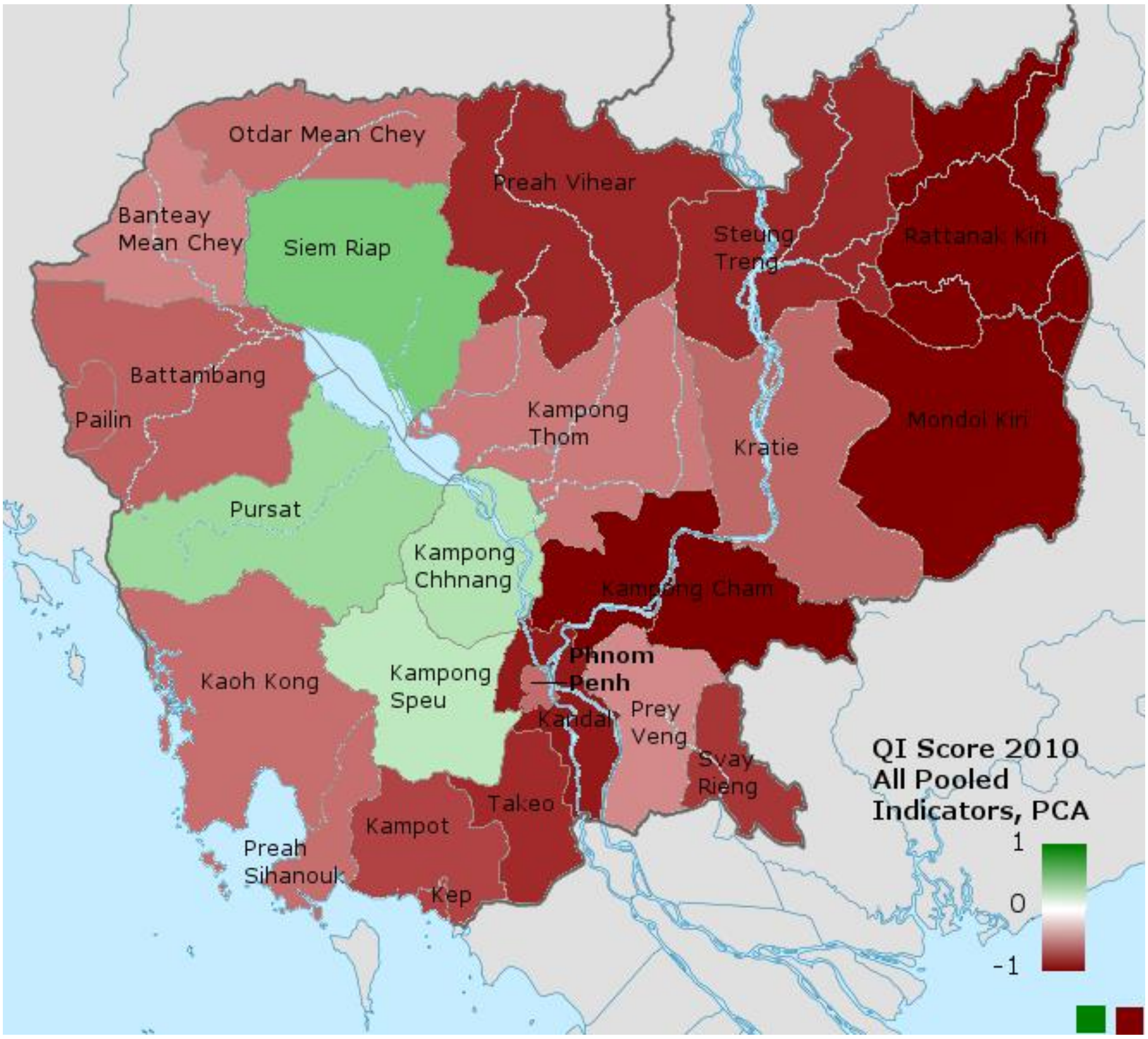
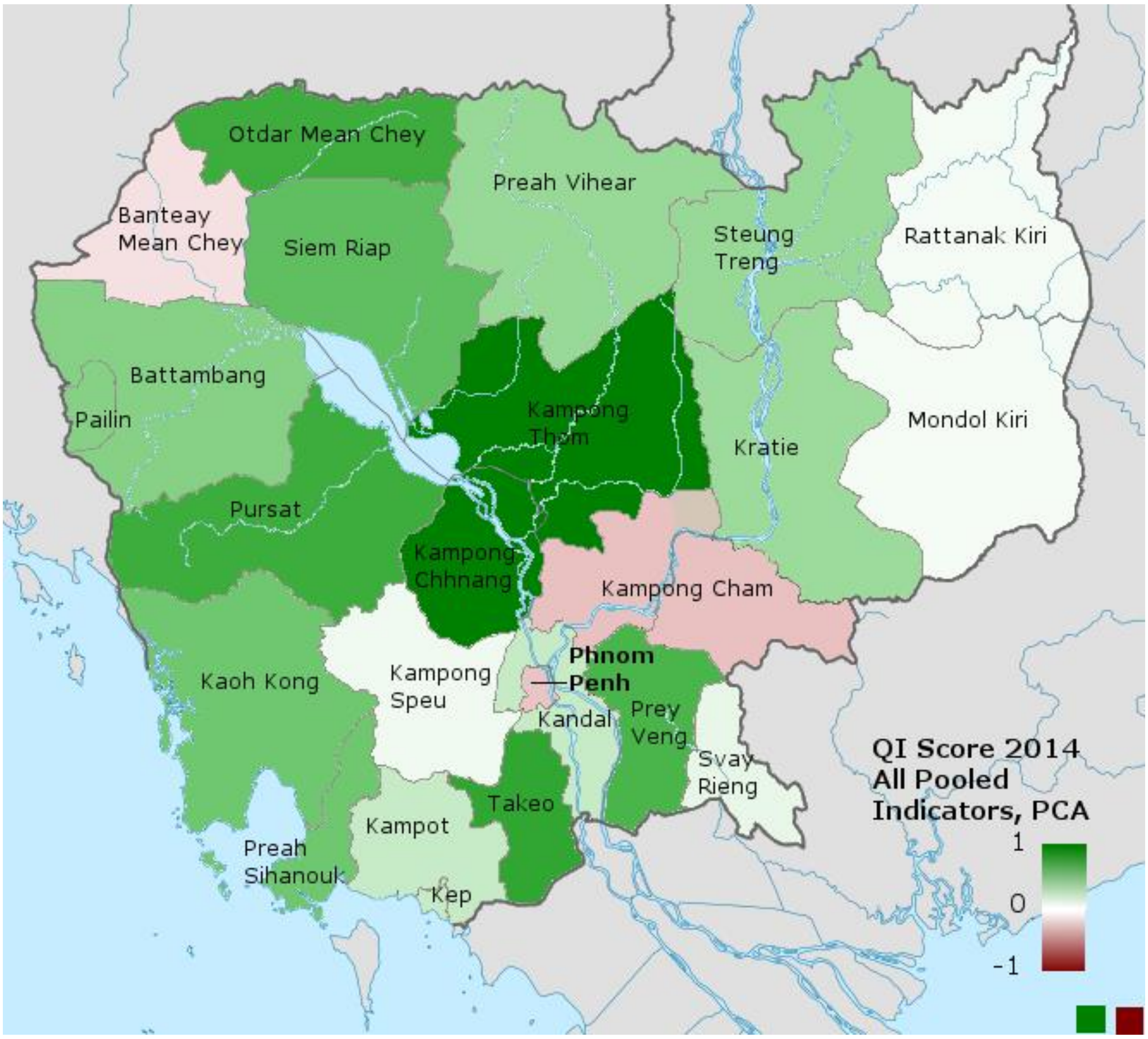


Figure 7.4.10 Map of mean QI scores by Region using PCA with All Pooled Indicators, Cambodia 2014

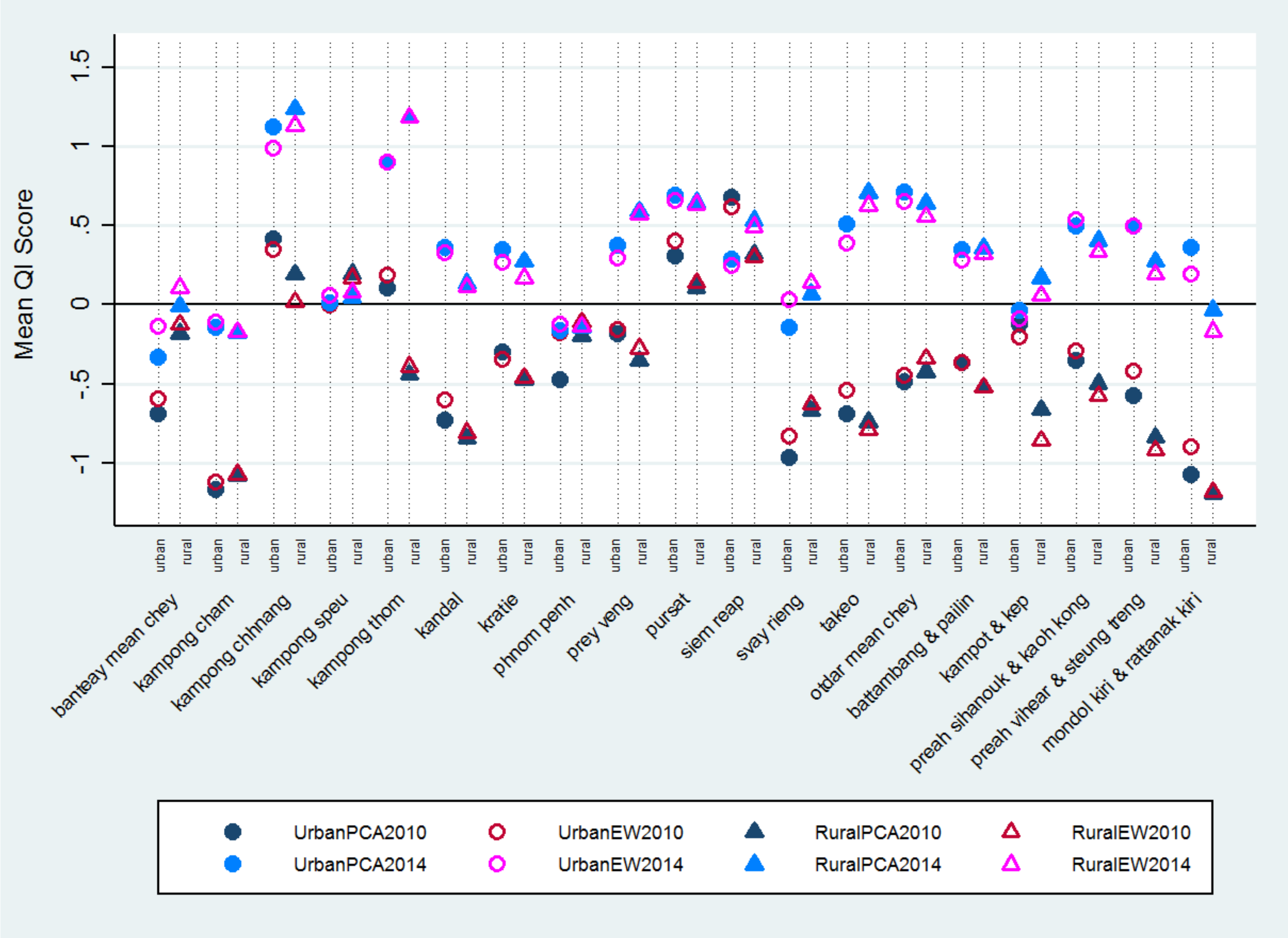


Similarly, at this point it is not clear if given Phnom Penh's disproportionately large richer and more educated population if there is truly a marked wealth and education based differential in QI scores or if wealth (particularly in the 2014 sample) is acting as a proxy for residence in the capital, and other factors related to health service delivery are affecting quality of care.

To explore the urban-rural issue, Figure 7.4.11 demonstrates that while there were a few provinces (such as Kampong Chhnang, Kampong Thom, Prey Veng and Kampot & Kep) in which the increase in QI score was much greater in rural areas, in most cases the magnitude of the increase was similar across the urban-rural divide. The lack of a consistent rural trend across regions does support the notion that it is regional rather than specifically rural factors driving quality improvements in these areas.

It should be noted however that Phnom Penh is by far the largest city in Cambodia with more than 1.5 million residents – Battambang city, the next largest population centre has an estimated population of less than 200 000. As such, the factors effecting urban areas outside the capital are likely to be very different, and it is possible that non-capital urban areas are more similar to rural areas in terms of the determinants of quality care.

Figure 7.4.11 Mean QI scores by Region for Urban and Rural Populations, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014



7.4.4 *Variation by Provider Type*

As there were a number of wide-ranging changes to health policy and planning that were implemented in Cambodia throughout the period covered by these surveys, it is useful to further examine how QI scores vary based upon how and where maternal and neonatal services are provided in order to understand how these policies may have interacted with regionally specific factors to lead to these results.

As can be seen in Figure 7.4.12, all types of SBA providers saw increases in QI scores between 2010 and 2014. Public facilities scored highest in both years, followed by Private facilities and then Home SBA, with Public Non-Hospital deliveries seeing the largest improvement between the surveys to become the best performer in 2014. As the most common place of delivery in both survey periods were PHCs (the overwhelming majority of Public Non-Hospital care), followed by various types of public hospitals, it is likely that these increases in quality within the public sector may be driving the overall positive trend in QI scores across the sample.

Figure 7.4.12 Mean QI scores by SBA Provider, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014

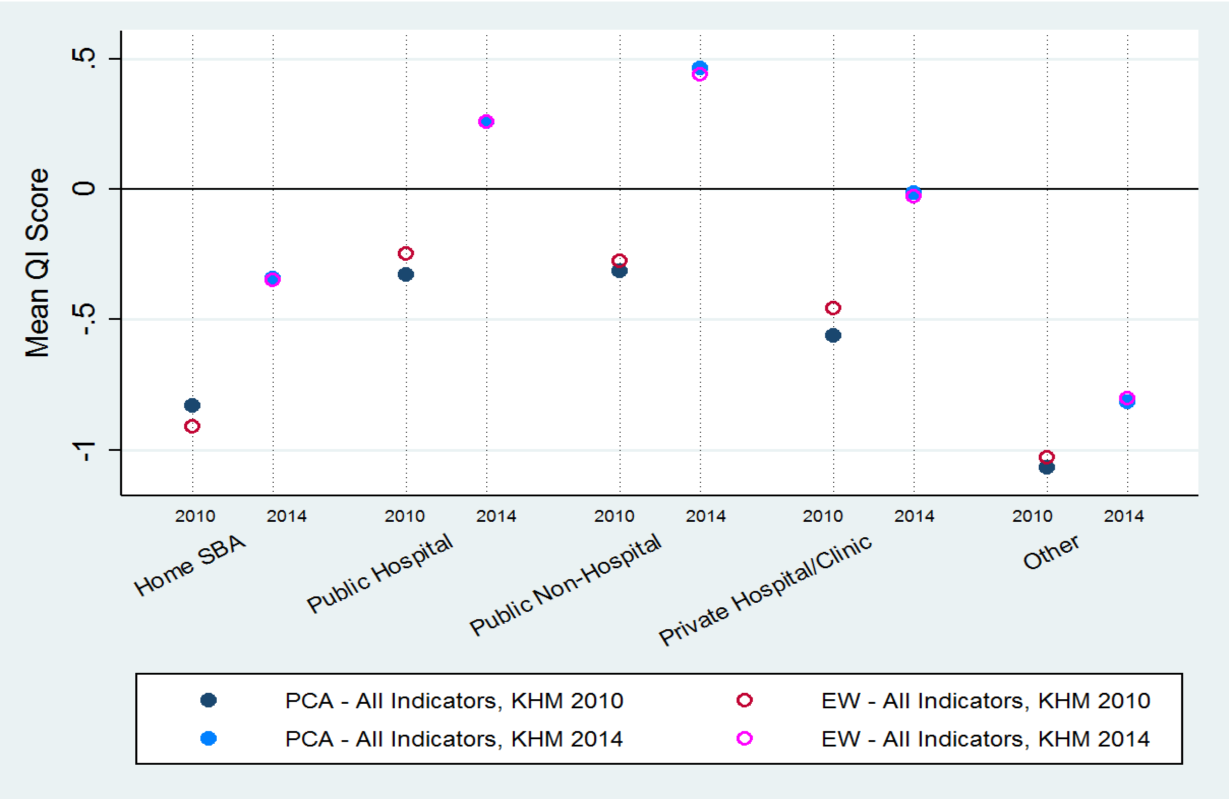
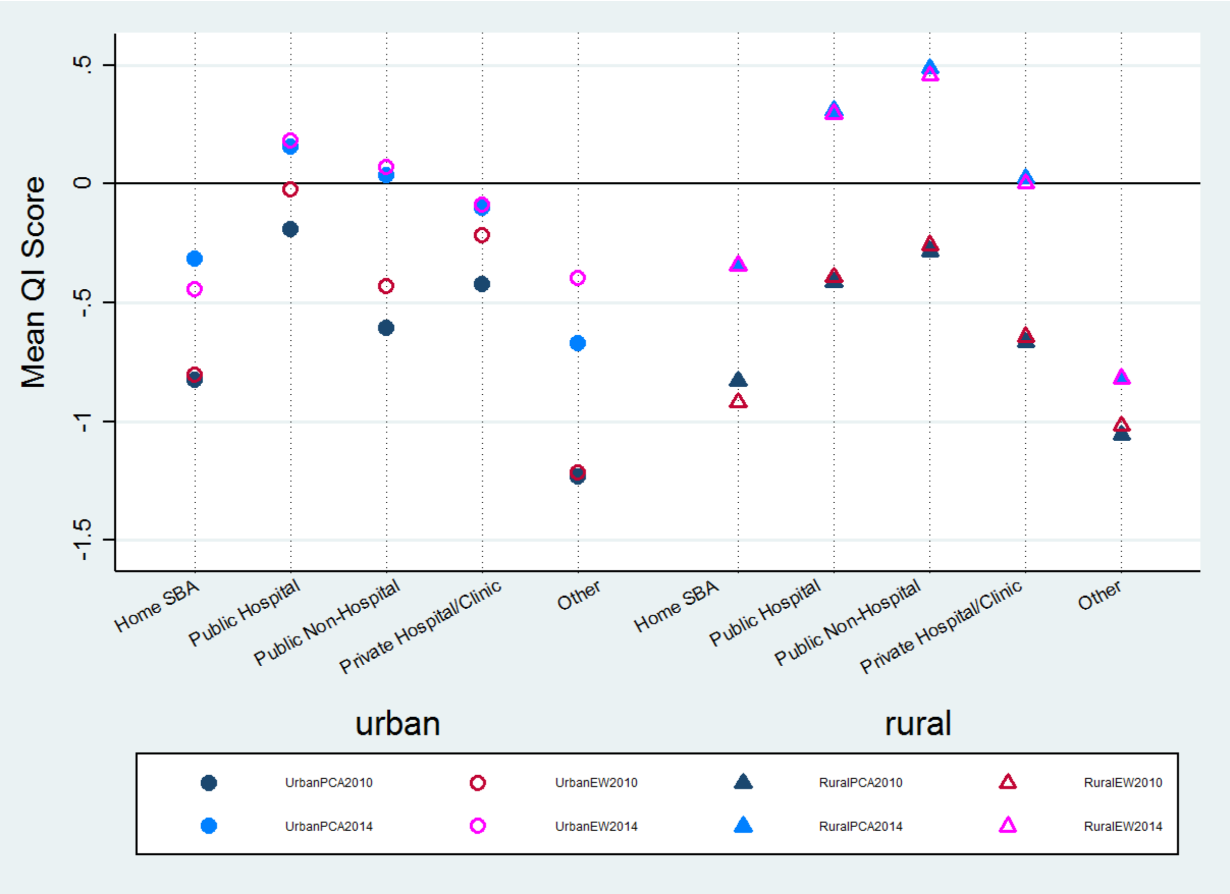


Figure 7.4.13 Mean QI scores by SBA Provider for Urban and Rural Populations, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014



Breaking these scores down further to examine urban/rural differences in Figure 7.4.13, we can see that it is again rural facilities that have experienced the greatest improvement – while the best scores in 2010 occurred in urban Public Hospitals, in 2014 it is rural PHCs that outperform the other provider types. Urban PHCs also saw a very large increase in scores, although as they started from a much lower mean in 2010 they still score lower than public hospitals. In fact, rural PHCs in 2010 were the second highest scoring group overall, with only urban public hospitals scoring higher – the fact that they have also shown the largest increases in QI score appears to reflect the importance placed upon primary health facilities by government initiatives to increase access to, and quality of, healthcare.

In terms of wealth, Figure 7.4.14 shows that while some facilities, such as Public Hospitals, showed a marked bias towards richer quintiles in 2010, QI scores did not always increase with wealth. By 2014, with the exception of Home based SBA, QI scores were generally far more equitable. However the decrease in QI scores for the richest compared to the richer quintiles in the sample overall is also visible across all facility types, although it is less marked with regards to public non-hospital deliveries. This strengthens the likelihood that if there is a difference in the standard of care received by those at the very top of the wealth spectrum it is not due to differences in choice of provider, as was the case in the Philippines, but may instead be a generalised effect of either wealth or residence in the relatively wealthier region of Phnom Penh.

This interaction between provider type and region is further explored in Figure 7.4.15. Again, while overall scores generally improved between survey periods there was substantial regional variation in trends. In Siem Reap for example the QI scores for Private Hospitals actually declined while those for public facilities rose slightly. In Banteay Mean Chey and Prey Veng the overall difference between provider types remained similar, but the mean scores rose as a whole. In Takeo the difference between Public and Private providers widened substantially while in Kampong Thom the difference in QI scores between facility based delivery providers seen in 2010 almost disappears as they achieve the highest regional scores. This variation in regional trends in quality of care, particularly for public providers, further supports the notion that decentralisation of the Cambodian health system may be contributing to the remarkable 2014 QI results.

Figure 7.4.14 Mean QI scores by SBA Provider and Wealth Quintile, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014

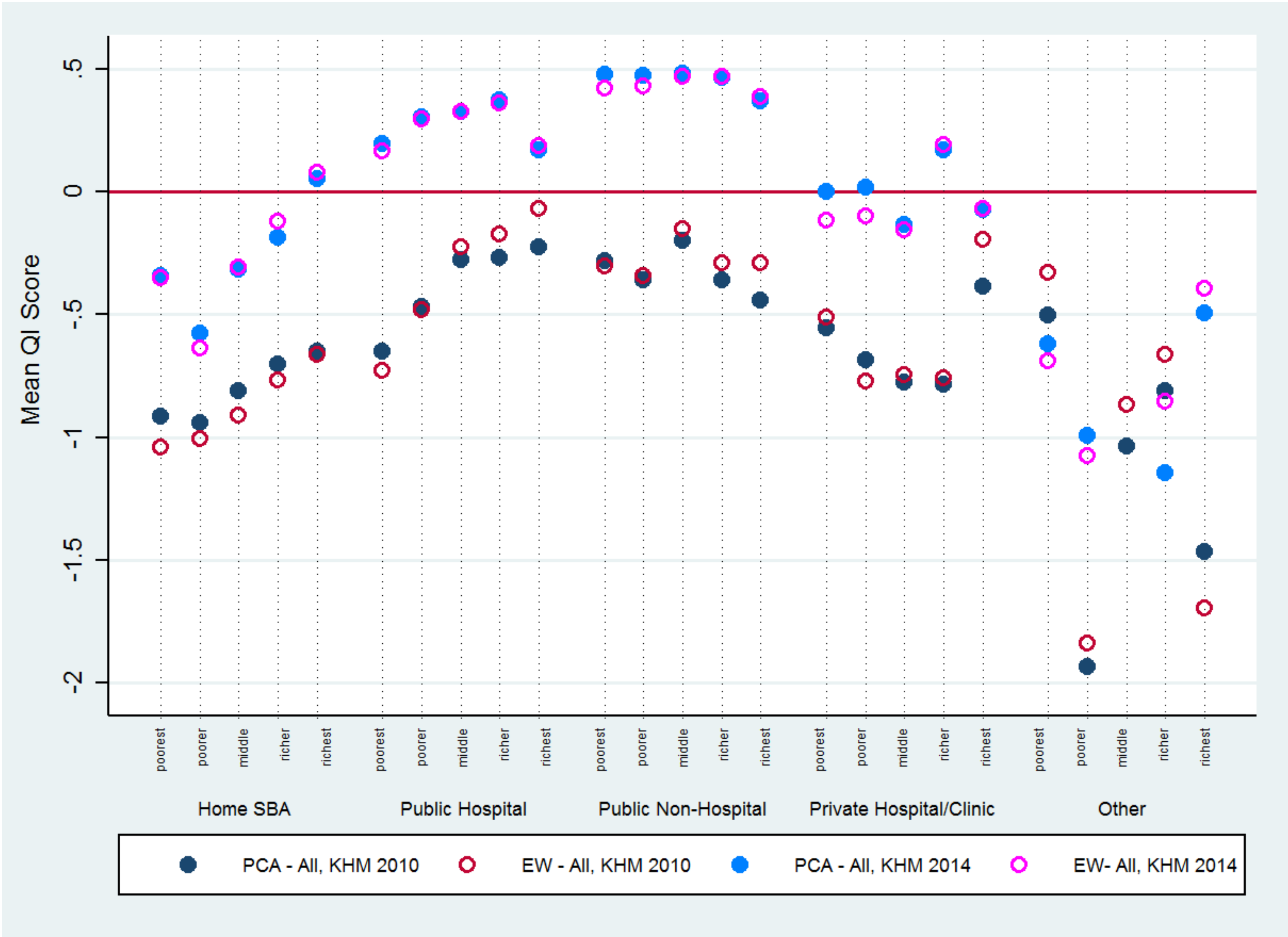
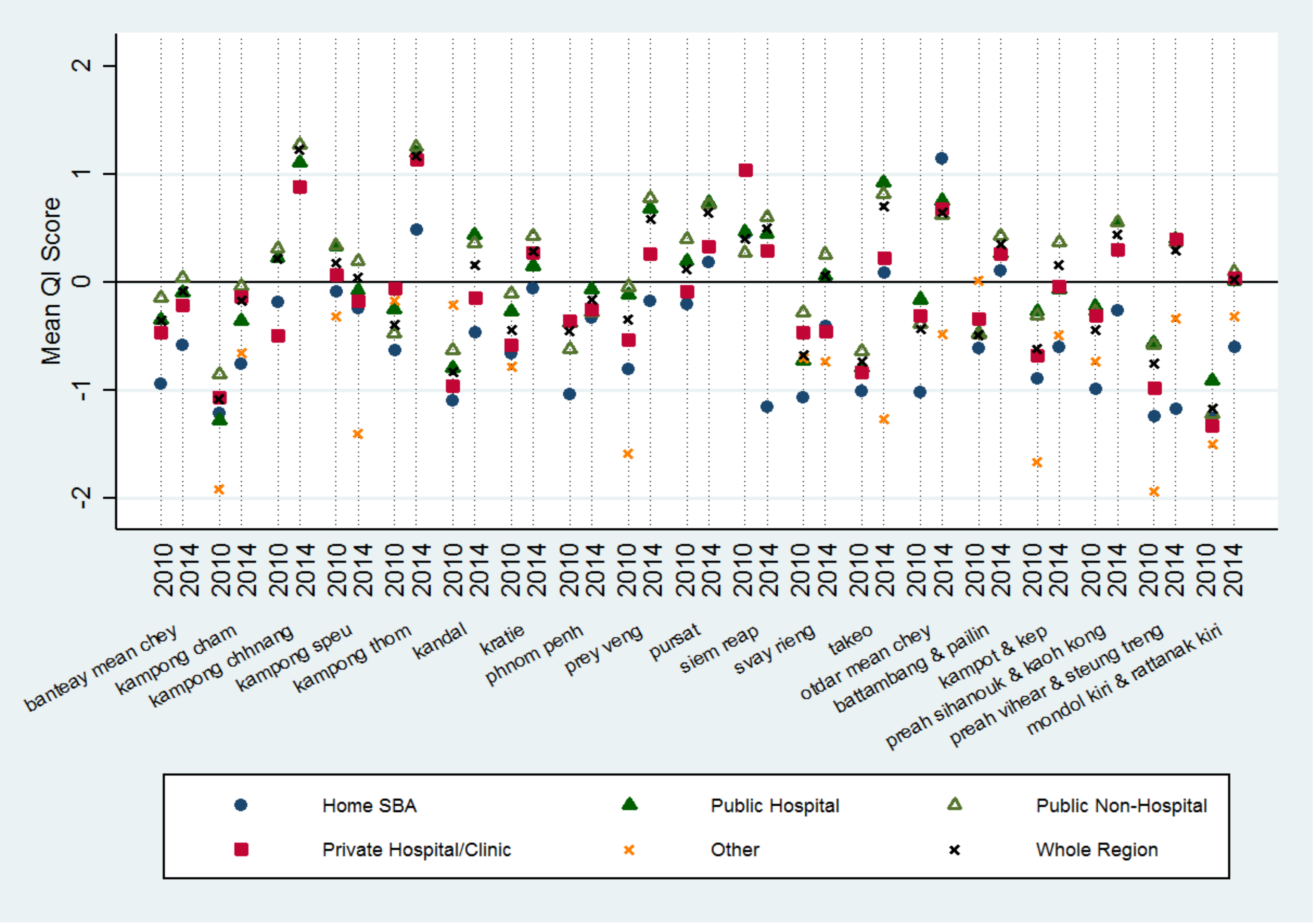


Figure 7.4.15 Mean QI scores by SBA Provider and Region, using PCA and EW based QI with All Pooled Indicators, Cambodia 2010-2014



One important note to consider when examining the change in provider based scores, particularly with regards to regions, is that the proportion of SBA deliveries occurring outside a facility dropped substantially between 2010 and 2014. In 2010 just over three quarter of all SBA deliveries were facility based, compared to 93% in 2014; this increase is generally attributed to the large number of government initiatives aimed at increasing access to primary health services and in particular programs such as the Maternal Voucher scheme that explicitly promote facility based delivery.

Figure 7.4.16 Proportion of women using SBA provider type by Region – Cambodia 2010

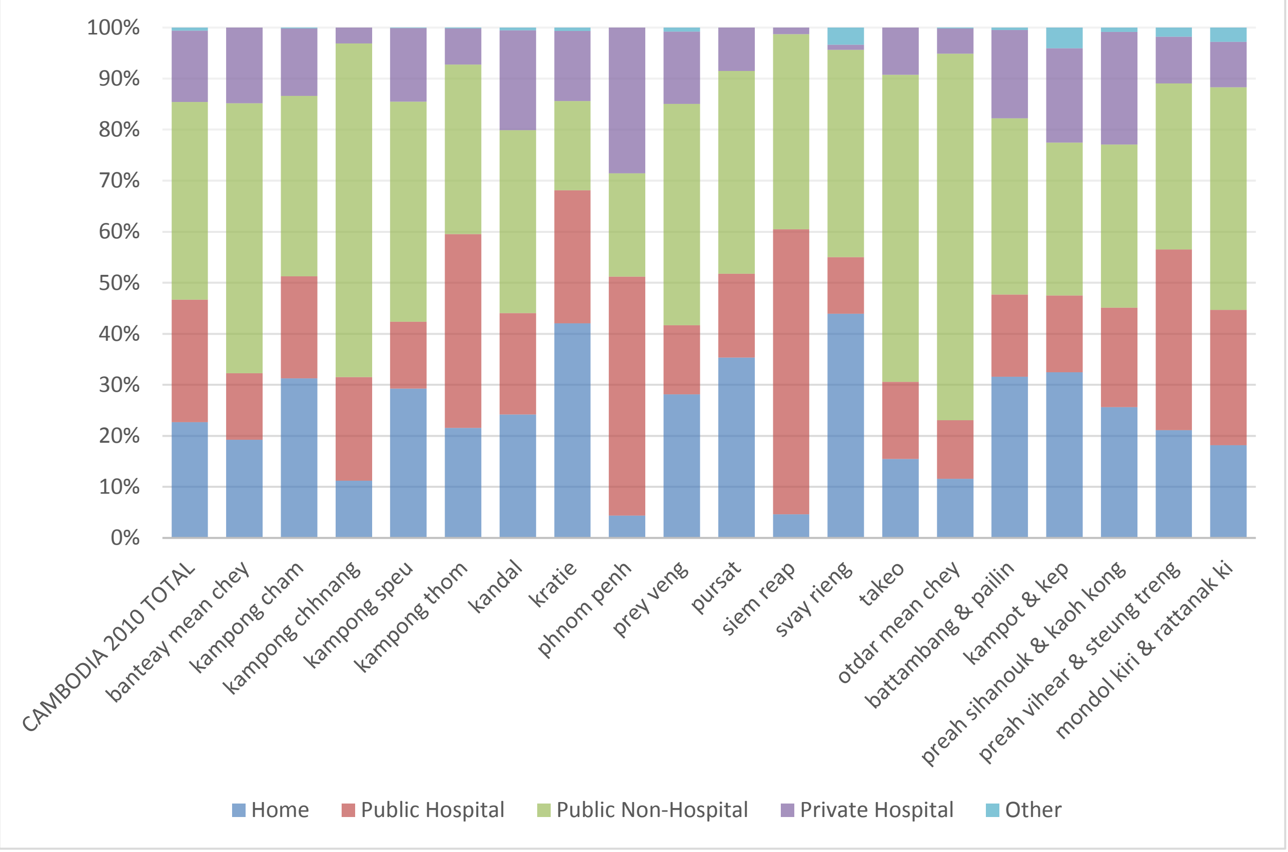
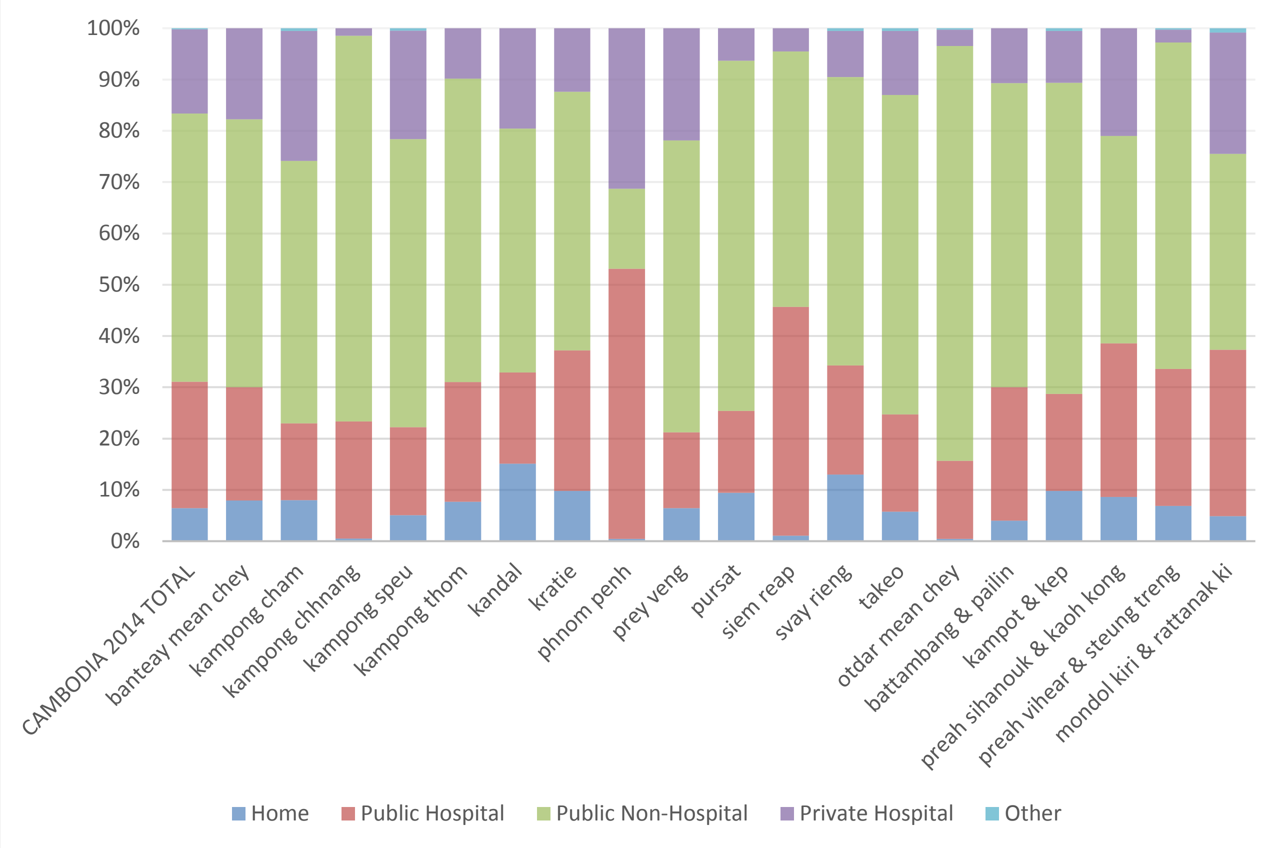


Figure 7.4.17 Proportion of women using SBA provider type by Region – Cambodia 2014



As can be seen in Figure 7.4.16 and 7.4.17 which show the proportion of SBA deliveries occurring for each type of provider by region, the number of observations for home SBA in 2014 is too small to produce reliable estimates for any but the most general of sub-categories. At the same time when looking at differences in place of delivery between the two surveys, it is apparent that the vast bulk of the increase in FBD occurred at PHCs (overall the proportions of observations with a Home SBA decreased from 20% to 5% at the same time the proportion of Non-Hospital deliveries increased from 37% to 49%).

This makes the fact that Public-Non-Hospital scores either maintained their quality or improved over the period particularly impressive, as it suggests that care improved despite increased service loads. From a policy perspective, this is an important finding, as it suggests that efforts to strengthen these services not only appear to be working, but are contributing to an overall increase in quality of care.

7.5 Linear Regression Results

Following the example set out in Chapter 4, multivariate regression techniques were used to further explore the factors affecting QI scores, and in particular help disentangle the effect of underlying differences in wealth, education, urban residence and region on overall scores. Additionally, because data from two time points were available, where applicable an additional dummy variable representing the year of survey was also included.

Weighted regression was carried out using the QI score based on all indicators and PCA based weighting. The decision on which category within each variable was to be used as the reference category, was complicated by the fact that for several of the variables the lowest scoring category differs between the two surveys and that some categories (such as Other SBA provider) contained too few observations to reliably act as a reference. A decision was therefore made that age, education and wealth (for which levels are based on quantities of the underlying variable) the lowest category would be used, while for the remaining categories (which contained no implicit measurement) the lowest scoring category in 2010 would be used as the standard unless the number of observations was too low, in which case the next lowest scoring group was used instead.

Table 7.5.1 and 7.5.2 show the results of the individual variable regressions and initial multivariate models for each survey round. For the 2010 DHS Rural-Urban status, Parity, Maternal Education, SBA provider, Wealth and Region all individually are produce models that are significant at the p=0.05 level; differences between Maternal age categories in contrast are not significant. Indeed, region is by far the greatest explanatory variable in 2010, with the next highest proportion of variance explained by SBA provider. In 2014 Maternal Education is no longer significant while Maternal Age is; the proportion of variance explained by the individual models is however similar in pattern, with region and SBA provider having the largest r-squared values.

Table 7.5.1 Results of Linear Regression of Individual and Multiple variables against PCA based QI score with All Indicators, Cambodia 2010

2010		**Individual Regression**						**Multiple Regression**			
CATEGORY	**N**	**Coef**	**P>t**	**(95%CI)**		***R-Sqr***	***Prob-F***	**Coef**	**P>t**	**(95%CI)**	
RURAL-URBAN											
Urban	1537	0.103	0	0.034	0.172			-0.024	0.59	-0.109	0.062
Rural	2812	(base)				*0.002*	*0.004*	(base)			
AGE											
15-19	335	(base)				*0.003*	*0.272*	(base)			
20-24	1373	0.077	0.259	-0.057	0.21			0.083	0.186	-0.040	0.205
25-29	1466	0.064	0.342	-0.068	0.195			0.111	0.092	-0.018	0.241
30-34	588	0.062	0.438	-0.095	0.219			0.19	0.018	0.033	0.348
35-39	409	-0.051	0.551	-0.219	0.117			0.07	0.426	-0.102	0.241
40-44	161	-0.126	0.287	-0.358	0.106			0.142	0.238	-0.094	0.377
45-49	17	0.186	0.563	-0.445	0.817			0.181	0.636	-0.568	0.929
EDUCATION											
No education	522	(base)				*0.002*	*0.205*	(base)			
Incomplete primary	1824	0.123	0.049	0	0.245			0.151	0.006	0.044	0.257
Complete primary	431	0.108	0.161	-0.043	0.26			0.222	0.001	0.086	0.359
Incomplete secondary	1285	0.244	0	0.12	0.369			0.289	0	0.170	0.408
Complete secondary	169	0.446	0	0.234	0.657			0.45	0	0.250	0.651
Higher Education	118	0.329	0.001	0.132	0.525			0.363	0	0.182	0.545

Table 7.5.1 Cont.

WEALTH											
Poorest	654	(base)				*0.006*	*0.001*	(base)			
Poorer	676	-0.048	0.442	-0.172	0.075			-0.027	0.62	-0.133	0.079
Middle	749	0.069	0.265	-0.052	0.19			0.08	0.139	-0.026	0.185
Richer	945	0.045	0.435	-0.069	0.159			0.054	0.33	-0.055	0.162
Richest	1325	0.157	0.003	0.053	0.262			0.126	0.06	-0.005	0.258
REGION											
banteay mean chey	215	0.814	0	0.619	1.01			0.791	0	0.594	0.989
kampong cham	218	0.083	0.336	-0.086	0.252	*0.108*	*0*	0.105	0.233	-0.067	0.277
kampong chhnang	274	1.384	0	1.213	1.555			1.331	0	1.156	1.505
kampong speu	243	1.35	0	1.176	1.524			1.32	0	1.143	1.497
kampong thom	185	0.775	0	0.59	0.96			0.762	0	0.577	0.947
kandal	257	0.34	0	0.163	0.517			0.311	0.001	0.132	0.489
kratie	167	0.724	0	0.554	0.895			0.745	0	0.570	0.919
phnom penh	338	0.717	0	0.564	0.871			0.545	0	0.374	0.716
prey veng	199	0.825	0	0.623	1.026			0.839	0	0.637	1.041
pursat	188	1.286	0	1.107	1.466			1.321	0	1.142	1.501
siem reap	271	1.572	0	1.401	1.742			1.512	0	1.335	1.689
svay rieng	269	0.49	0	0.31	0.67			0.565	0	0.387	0.743
takeo	262	0.43	0	0.265	0.595			0.366	0	0.195	0.538
otdar mean chey	222	0.739	0	0.546	0.932			0.672	0	0.477	0.867
battambang & pailin	214	0.678	0	0.498	0.859			0.666	0	0.482	0.85
kampot & kep	183	0.553	0	0.352	0.755			0.581	0	0.382	0.779

Table 7.5.1 Cont.

preah sihanouk & kaoh kong	283	0.73	0	0.555	0.904			0.721	0	0.545	0.897
preah vihear & steung treng	152	0.419	0	0.197	0.642			0.401	0	0.186	0.616
mondol kiri & rattanak kiri	209	(base)				*0.201*	*0*	(base)			
Home SBA	887	(base)				*0.04*	*0*	(base)			
Public Hospital/Clinic	1167	0.502	0	0.398	0.607			0.32	0	0.218	0.422
Public Non-Hospital/Clinic	1609	0.513	0	0.418	0.608			0.44	0	0.350	0.53
Private Hospital/Clinic	656	0.268	0	0.155	0.381			0.19	0.001	0.075	0.305
Other	30	-0.238	0.206	-0.608	0.131			-0.264	0.227	-0.693	0.164
PARITY											
1st Birth	1528	0.162		0.058	0.266			0.126	0.048	0.001	0.251
2nd Birth	1292	0.11		0.001	0.219			0.106	0.076	-0.011	0.223
3rd Birth	746	0.109		-0.013	0.232			0.079	0.187	-0.038	0.197
4+ Birth	783	(base)				*0.003*	*0.025*	(base)			
_cons								-1.698	0	-1.922	-1.47
TOTAL	**4349**							**R-Sqr**	0.25		0

Table 7.5.2 Results of Linear Regression of Individual and Multiple variables against PCA based QI score with All Indicators, Cambodia 2014

2014		**Individual Regression**						**Multiple Regression**			
CATEGORY	**N**	**Coef**	**P>t**	**(95%CI)**		***R-Sqr***	***Prob-F***	**Coef**	**P>t**	**(95%CI)**	
RURAL-URBAN											
Urban	1547	-0.283	0	-0.349	-0.22			-0.041	0.59	-0.122	0.04
Rural	3550	(base)				*0.013*	*0*	(base)			
AGE											
15-19	475	(base)				*0.006*	*0.013*	(base)			
20-24	1568	0.081	0.184	-0.039	0.202			0.034	0.532	-0.073	0.142
25-29	1605	0.174	0.004	0.054	0.293			0.129	0.031	0.012	0.245
30-34	955	0.117	0.081	-0.014	0.248			0.142	0.035	0.010	0.273
35-39	340	0.054	0.547	-0.122	0.23			0.124	0.152	-0.045	0.293
40-44	138	-0.177	0.2	-0.449	0.094			-0.107	0.367	-0.338	0.125
45-49	16	0.024	0.921	-0.446	0.494			0.356	0.179	-0.164	0.876
EDUCATION											
No education	537	(base)				*0.002*	*0.205*	(base)			
Incomplete primary	1948	0.026	0.657	-0.089	0.142			0.074	0.144	-0.025	0.174
Complete primary	516	0.055	0.481	-0.098	0.209			0.16	0.015	0.031	0.289
Incomplete secondary	1627	0.098	0.101	-0.019	0.214			0.227	0	0.117	0.338
Complete secondary	254	0.133	0.116	-0.033	0.298			0.258	0.001	0.102	0.414
Higher Education	215	-0.03	0.757	-0.218	0.158			0.229	0.012	0.050	0.408

Table 7.5.2 Cont.

WEALTH											
Poorest	906	(base)				*0.009*	*0*	(base)			
Poorer	914	-0.026	0.644	-0.139	0.086			-0.023	0.634	-0.117	0.071
Middle	848	-0.011	0.834	-0.117	0.094			0.049	0.311	-0.046	0.145
Richer	1000	-0.002	0.978	-0.107	0.104			0.086	0.091	-0.014	0.186
Richest	1429	-0.218	0	-0.318	-0.12			0.051	0.401	-0.068	0.171
REGION											
banteay mean chey	248	-0.11	0.202	-0.28	0.059			-0.124	0.148	-0.293	0.044
kampong cham	297	-0.199	0.024	-0.372	-0.03	*0*	*0*	-0.172	0.05	-0.343	0
kampong chhnang	264	1.199	0	1.052	1.346			1.109	0	0.956	1.262
kampong speu	300	0.014	0.867	-0.146	0.174			-0.022	0.788	-0.183	0.139
kampong thom	234	1.142	0	0.992	1.291			1.127	0	0.975	1.278
kandal	244	0.127	0.193	-0.064	0.318			0.139	0.145	-0.048	0.325
kratie	239	0.259	0.002	0.091	0.427			0.262	0.002	0.095	0.429
phnom penh	357	-0.188	0.015	-0.34	-0.04			-0.206	0.01	-0.364	-0.05
prey veng	257	0.56	0	0.388	0.732			0.547	0	0.377	0.717
pursat	281	0.621	0	0.443	0.8			0.601	0	0.421	0.781
siem reap	278	0.473	0	0.31	0.637			0.459	0	0.294	0.624
svay rieng	265	0.033	0.703	-0.137	0.204			0.036	0.677	-0.135	0.207
takeo	238	0.679	0	0.513	0.845			0.61	0	0.444	0.775
otdar mean chey	286	0.618	0	0.451	0.784			0.529	0	0.359	0.698
battambang & pailin	257	0.33	0	0.157	0.502			0.264	0.003	0.090	0.437
kampot & kep	222	0.127	0.157	-0.049	0.302			0.083	0.349	-0.091	0.257

Table 7.5.2 Cont.

preah sihanouk & kaoh kong	310	0.413	0	0.253	0.574			0.423	0	0.265	0.582
preah vihear & steung treng	256	0.27	0.004	0.088	0.451			0.247	0.005	0.073	0.421
mondol kiri & rattanak kiri	264	(base)				*0.19*	*0*	(base)			
Home SBA	273	0				*0.07*	*0*	(base)			
Public Hospital/Clinic	1500	0.603	0	0.453	0.753			0.554	0	0.410	0.698
Public Non-Hospital/Clinic	2480	0.807	0	0.663	0.951			0.716	0	0.581	0.851
Private Hospital/Clinic	835	0.328	0	0.17	0.486			0.37	0	0.216	0.524
Other	9	-0.472	0.003	-0.786	-0.16			-0.225	0.396	-0.745	0.295
PARITY											
1st Birth	1926	0.065		-0.045	0.175			0.062	0.311	-0.058	0.182
2nd Birth	1623	0.171		0.059	0.283			0.157	0.006	0.045	0.27
3rd Birth	845	0.144		0.017	0.272			0.091	0.121	-0.024	0.206
4+ Birth	703	(base)				*0.005*	*0.004*	(base)			
_cons								-0.787	0	-1.025	-0.55
TOTAL	**5097**							**R-Sqr**	0.251		0

As with the other countries, there appears to be a somewhat complex situation with regards to maternal age and education in the multivariate models. Based on the Individual Variable regressions we would expect a lack of significant difference between Age in 2010 and Education in 2014. Instead both single year regressions show that only the 30-34 year age group and 25-29year group in 2014 have a significantly higher QI score than the 15-19 year category. At the same time all educational categories with the exception of incomplete primary education in the 2014 data are significantly better compared to those with no education.

Both these patterns are also visible in the combined dataset model, which includes an additional variable representing year with 2010 used as standard (Table 7.5.3.). However when looking at the distribution of observations within each category it is possible that, particularly with regards to age, the non-significance of results may possibly be due to low number of observations within some categories.

As such Table 7.5.4 shows the results of a model using the revised categorisation for age and education used in previous analyses; maternal age as <25, 25-34 and 35+ and education as “Primary or Lower” “Some Secondary”, “Completed Secondary” and “Higher Education”.

Table 7.5.3 Results of Linear regression of multiple variables against PCA based QI score with All Pooled Indicators, Cambodia 2010-2014

CATEGORY	**N**	**Coef**	**P>t**	**(95%CI)**		**CATEGORY**	**N**	**Coef**	**P>t**	**(95%CI)**	
YEAR						REGION					
2010	4349	(base)				banteay mean chey	463	0.205	0.002	0.072	0.338
2014	5097	0.651	0	0.606	0.695	kampong cham	515	-0.088	0.173	-0.215	0.039
						kampong chhnang	538	1.154	0	1.034	1.274
RURAL-URBAN						kampong speu	543	0.518	0	0.388	0.648
Urban	3084	-0.012	0.705	-0.072	0.049	kampong thom	419	0.933	0	0.804	1.062
Rural	6362	(base)				kandal	501	0.124	0.066	-0.008	0.255
						kratie	406	0.433	0	0.308	0.557
AGE						phnom penh	695	0.085	0.17	-0.036	0.206
15-19	810	(base)				prey veng	456	0.63	0	0.496	0.764
20-24	2941	0.054	0.203	-0.029	0.137	pursat	469	0.862	0	0.729	0.995
25-29	3071	0.11	0.015	0.021	0.200	siem reap	549	0.911	0	0.784	1.038
30-34	1543	0.163	0.002	0.059	0.266	svay rieng	534	0.225	0.001	0.098	0.353
35-39	749	0.094	0.137	-0.03	0.217	takeo	500	0.382	0	0.255	0.51
40-44	299	-0.011	0.904	-0.181	0.16	otdar mean chey	508	0.574	0	0.442	0.706
45-49	33	0.255	0.249	-0.179	0.688	battambang & pailin	471	0.396	0	0.265	0.526
						kampot & kep	405	0.264	0	0.129	0.399
						preah sihanouk & kaoh kong	593	0.497	0	0.375	0.619

Table 7.5.3 Cont.

EDUCATION						preah vihear & steung treng	408	0.305	0	0.167	0.443
No education	1059	(base)				mondol kiri & rattanak kiri	473	(base)			
Incomplete primary	3772	0.115	0.003	0.041	0.19						
Complete primary	947	0.176	0	0.079	0.272	SBA PROVIDER					
Incomplete secondary	2912	0.268	0	0.185	0.35	Home SBA	1160	(base)			
Complete secondary	423	0.35	0	0.221	0.48	Public Hospital/Clinic	2667	0.374	0	0.291	0.456
Higher Education	333	0.298	0	0.163	0.433	Public Non-Hospital/Clinic	4089	0.539	0	0.465	0.613
						Private Hospital/Clinic	1491	0.213	0	0.123	0.303
WEALTH						Other	39	-0.264	0.12	-0.596	0.069
Poorest	1560	(base)									
Poorer	1590	-0.016	0.666	-0.088	0.056	PARITY					
Middle	1597	0.09	0.014	0.018	0.163	1st Birth	3454	0.099	0.029	0.01	0.187
Richer	1945	0.089	0.02	0.014	0.164	2nd Birth	2915	0.128	0.002	0.045	0.211
Richest	2754	0.109	0.018	0.019	0.199	3rd Birth	1591	0.092	0.031	0.008	0.176
						4+ Birth	1486	(base)			
_cons		-1.4531	0	-1.616	-1.291						
TOTAL	**0**							**R-Sqr**	0.3065	**Prob-F**	0

Table 7.5.4 Results of Linear regression of multiple variables with revised categorisation against PCA based QI score with All Pooled Indicators, Cambodia 2010-2014

CATEGORY	**N**	**Coef**	**P>t**	**(95%CI)**		**CATEGORY**	**N**	**Coef**	**P>t**	**(95%CI)**	
YEAR						REGION					
2010	4349	(base)				banteay mean chey	463	0.205	0.002	0.072	0.338
2014	5097	0.651	0	0.606	0.695	kampong cham	515	- 0.088	0.173	-0.215	0.039
						kampong chhnang	538	1.154	0	1.034	1.274
RURAL-URBAN						kampong speu	543	0.518	0	0.388	0.648
Urban	3084	-0.012	0.705	-0.072	0.049	kampong thom	419	0.933	0	0.804	1.062
Rural	6362	(base)				kandal	501	0.124	0.066	-0.008	0.255
						kratie	406	0.433	0	0.308	0.557
AGE						phnom penh	695	0.085	0.17	-0.036	0.206
15-19	810	(base)				prey veng	456	0.63	0	0.496	0.764
20-24	2941	0.054	0.203	-0.029	0.137	pursat	469	0.862	0	0.729	0.995
25-29	3071	0.11	0.015	0.021	0.2	siem reap	549	0.911	0	0.784	1.038
30-34	1543	0.163	0.002	0.059	0.266	svay rieng	534	0.225	0.001	0.098	0.353
35-39	749	0.094	0.137	-0.03	0.217	takeo	500	0.382	0	0.255	0.51
40-44	299	-0.011	0.904	-0.181	0.16	otdar mean chey	508	0.574	0	0.442	0.706
45-49	33	0.255	0.249	-0.179	0.688	battambang & pailin	471	0.396	0	0.265	0.526
						kampot & kep	405	0.264	0	0.129	0.399
EDUCATION						preah sihanouk & kaoh kong	593	0.497	0	0.375	0.619
No education	1059	(base)				preah vihear & steung treng	408	0.305	0	0.167	0.443
Incomplete primary	3772	0.115	0.003	0.041	0.19	mondol kiri & rattanak kiri	473	(base)			

Table 7.5.4 Cont.

Complete primary	947	0.176	0	0.079	0.272	SBA PROVIDER					
Incomplete secondary	2912	0.268	0	0.185	0.35	Home SBA	1160	(base)			
Complete secondary	423	0.35	0	0.221	0.48	Public Hospital/Clinic	2667	0.374	0	0.291	0.456
Higher Education	333	0.298	0	0.163	0.433	Public Non-Hospital/Clinic	4089	0.539	0	0.465	0.613
						Private Hospital/Clinic	1491	0.213	0	0.123	0.303
WEALTH						Other	39	-0.264	0.12	-0.596	0.069
Poorest	1560	(base)									
Poorer	1590	-0.016	0.666	-0.088	0.056	PARITY					
Middle	1597	0.09	0.014	0.018	0.163	1st Birth	3454	0.099	0.029	0.01	0.187
Richer	1945	0.089	0.02	0.014	0.164	2nd Birth	2915	0.128	0.002	0.045	0.211
Richest	2754	0.109	0.018	0.019	0.199	3rd Birth	1591	0.092	0.031	0.008	0.176
						4+ Birth	1486	(base)			
_cons		-1.453	0	-1.616	-1.291						
TOTAL	**0**							**R-Sqr**	0.3065	**Prob-F**	0

Under the revised categorisation maternal age does show a significant increase in QI for women aged 25-35, however the coefficients involved are quite small. It appears that the patterns associated with maternal age in the graphical analysis may due to other correlated factors such as maternal education, for which all categories above primary are associated with substantial and significant increases in mean QI. As per the graphical analysis, having only a completed secondary education is associated with a greater increase in QI than higher education.

Looking at the wealth categories it is interesting to note in both 2010 and 2014, the multivariate model only indicates that those in the Richest wealth quintile are significantly different from those in the Poorest – albeit in opposite directions. The dramatic shift in wealth based patterns of QI scores between surveys has resulted in the Middle, Richer and Richest wealth quintiles being significantly better than the Poorest in the combined model. That is, if a $p<0.05$ is used to determine significance; if $p<0.01$ is used wealth, unlike education, no longer demonstrates significant difference.

Similarly Parity demonstrates significance for all categories in the combined model, but only for one category in 2014 and not at all in the 2010 dataset. Again, this significance disappears if a more stringent threshold is used. Of all the categories, second births appear to carry the greatest association with increased QI compared to fourth order births and above.

At the same time, the year of survey is not only significant at all levels but has a notably large coefficient; membership in the 2014 dataset is associated with a 0.65 point increase in QI score compared to those in the 2010 dataset. That the observed increase in QI between years remains so substantial despite controlling for wealth, region and delivery type strongly indicates that there has been a general increase in QI scores across the population as a whole.

Existing patterns of inequity have also improved; while rural-urban differences are small and non-significant, region remains a major predictor of QI score variance and the differences between the 2010 and 2014 are stark. In 2010 every region with the exception of Kampong Cham was not only significantly better than Mondol Kiri & Rattanak Kiri, but was associated with coefficient higher than almost any other variable category. In 2014 this region was no longer the lowest scoring: Phonm Penh instead had the lowest mean QI when adjusting for other demographic factors.

Other regions such as Kampong Thom and Pursat also saw substantial differences in their ranking. In the combined year model, which adjusts for the year based differences, all regions except for Kampong Cham and Phnom Penh are significantly better than the reference region. The magnitude of the coefficient varies greatly, Banteay Mean Chey for example averages an increase in QI of only 0.21 while residence in Kampong Chhnang, Kampong Thom and Siem Reap is associate with an increase of over 0.9, showing the impact of regional differences on quality of care.

Having a facility based delivery unsurprisingly is also significantly and substantially associated with increased QI score. Public providers tend to score better than private providers in both years, however Public Non-Hospital deliveries show a much higher coefficient than either type of hospital in 2014, most likely a result of efforts aimed at strengthening these services in order to accommodate increased coverage of FBD.

The impact of SBA provider also appears to be more marked in the 2010 sample compared to the 2014, with the associated coefficients being noticeably larger. However the proportion of variance explained by the 2010 model is almost the same as the 2014 model, and it is likely that the decrease in home based delivery (against which the other categories are compared to) may be responsible. Overall it appears that changes in health service provision over the period covered by the surveys appear to be reaping great rewards in terms of the quality of routine maternal and neonatal health care in Cambodia.

7.6 Discussion of Variation in Quality of Care in Cambodia

Over the past two decades Cambodia has faced the unenviable task building a health system capable of provided essential care to the population from a position of limited resources. Despite this, data from the 2010 and 2014 Cambodian DHS shows that there have been large increases in the coverage of MNCH services, particularly with regards to delivery care[167,168]. It is essential that such increases in service coverage are not accompanied by declining quality of care as a result of poor implementation or resourcing. This analysis therefore not only represents one of the most up to date comparisons of quality of care within Cambodia, but also an opportunity to examine the effects of recent health reforms[160] have had on the distribution of quality care across vulnerable populations. The results from this analysis suggest that health reforms have not only resulted in marked increases in the coverage among disadvantaged groups[162,169], but also substantial improvements in the quality of care offered to those who utilise these services.

A major strength of this analysis was the large range of questions relating to care provided during the antenatal and postnatal period in both the 2010 and 2014 DHS. This allowed for a meaningful comparison across survey periods and equity markers. At the same time, the omission of many potential indicators due to inconsistencies in both the type of questions asked and the time range to which questions pertained, highlights the importance of establishing a consistent set of indicators if such measures are to be used in the future to provide ongoing monitoring of quality of care. The omission of postnatal Vitamin A supplementation from the 2014 DHS is particularly problematic, as this is one of the “key DHS” indicators, which is part of the standard DHS module.

As was the case in the Philippines, PNC content carried substantial weight into the final QI, however in the Cambodian context having timely PNC is also strongly associated with other quality indicators. This fits with existing knowledge regarding PNC in Cambodia that suggests that not only was it not traditionally a priority for SBA providers due to limited financial incentives and training[84,164] but that inequality in the coverage of PNC had not decreased at the rate of other services[169]. These results are however based on pre 2014 data, and somewhat counterintuitively, the more recent observations suggest that it is those who are both wealthy and educated who appear to be receiving limited PNC despite having most ANC content.

This is a remarkable divergence from the existing literature on quality of care in Cambodia, as well as general global trends, which suggests those in higher socioeconomic groups receive better quality care[1,12,164,170]. One potential explanation lies with the large concentration of wealth in Phnom Penh, which trails behind many other regions in terms of QI scores – it is possible that local factors affecting health services in the capital are disproportionately affecting the highest wealth quintile as a whole. However the fact that wealth and education remain significant even accounting for region suggests that this is not the only factor at play.

It is possible that a perceived lack of need for or lower social desirability of particular elements of care may contribute to this difference - there is some evidence that higher cost procedures and more interventionist techniques are perceived by Cambodian women as being of higher quality resulting in wealthier women receiving medically unnecessary care[164]. If this is the case then steps should be considered to examine specific practices ensuring that both patient and provider perceptions of quality care align with the recommended standard of care.

More generally however, the quality of routine maternal and neonatal care has substantially improved overall across all equity markers. Notably regional inequalities, a key concern with regards to many related health indicators[156,167] , have decreased substantially and the quality of care provided at primary health facilities, which are heavily utilised by rural and less wealthy parts of the population[163], is very high. Incredibly, despite known issues regarding high levels of poverty within the country, both rural, urban and wealth based disparities in quality of care for the poor and near poor almost disappear once underlying regional variation is accounted for.

From a policy perspective this is an extremely heartening result; both the health equity funds and the maternal voucher scheme are directly aimed at decreasing economic barriers to maternal health care[160,166], however it was also hoped that increases in available funding combined with increased local autonomy of the administration and delivery of services would result in improvements in the quality of care on offer. At a national level this certainly appears to have been the case.

At the same time significant regional disparities still remain. Leaving aside the unexpectedly low scores seen in the capital, regions such as Kampong Cham and Banteay Mean Chey lag well behind other provinces in terms of quality care, despite having had substantial increases in FBD coverage[158]. In contrast provinces like Kampong Thom and Kampong Chhnang saw similar increases in coverage but also incredible increases in QI scores; by 2014 residents in these regions had on average four to five more quality indicators than their counterparts in the capital.

Given the apparent impact of decentralisation on health services in Indonesia and the Philippines, it might be expected that wealthier and more urbanised areas would see the greatest benefits from the health reforms implemented by the Cambodian Government. These results however appear to indicate that for at least some regions the benefits of increased local autonomy have impacted some of the areas in greatest need.

There are several major caveats however; as often mentioned the QI only measures routine maternal and neonatal care, without accounting for the capacity and functioning of emergency services that can have a more direct effect on mortality and morbidity rates. Access to and use of EMOC facilities, particularly in the more remote areas of Cambodia remain limited[162] , which may limit the health benefits of good quality care in the primary health system unless efforts are made to strengthen referral systems.

Based on this analysis Cambodia has achieved remarkable gains in coverage, equity and quality of routine maternal and neonatal health care in a relatively short period of time. To ensure that the country continues to see marked improvements in health outcomes it is essential that these services continue to be monitored to ensure that quality does not diminish, particularly as access to the private sector increases, and that the population as a whole continues to see the benefits of investments in the health system.

Cambodia, like Indonesia and the Philippines, has demonstrated considerable within country variation in quality of care. These patterns are however based on country specific indices, and cannot be directly compared. The next chapter will examine the use of a multi-country QI to compare and contrast QI scores across countries, in order to place the noted trends within a more global context.

8 Variation in the Quality of Maternal and Neonatal Care Across Countries

One of the potential benefits of using DHS data to examine quality of care is that the surveys are conducted using standard set of modules with minor country specific modification, allowing for a high degree of comparability between countries[68]. The survey questionnaires were not, however, designed to specifically capture information relating to quality of care, and evidence from the country specific analyses suggests that many of the stronger indicators are the result of country specific modifications to the survey design. Despite this, the standard DHS questionnaire on which all Phase 6 surveys are based does include twelve potential quality indicators; the Core DHS indicator set outlined in previous chapters. This standard set of indicators forms the basis of cross country comparison in the quality of routine Maternal and Neonatal Care.

8.1 Combining Datasets

Following the initial country analyses, four datasets were available for comparison; the Indonesia 2012 DHS, the Philippines 2013 DHS, and the 2010 and 2014 Cambodian DHS. All datasets utilised identical inclusion criteria, quality definitions and methodology for indicator construction. Critically however the 2014 Cambodian DHS did not include a question relating to postnatal Vitamin A supplementation. While in the country analysis this did not prove to be a major impediment, its absence from an already small list of Core DHS indicators is problematic. At the same time the country analysis shows substantial changes between 2010 and 2014, and omitting this dataset completely from the analysis may be misleading when drawing conclusions about the relative quality of care between the three countries.

As such, the decision was made to include both Cambodian datasets and construct two mutually exclusive sets of QI; one utilising 13 indicators and the 2010 dataset and the other using only 12 indicators and the 2014 dataset. This not only allows for consideration of the changes that occurred in Cambodia between survey rounds, but of the effect of further reducing the number of indicators used to construct the index.

The final datasets used in the country analyses were pooled, retaining common indicators and explanatory variables. There were 25069 observations in total; 11831 from Indonesia

2012, 3792 from Philippines 2013, 4349 from Cambodia 2010 and 3792 from Cambodia 2014. Table 8.1.1 shows the mean value for each of the included indicators for each of the indicator sets (2010 and 2014, named for the Cambodian Dataset used in their construction.

Table 8.1.1 Quality Indicators with mean scores for 2010 and 2014 Multicountry indicator sets

Indicator	**2010**		**2014**	
	Mean	**Std. Error**	**Mean**	**Std. Error**
1+ ANC visit in 1st Trimester	0.769	0.003	0.798	0.003
Blood Pressure measured during ANC	0.962	0.001	0.971	0.001
Urine sample taken during ANC	0.492	0.004	0.518	0.003
Blood sample taken during ANC	0.487	0.004	0.552	0.003
90+ days Iron supplementation during pregnancy	0.425	0.003	0.467	0.003
Fully protected from Tetanus during pregnancy	0.740	0.003	0.751	0.003
Told about pregnancy complications during ANC	0.658	0.003	0.671	0.003
Baby was weighed at birth	0.955	0.001	0.969	0.001
Baby was breastfed within 1 hr of birth	0.528	0.004	0.521	0.003
No liquids given before milk began to flow (no prelacteal feed)	0.493	0.004	0.491	0.003
Maternal postnatal check within 2 hrs of delivery	0.539	0.004	0.586	0.003
Neonatal postnatal check within 2 hrs of delivery	0.322	0.003	0.426	0.003
Mother received postpartum Vitamin A within 2 months of delivery	0.545	0.004	-	-
Cronbach's Alpha	**0.5441**		**0.6002**	

As can be seen the 2014 set has a noticeably higher prevalence of indicators relating ANC content and timely PNC compared to the 2010 set, reflecting the large gains seen in Cambodia between the two time periods. It is also evident that neither indicator set reflects a particularly consistent underlying factor; both sets have a Cronbach's alpha value of well under 0.7, suggesting a high level of heterogeneity. This is not unexpected given the relatively small number and high diversity of indicators, however it is a point that should be considered when evaluating QI for use in the comparative analysis.

8.2 Constructing the QI

Given that almost half the total observations come from the Indonesian dataset it was necessary to construct frequency weights for use in the PCA analysis to ensure that all countries contributed equally to the final results, these weights were equal to the 1/N where N is the number of observations in the original dataset as laid out in section 3.3.1. The results of the weighted PCA can be seen in table 8.2.1.

The pattern of weights do appear somewhat different depending on the indicators and Cambodian dataset used. While overall the 2010 set tends to place higher emphasis on ANC related indicators, the 2014 set appears more balanced towards birth and PNC related indicators. The proportion of variance explained by the primary component is also noticeably larger in the 2014 set compared to the 2010 set, suggesting a potentially greater level of agreement between countries in terms of the underlying associations of the indicators. Unlike the country analyses PNC content plays little role in the overall weighting scheme; the only indicator of PNC content, Postnatal Vitamin A supplementation, is not present in the 2014 set, and although it carries a substantial weight, appears to be more greatly associated with ANC indicators than timely PNC indicators.

Given the notably different patterns of weighting seen between the 2010 and 2014 sets, the low Cronbach's alpha and the fact that the number of indicators is comparatively low, a decision was made utilise EW based QI for the remaining cross-country analysis (for the sake of comparison individual country results using similar QI may be found in Appendix 4) . This minimises the effect of differential weighting between the 2010 and 2014 sets, and, as there are only a maximum of twelve indicators, prevents the resulting index from being dominated by the prevalence of an even smaller group of indicators.

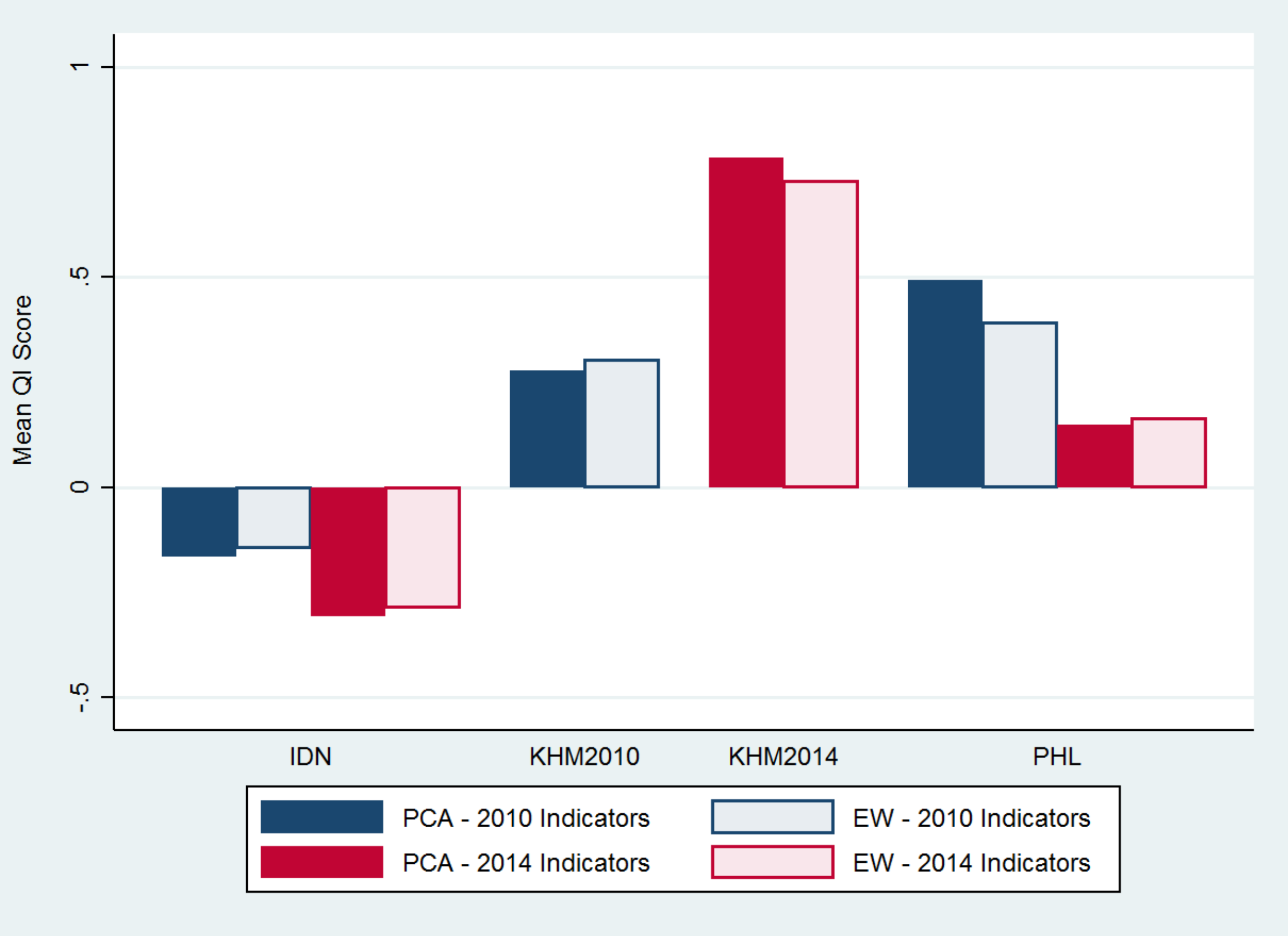
Table 8.2.1 PCA derived variable weights for primary and secondary components using different indicator sets, All Countries

Indicator	**2010 Indicators**		**2014 Indicators**	
	Comp 1	**Comp 2**	**Comp 1**	**Comp 2**
1+ ANC visit in 1st Trimester	0.1409	-0.1127	0.1133	0.1009
Blood Pressure measured during ANC	0.0555	-0.0381	0.0292	0.0349
Urine sample taken during ANC	0.4649	-0.3977	0.2817	0.5615
Blood sample taken during ANC	0.4713	-0.3412	0.3804	0.4528
Iron supplementation during pregnancy	0.3617	0.1384	0.3908	0.1304
Fully protected from Tetanus during pregnancy	0.1744	0.0891	0.1831	0.0589
Told about pregnancy complications during ANC	0.3064	0.0096	0.2668	0.1696
Baby was weighed at birth	0.053	-0.0338	0.0341	0.0121
Baby was breastfed within 1 hr of birth	0.1918	0.5759	0.2685	-0.2303
No liquids given before milk began to flow (no prelacteal feed)	0.2292	0.564	0.3189	-0.179
Maternal postnatal check within 2 hrs of delivery	0.2544	0.1653	0.3848	-0.4109
Neonatal postnatal check within 2 hrs of delivery	0.2165	0.0762	0.4264	-0.4062
Mother received postpartum Vitamin A within 2 months of delivery	0.2829	-0.0048		
Rho	**0.1754**	**0.1361**	**0.2186**	**0.151**
Observations	19972		20720	

8.3 QI Score by Country and Key Equity Markers

As can be seen in figure 8.3.1, there were substantial differences in QI score between countries regardless of the indicator set used. Indonesia 2012 scored the lowest, followed by Cambodia 2010 and the Philippines 2013. Cambodia 2014 had the highest score by far in both relative and absolute terms (as seen in Figure 8.3.2, which shows the distribution of unstandardized EW scores for both the 2014 and 2010 sets). While Cambodia 2010 and the Philippines 2013 had quite similar mean scores and distribution patterns, Cambodia 2014 not only shows an increased mean score, but also a more highly skewed distribution, concentrated at the upper end of scores.

Figure 8.3.1 Mean QI scores by Country Dataset, using PCA and EW based QI with 2010 and 2014 Indicators, All Countries



In accordance with the country analysis, there has been a substantial increase in QI scores in rural Cambodia. As can be seen in Figure 8.3.3, in the 2010 set there was a clear urban advantage across all countries – in fact the Cambodian urban population had the highest score, above even the Philippines urban population. At the same time Indonesia's urban population remains lower than the rural populations of Cambodia and the Philippines in both sets, showing that the overall quality of care in Indonesia is not driven by urban-rural differences.

Figure 8.3.2 Distribution of Unstandardized QI scores with 2010 and 2014 Indicators, All Countries

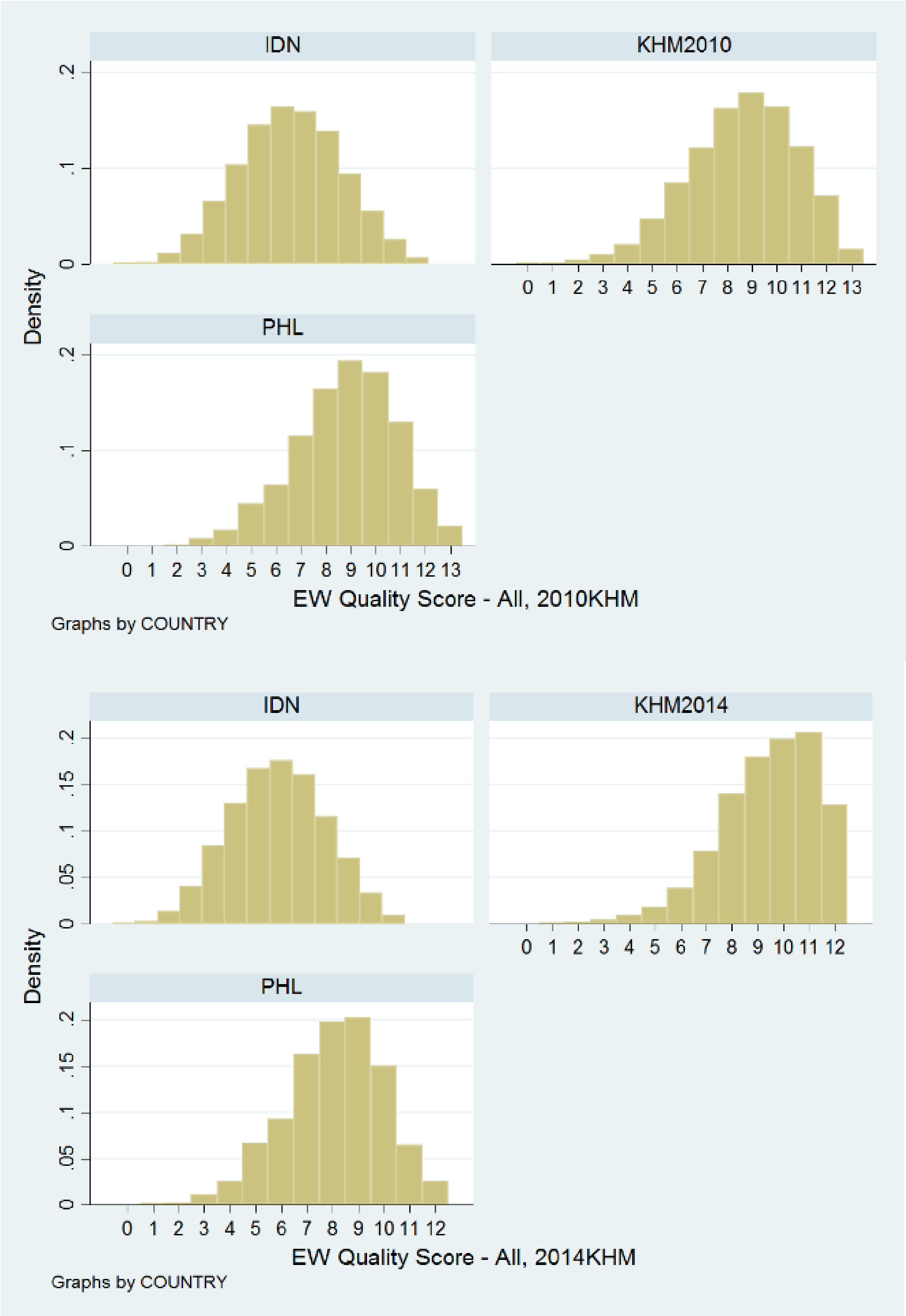
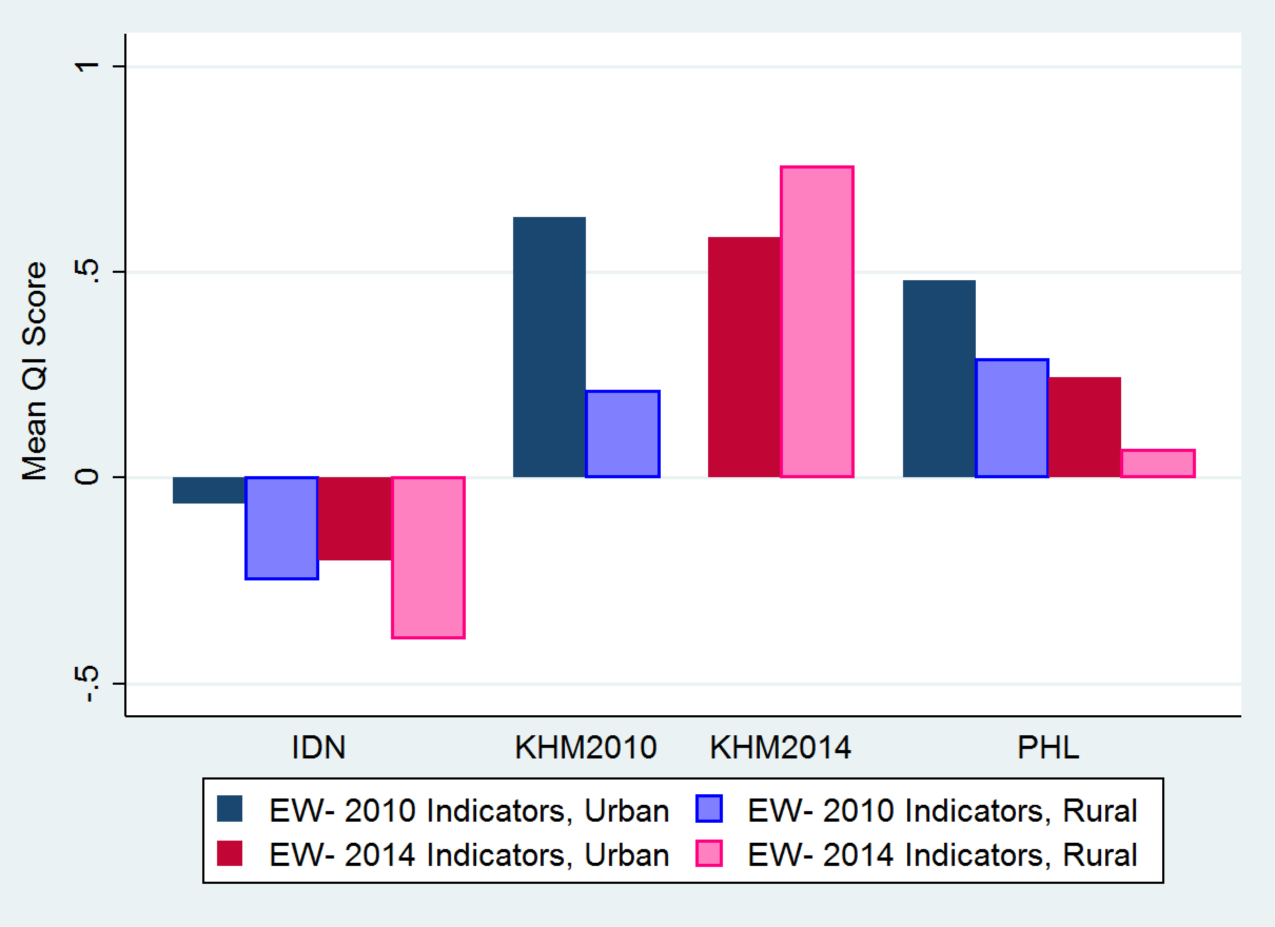


Figure 8.3.3 Mean QI scores for Urban and Rural Populations by Country Dataset, using EW based QI with 2010 and 2014 Indicators, All Countries



It also does not appear to be driven by wealth disparities; as seen in Figure 8.3.4, the wealthiest Indonesians have lower scores than the poorest Philippines or Cambodians even in the 2010 set. As can be seen in Table 8.3.5, this is most likely due to the much lower prevalence of appropriate breastfeeding indicators and irons supplementation in the sample as a whole. Scores from PCA derived QI show similar patterns as correlations between other indicators and appropriate breastfeeding remain high in the weighted sample.

Figure 8.3.4 Mean QI scores by Wealth Quintile and Country Dataset, using EW based QI with 2010 and 2014 Indicators, All Countries

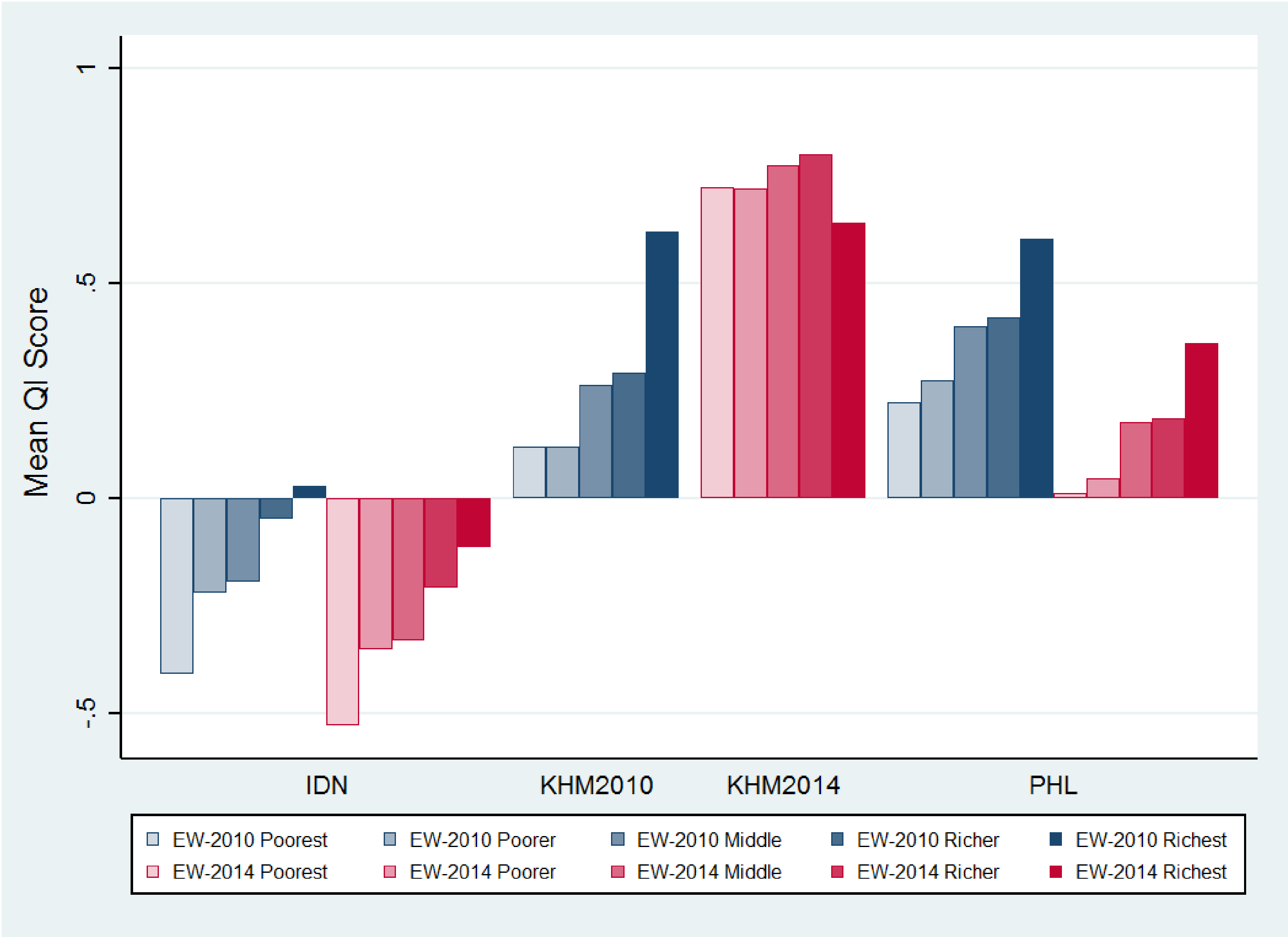
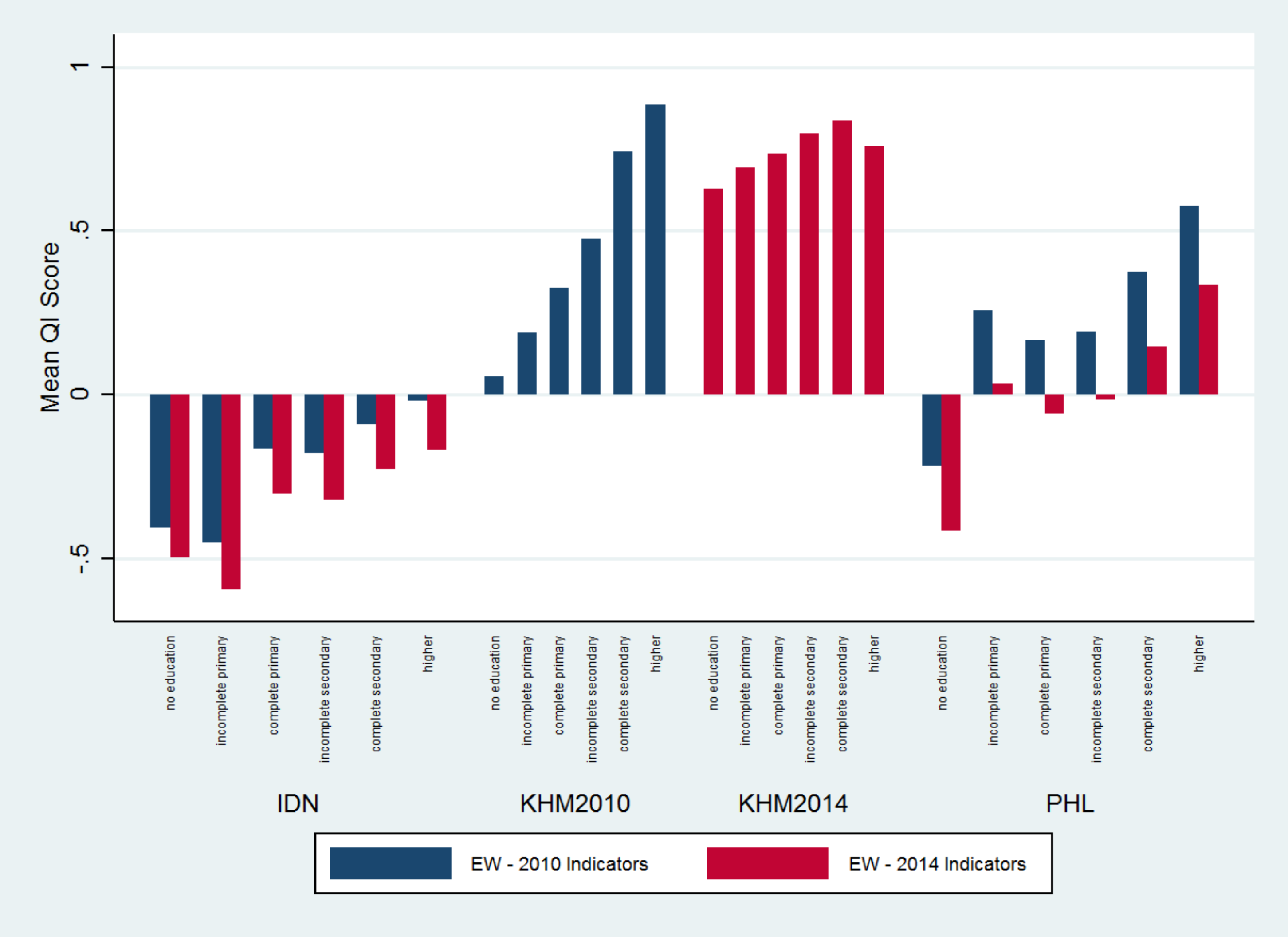


Table 8.3.5 Quality Indicators with Mean Prevalence by Country Dataset, All Countries

	IDN	KHM 2010	KHM 2014	PHL
1+ ANC visit in 1st Trimester	0.819	0.714	0.841	0.675
Blood Pressure measured during ANC	0.968	0.922	0.965	0.991
Urine sample taken during ANC	0.461	0.386	0.508	0.711
Blood sample taken during ANC	0.428	0.513	0.775	0.640
Iron supplementation during pregnancy	0.306	0.668	0.802	0.517
Fully protected from Tetanus during pregnancy	0.654	0.884	0.907	0.842
Told about pregnancy complications during ANC	0.549	0.812	0.842	0.825
Baby was weighed at birth	0.969	0.918	0.978	0.956
Baby was breastfed within 1 hr of birth	0.482	0.682	0.629	0.498
No liquids given before milk began to flow (no prelacteal feed)	0.354	0.790	0.736	0.588
Maternal postnatal check within 2 hrs of delivery	0.537	0.589	0.774	0.487
Neonatal postnatal check within 2 hrs of delivery	0.336	0.260	0.689	0.350
Mother received postpartum Vitamin A within 2 months of delivery	0.503	0.510	-	0.716

Also of interest is that while all but the richest Cambodians score lower than their Philippine counterparts in the 2010 set, by 2014 even the poorest scored well above the richest Philippine wealth quintile. Between the two survey years wealth based disadvantage in QI scores appears to have disappeared. Similar effects can be seen in terms of maternal education attainment (Figure 8.3.6), where QI scores for less educated women increased substantially in Cambodia such that in the 2014 set even those with only a primary education or lower have higher scores than even tertiary educated women in the Philippines. In both the Philippines and Indonesia QI scores appear to increase with education, however while each additional category is associated with increases in scores in Indonesia, the Philippines shows little difference between having a primary or lower education and having an incomplete secondary education.

Figure 8.3.6 Mean QI scores by Educational Attainment and Country Dataset, using EW based QI with 2010 and 2014 Indicators, All Countries



In contrast to the diverse patterns seen with regards to education, scores for maternal age (Figure 8.3.7) and parity (Figure 8.3.8) increased in Cambodia while maintaining the same general pattern of scores and similar trends were seen across all countries. In general the 25-35 year age group has the highest scores within each country, with Cambodia being slightly unusual in that QI scores are slightly higher for the <25 year age group compared to the 35+ age group. In terms of parity those with three or more previous births score noticeably lower than other groups across all countries, although there is also some sign that first births may also be at a slight disadvantage.

Figure 8.3.7 Mean QI scores by Maternal Age and Country Dataset, using EW based QI with 2010 and 2014 Indicators, All Countries

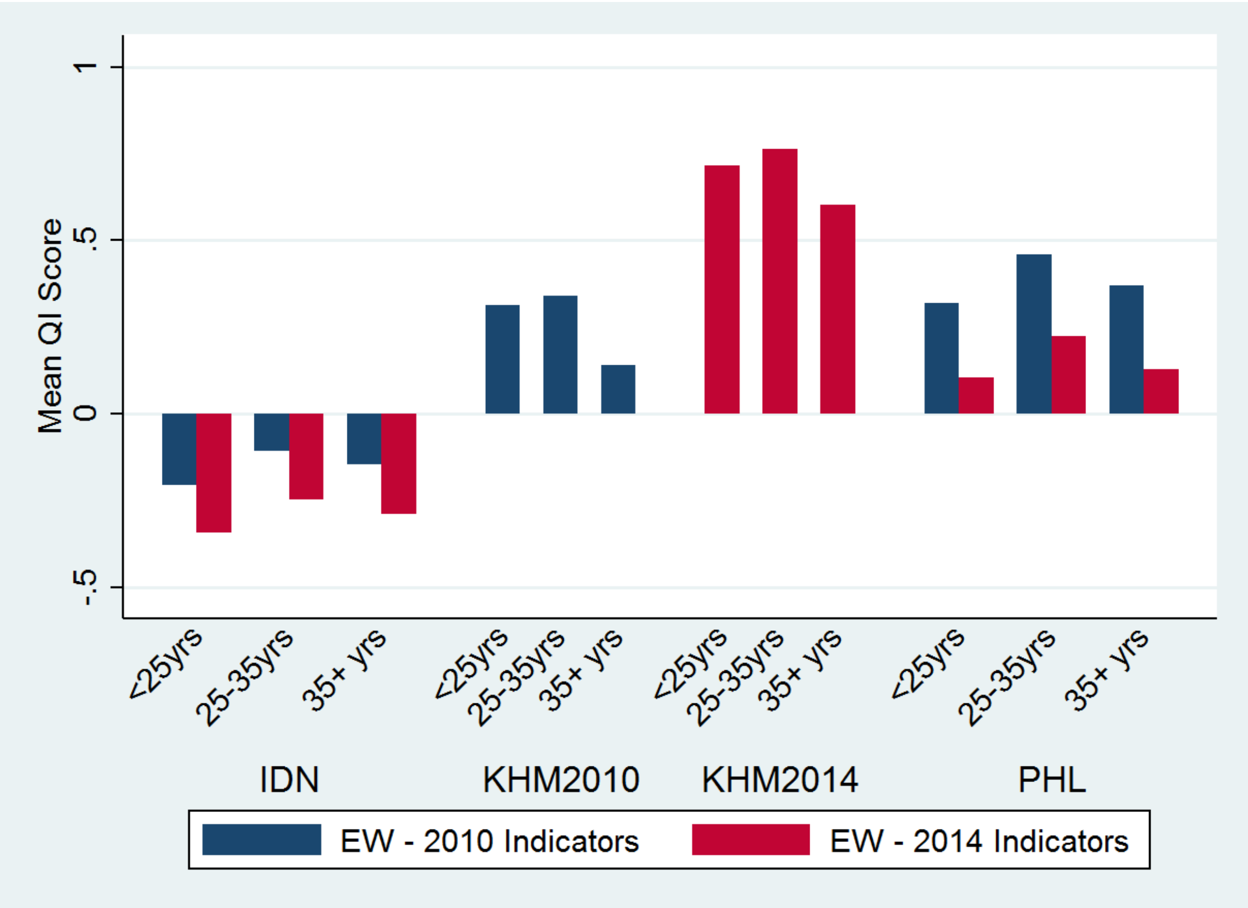


Figure 8.3.8 Mean QI scores by Birth Order and Country Dataset, using EW based QI with 2010 and 2014 Indicators, All Countries

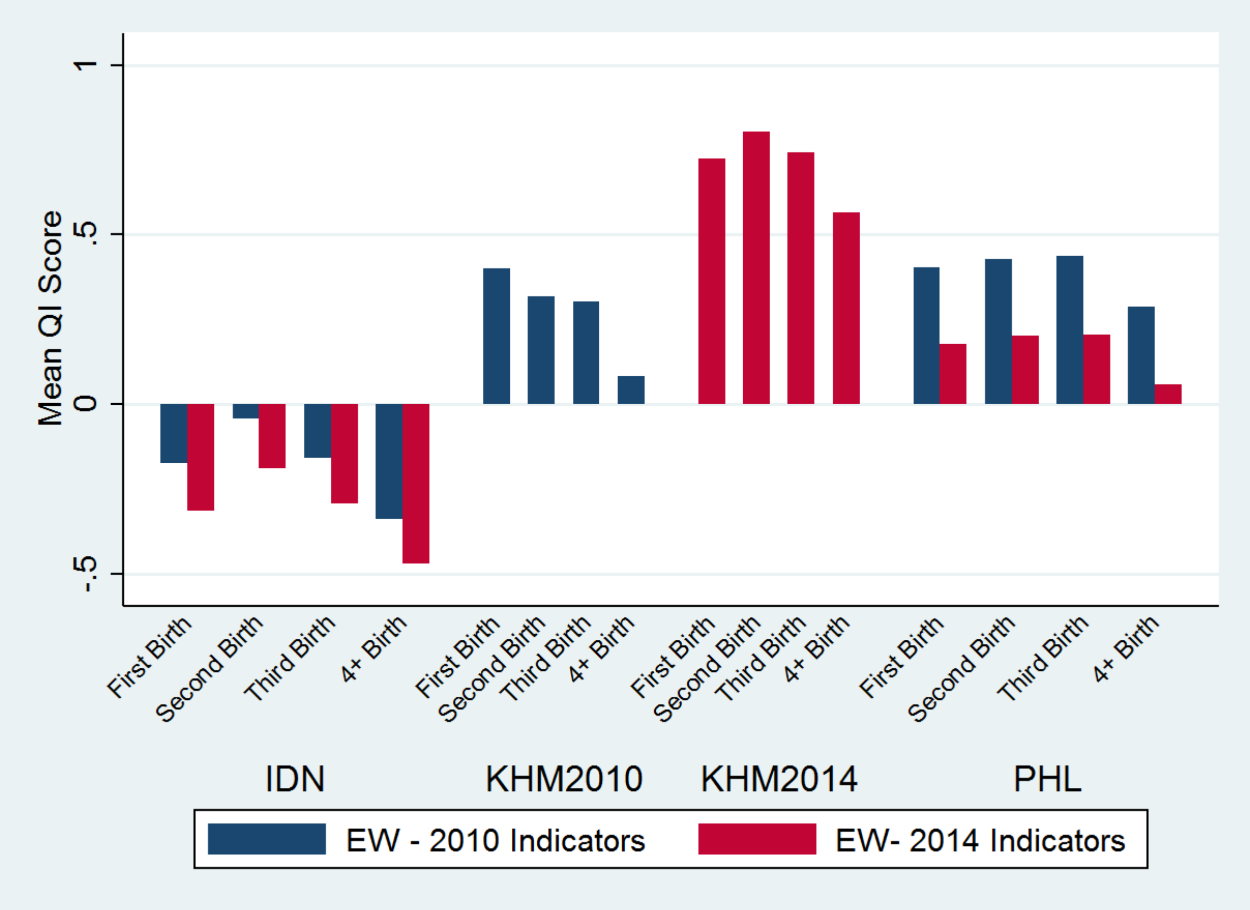
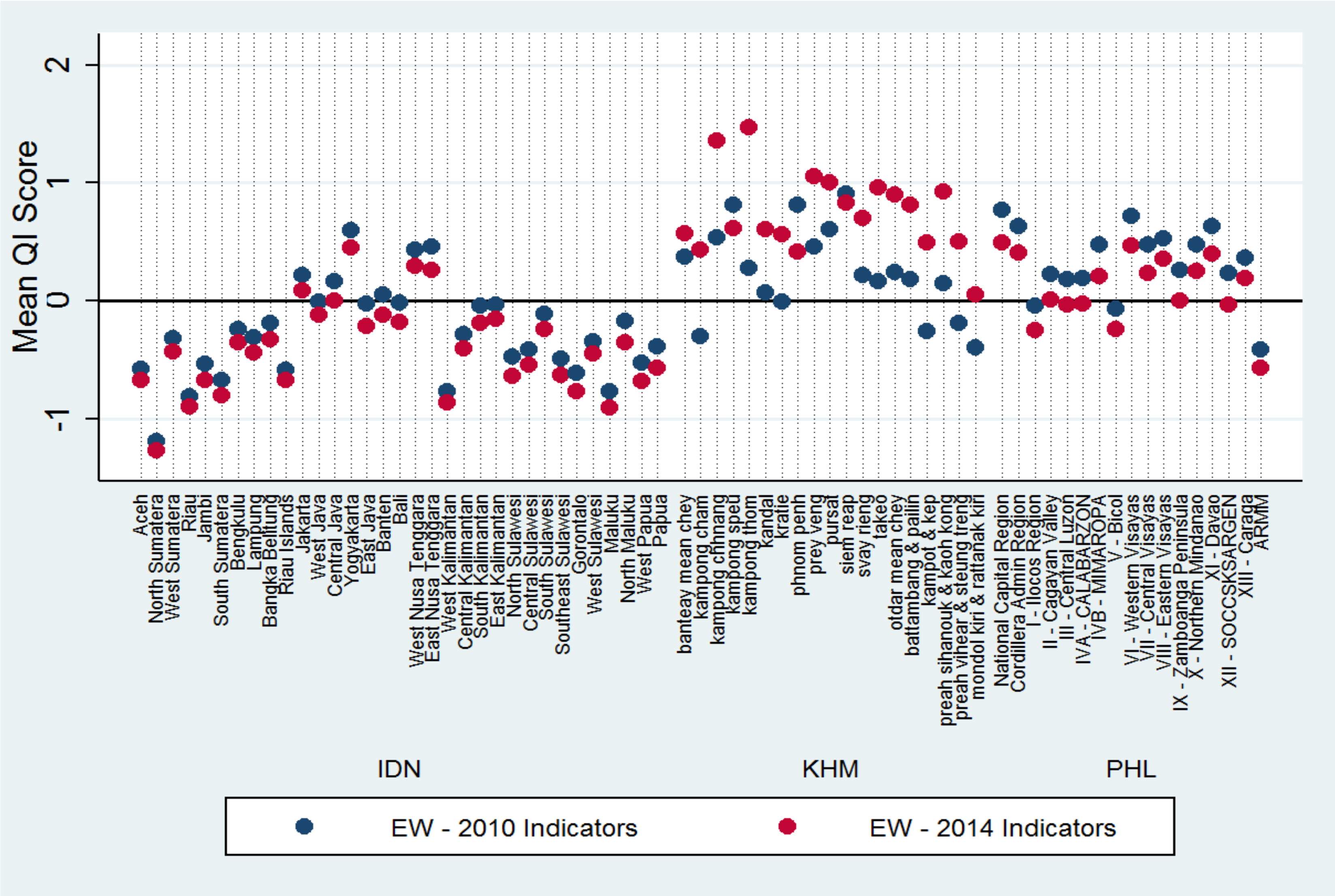


Figure 8.3.9 shows regional QI scores, grouped by country. Here the relative disadvantage of Indonesia is particularly visible. In the 2010 set the worst regions in the Philippines and Cambodia (ARMM and Mondol Kiri & Rattanak Kiri) have higher scores than over a third of Indonesia's regions. At the other end of the spectrum Yogyakarta has comparable scores to other relatively high performing regions such as Siem Reap and Davao, however it is by far the outlier. In the 2014 set the large increases in QI seen in Cambodia mean that even the best regions of Indonesia and the Philippines are lower than all but that worst performing Cambodian provinces.

Figure 8.3.9 Mean QI scores by Region and Country Dataset, using EW based QI with 2010 and 2014 Indicators, All Countries



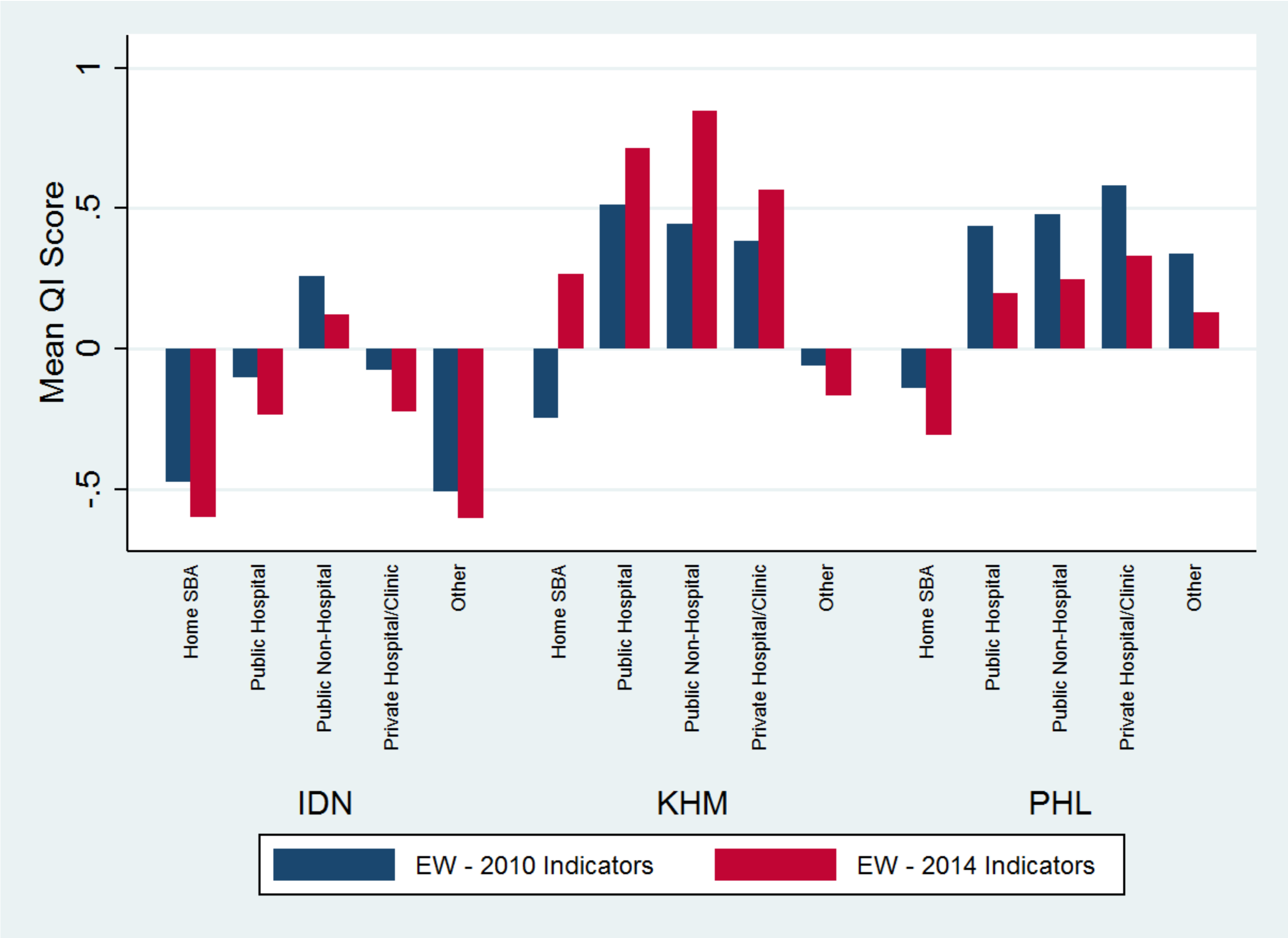
It is particularly noticeable in terms of Indonesia where the worst performing Cambodian region in 2014, Mondol Kiri & Rattanak Kiri, has a similar score to the capital of Jakarta. Still, the second lowest scoring region, the capital Phnom Penh, is still better than all but the NCR (Manila Metro) and Western Visayas regions in the Philippines. It is apparent that between country differences in QI scores can be larger than within country regional differences; while the spread of regional scores in 2010 was quite similar between the Philippines and Cambodia, with the best performing and worst performing regions scoring very similarly, all scores appear to “shift upwards” as a result of the 2014 dataset.

Much of these patterns can be attributed to the remarkable strengthening of primary health services in Cambodia. As seen in Figure 8.3.10, facility based services in Cambodia started out at similar levels to the Philippines, but saw marked increases by 2014. Indonesia again scores lowly, and while its facility based deliveries do score more highly than SBA home deliveries in the Philippines, even the best performing category (Public Non-Hospital) lags well behind providers in other countries.

It should be noted that due to standardisation issues, the “Private Non-Hospital” category of provider that accounted for a substantial proportion of births in the Indonesian country analysis is now part of the “Private Hospital/Clinic” category – Indonesia is unusual in its reliance on small private practices to provide delivery services and thus questionnaires for both Cambodia and the Philippines do not distinguish between large and small providers. At the same time, the country results also suggest little difference between these groups in terms of QI scores, suggesting that this change would not substantially affect the results.

Despite the overall lower scores across all providers, the pattern of scores is quite similar between Cambodia and Indonesia, with Public Non-Hospital providers scoring much higher than either public or private hospitals. Both countries have made the prioritisation of primary health services a major part of national health programs, which may help to explain this pattern particularly with regards to how scores within Cambodia have changed between the survey periods. In contrast, it is private facilities in the Philippines which score highest, although the variation between facility types is lower than in the other countries.

Figure 8.3.10 Mean QI scores by SBA Provider and Country Dataset, using EW based QI with 2010 and 2014 Indicators, All Countries



8.4 Discussion of Country Based Variation in Quality of Care

The above sections show that while country based comparison of quality of maternal and neonatal care using DHS data is possible, it remains severely limited at this point in time. The small number of indicators is a major problem, both in terms of overall reliability of the QI and with regards to comparability between countries. For example, the large differences seen between Indonesia and the other countries across multiple equity markers is predominantly due to the much lower levels of breastfeeding in the country, which account for two of the 12-13 quality indicators available.

The disproportionate impact of these indicators highlights the inability of this indicator set to encompass the wide-ranging nature of interventions provided along the continuum of care. In particular, the lack of PNC content indicators and indicators relating to advice provided by health staff represent critical areas in which the multicounty QI falls short compared to the individual country analyses. As shown in Chapter 5, the content and timing of PNC is a major point of difference between different population groups, and as such this more limited range of indicators cannot capture this variation.

Similarly, the smaller range of ANC indicators means that less comprehensive ANC visits can still score quite highly – particularly if affected groups also have high breastfeeding rates. Indeed, the score of an individual who breastfed but did not have blood or urine testing and an individual who had the reverse could be very similar despite the factors influencing breastfeeding practices being quite different from those affecting receipt of ANC care. As such the reduced indicator set represented by the Core DHS questionnaire suffers difficulty in appropriately reflecting quality of care as a whole.

There were, however, several conclusions about quality of care across these three Southeast Asian countries that can be made. Firstly, while not used to create a QI for analysis, the results of the PCA process highlighted strong association between Blood and Urine testing during ANC and other quality markers across all datasets. Given the importance of early detection of pregnancy complications in ensuring appropriate monitoring and prompt treatment[39,77], policies designed to increase access to key diagnostic tests at lower levels of care may provide an opportunity not only to increase overall quality, but also to better target EMOC services to those who require them.

In terms of comparative measures, the remarkable increases in quality noted in the Cambodian country analysis are not only impressive in relative terms but also when considered against other countries in the region. Additionally, the fact that this increase has occurred within many previously disadvantaged groups has made the distribution of quality care noticeably more equitable. In the earlier dataset Cambodia had a roughly similar profile to the Philippines in terms of QI scores based on wealth and urban-rural status, however by the time of the later survey, formerly disadvantaged groups were scoring higher than even the best performing Philippines categories. This not only shows that that large gains in quality of care are possible, even in a country with limited fiscal resources, but that addressing inequality may also result in benefits for the population as a whole.

There were several overarching trends in quality of care that were evident in all countries with the exception of the 2014 Cambodian DHS. Generally QI scores increased with wealth echoing global trends in quality of care[3,171], although the gap between the richest wealth quintile and all others was less marked in Indonesia than in the Philippines or Cambodia. Similarly higher levels of educational attainment, particularly those above secondary schooling, were associated with higher QI scores – possibly supporting the importance of health knowledge in driving demand based shifts toward higher standards of care[3].

Urban areas also performed much better than rural areas. Whether this is due to resource limitations is unknown, however it is unlikely to be due to difficulties in accessing better types of providers. In particular, Public Non-Hospital Providers, which encompass the primary health care providers often utilised in remote and rural areas[1,3] scored highly overall across all countries.

While there are significant limitations to this analysis, the fact that large proportions of the population across multiple countries appear not to be reaching the very basic standard of care represented by the Core DHS indicator set is cause for concern. Even without taking into account access to, and quality of EMOC services, it is unlikely that health outcomes for mothers and neonates can substantially improve unless the very basic services necessary to identify issues for referral are being utilised. This requires not only a strong primary health system but also measures to ensure services can be accessed by the poor and those living in remote and rural areas. This is not, however an impossible dream; the results from Cambodia provides an example of how improving access to and resourcing of services at the primary health level can lead to significant improvements in overall quality of care as well as its equitable distribution.

9 Discussion

The two major aims of this study were firstly to determine if it was feasible to construct a measure of the quality of maternal and neonatal care using DHS data, and secondly to examine how the distribution of quality varies within Southeast Asian contexts.

With regards to the first goal, it is apparent that although it is possible to use DHS data for monitoring of quality of care, in the absence of functioning HMIS systems there are several limitations. The nature of care that can be monitored, and the aspects of that care that are included in standard survey questionnaires, limit the capacity of current DHS surveys to provide a comprehensive assessment of healthcare quality. As such, the QI is best considered as a “tracer” for the overall quality of routine maternal and neonatal care and must be interpreted with care.

The second aim, involving the use of the QI to perform an equity based analysis of quality in three countries, Indonesia, the Philippines and Cambodia, found that not only was quality of care generally sub-optimal across countries as a whole, but that there was considerable within-country variation. All three countries showed distinct patterns of geographical and wealth based disadvantage, as well as marked variation in the quality of care associated with different types of service provider. Common themes emerged regarding the effects of the decentralisation of health services as well as the importance of primary health services in ensuring access to good quality care across the population as a whole.

9.1 Limitations of the QI

While it proved possible in all three countries to produce indices that appeared to reflect elements of quality Maternal and Neonatal care, these indices had several major limitations.

The first issue stems from the small number of potential indicators available for inclusion in the index. The core DHS questionnaire includes only thirteen indicators relevant to the quality of maternal and neonatal care, which is insufficient to appropriately reflect the full continuum of care, and reflects a general lack of available quality indicators relating to

MNCH coverage in LMICs[172]. Similarly, indicators were not balanced with regards to the continuum of care, with few neonatal and no maternal intrapartum care indicators. As a result, the QI may not fully reflect quality of care received in the critical period during and immediately following birth. The ubiquitous nature of several core DHS indicators among women with both ANC and SBA care (such as blood pressure measurement during ANC and baby being weighed after birth) also hindered the ability of the index to discriminate between observations. The inclusion of additional country specific indicators highlights this insufficiency; across all countries the additional indicators relating to ANC and PNC content (Cambodia and the Philippines) and birth preparedness (Indonesia) not only provided a more robust index, but also demonstrated the general limitations of the core DHS questionnaire.

As an example, despite the importance of provider-client interactions to ensuring client satisfaction[66,173] and ensuring the transference of appropriate health knowledge[3,65,174], the only core DHS question relating to these types of interactions involved asking if the respondent had been told about potential signs of problems with the pregnancy. This is a critical knowledge gap; indicators relating to advice given during ANC and PNC visits in the Philippines and Cambodia showed that there do appear to be substantial issues with the provision of appropriate health knowledge even among women who are otherwise receiving a good standard of care. Likewise, the results from Indonesia suggest that many ANC providers are missing opportunities to discuss and promote key health messages regarding birth preparedness.

Furthermore, the lack of association seen in the Philippines between breastfeeding indicators and breastfeeding advice during PNC demonstrates the potential for quality deficiencies resulting from inappropriate provider practices. Professional barriers involving financial incentives[175], limited health knowledge[65] and sociocultural expectations[4] have been known to limit the adoption of evidence based practices by health staff, and without indicators reflecting this aspect of quality care it is impossible to appropriately design programs and policies to address these deficiencies.

A similar situation exists with regards to PNC. The mechanism through which PNC prevents poor maternal and neonatal health outcomes is primarily through the early detection and treatment of medical conditions[77,176]. However as seen in the country analyses, not all women with PNC are receiving appropriate preventative care or health assessments. For countries utilising community based services to increase access to PNC[60,77] it is vital that these indicators be available, as traditional facility based systems will not tend to report on these modes of care.

Coverage of the birth phase was severely limited in these datasets; while other DHS have previously included questions around key interventions such as aseptic delivery [177], active management of third stage of labour[178], or thermal regulation of the newborn[177], none of these were included here. Coverage of specific disease related care was also limited by issues with the standardisation of denominators and ability to determine need. For example in Cambodia, questions relating to HIV advice and testing during ANC were limited to only those with a birth in the previous two years, despite all other ANC questions being asked for those with a birth in the last five years, preventing the inclusion of these indicators in the final index.

Similarly, although preventative treatment during pregnancy is considered an important aspect of preventing malaria associated morbidity and mortality[39], questions relating to treatment during ANC could not be used in Indonesia due to variation in the geographical need for such services. A consolidation of questions relating to ANC, SBA and PNC across the DHS as a whole may ensure a more holistic representation of care, as might additional markers expressing variations in the need for particular health services across geographic bounds.

In addition to limited coverage of specific care practices, the DHS also suffered from a heavy bias towards process based indicators of quality. There were for example no indicators relating to the underlying structural quality of health services or the client perceptions of quality. The inclusion of such indicators is not impossible; several countries including Bangladesh, Nepal and Senegal have included facility based Service Provision Assessments (SPA) as part of their most recent DHS survey programs[179-183], which provide important measures of the physical readiness of facilities, the availability of key supplies and measures of availability and adherence to appropriate care guidelines[183]. Similarly, while not specific to MNCH, the IFLS includes questions relating to client satisfaction as part of its module relating to use of health services[135] which may be used to explore local understandings of quality care.

One issue that is almost impossible to overcome however is the fact that all indicators only relate to routine maternal and neonatal care, and cannot reflect availability or quality of higher level emergency obstetric care. This is an important caveat – many of the elements considered representative of good quality routine care are reliant upon the presence of EMOC services in order to result in better health outcomes[3,128]. The DHS is however fundamentally unsuited to capturing EMOC related experiences – by their very nature those utilising EMOC services are at a higher risk of death, which would preclude their inclusion in the DHS sampling frame. Any information collected would thus be heavily affected by sampling bias, omitting those who received insufficient care. From a health systems point of view however there is still benefit in assessing the quality of routine maternal and neonatal care; with the push towards universal health coverage governments are increasingly reliant upon primary health care and referral systems to manage access to higher levels of curative care[2,133]. Ensuring that routine health care is of high quality helps to ensure the rational management of limited health system resources.

Care must be taken however to balance the needs for quality measurement with the overall complexity of administering the DHS survey. There is by necessity a fine balance between the total number of questions and the range of topics covered. Lengthy interviews may not only result in a higher rate of refusal but may also increase the potential for recall bias. Although several studies have shown that recollection of events that happened during a pregnancy several years ago can be generally high[184,185], an increase in the specificity of questions may result in larger proportions of “missing/don’t know” responses or a bias towards more socially desirable responses among those who no longer recall all the aspects of their care. Including the country specific questions, the QI used in the country analyses involved the use of 22-25 indicators suggesting that there is capacity available for additional questions to be asked without placing undue burden on the interview process. Ideally any set of additional indicators would be balanced so as to address the areas where the existing DHS indicator sets are problematic.

One last factor to note with regards to the indicator selection is the fact that the questions asked in the DHS only reflect a woman’s recall as to if a particular procedure was carried out- not if it was performed correctly. For example, the DHS asks if during ANC the respondent’s blood pressure was measured – without observation it is unknown if the measurement was carried out correctly or if a diagnosis was communicated in the case of an abnormal reading. Similarly, while the Philippines DHS asks about breastfeeding advice during PNC, there is no indication as to what the advice received was. To address these issues would stretch the capabilities of the DHS, and as such many of the indicators can only be understood to reflect the comprehensiveness of care rather than its technical quality.

In terms of the QI itself, several important issues must be considered from the standpoint of reliability and validity. Firstly, as noted in Chapter 3, Quality is a highly heterogeneous concept to attempt to capture in a single index and as a result the QI do not demonstrate high levels of internal consistency, as demonstrated by the low Cronbach's Alpha values across all countries. Similarly, a lack of standards against which to compare QI based measurements hampers the estimation of the external validity of the index.

For the most part these limitations stem from the nature of the datasets being used; traditional methods of establishing reliability of health measurement scales are dependent upon having either multiple assessors or multiple rounds of testing[78]. As the DHS are cross sectional, none of these methods are applicable. Similarly, the fact that DHS data is collected at regional/provincial level makes its comparison with individual facility based assessments of quality problematic, particularly as these do not typically assess variation in quality care, necessary to identify high or low performing groups. Additionally, this emphasis on routine care combined with highly variable access to health services further prevents the use of mortality and morbidly outcomes as measures of QI reliability.

The results from each of the countries in this study do appear to accord with existing literature regarding quality of care. Multiple rounds of the IFLS have noted concerns with the quality of curative care provided by private providers in Indonesia, as well differences between Java/Bali and more remote areas[83,107-109,123]. Similarly, studies of hospital based care for children in the Philippines noted variation in the quality of care depending on both financial and regulatory factors[20,142], and socioeconomic variation in the provision of care[164], as well as the impact of health reform on the rural population in Cambodia[162,168] have also been noted in the literature. As such, the QI does appear to reflect known variation in quality of care within these countries, making it a potentially useful monitoring tool until such time as additional, comprehensive quality assessments can be undertaken.

On the subject of using the QI as a measurement tool, the analyses provided several important lessons. While the use of PCA to create variable weights was informative in exploring the underlying patterns of correlation between indicators, it had several major limitations that make its routine use problematic. Firstly, it is most beneficial when there is a large number of indicators - as can be seen in the case of the DHS indicator sets, when there is a small number of indicators that are not highly correlated, the PCA derived QI can be misleading, creating a distinct mismatch between objective quality of care (as defined by IMPAC recommendations) and measured quality of care (as calculated by QI scores. Notably, several of the country datasets demonstrated a negative correlation between breastfeeding related indicators and indicators of ANC content; as a result the PCA based QI experiences difficulty reflecting this element of quality care from the resulting analysis.

Secondly, it is not easily interpretable. While the use of PCA versus EW based QI did not change the overall conclusions of the analysis in any of the countries studied, compared to the EW based QI, where scores were directly relatable to the number of indicators present, PCA based QI produce scores that appear somewhat opaque. While they do allow for greater discriminatory ability between observations, and thus comparison of relative variation in quality, the ease of interpretation combined with the lower analytical demands makes EW based QI more attractive for use in policy planning and benchmarking initiatives.

At the same time, both forms of the QI proved capable of identifying population groups experiencing low quality of care. At a national level this may help identify not only population groups that require additional support to improve quality of care, but also particular regions or health providers. As seen in the case of Cambodia, the QI can also be used to help assess the impact of changes to health policy on not only the bodies being targeted but also on the population as a whole. The QI may also assist in better targeting local initiatives – a lack of information regarding quality of care at the appropriate level has specifically been noted as impeding evidence based planning and budgeting at district level in both Indonesia and the Philippines[130], with policymakers unable to determine if poor quality was a factor in low service uptake. The availability of information regarding sub-national estimates of quality in the absence of other data collection methods is thus one of the greatest QI's strengths.

Importantly however, the QI is not, in itself, capable of providing sufficient information to fully understand the drivers of quality of care within a particular setting. In addition to the limitation mentioned above, the examples of East and West Nusa Tenggara, the ARMM and Mondol Kiri and Rattanak Kiri demonstrate there is a clear need for complementary social and health systems research in order to understand not only the nature of quality of care in these settings, but also the factors driving the patterns seen – particularly in regions with large ethnic or religious minorities

9.2 Major themes in Distribution of Quality Care

While this is not the first study to examine quality of care in Southeast Asia, it does fill a much needed gap in terms of understanding the relative distribution[81] of quality care. In particular, while there is a growing base of knowledge regarding the impact of recent health reforms on the coverage of health services[186] and the equality of health outcomes[9,85,187] , this is the first study to note their effects on quality of care. While the elements examined were not sufficient to fully explain all variation in quality (as evidenced by substantial residual confounding in the regression analyses), they were significant enough to draw conclusions relating to the local health systems. Notably, the decentralisation of health services and expansion of health financing initiatives in each of the countries examined here have resulted in a complex and context specific relationship between wealth, location and the quality of maternal and neonatal care.

Without a doubt, the greatest finding was the overwhelming effect of place of residence on quality of care across all three countries. Not only were there clear differences in the mean regional scores, but these differences persisted to a large extent even when accounting for variation in the underlying demographic structure of the population. In Indonesia QI scores mimicked known patterns in service coverage[9], with quality gradually decreasing with distance from the Java/Bali island groups. In the Philippines there are distinct differences between the capital and all other regions, largely paralleling the economic divide seen within the country[149]. In Cambodia, where multiple survey rounds allowed for comparison not only in overall QI scores but also improvements over time, the capital remained stagnant while predominantly rural regions shows great improvements, in a reversal of expected trends[168,170].

These differences in regional QI patterns appear to reflect the very different experiences these countries have had with regards to recent health reforms. In Indonesia decentralisation of health services occurred very quickly, and limited human and financial capacity in already underdeveloped areas is believed to have exacerbated regional differences in terms of health outcomes and service delivery[9,12,93,109,110,124] despite the expansion of social insurance programs increasing coverage of services [133,188] . As a result, it is not surprising that these local barriers to the provision of maternal and neonatal care also appear to drive the quality of these services.

In the Philippines the regions used in the DHS sampling frame do not align with the LGUs responsible for service provision, however the quality divide between Manila and other parts of the country echoes known limitations with regards to local planning and budgeting[143] as well as competition between local governments for human and physical resources[63,124]. Similarly, while expansions to the PhilHealth insurance scheme appear to have increased overall coverage of MNCH services among the poor[137,140], the limited availability of accredited facilities outside urban regions, as well as still considerable OOP expenses[189,190] limits access to higher levels of care. In combination this has resulted in a situation where access to good quality care is largely driven by wealth based considerations.

In contrast Cambodia has had a much slower move towards decentralisation, working through pre-existing models based on contracting of services to NGOs[156,160,191], and implementing a number of health financing and system strengthening initiatives over the same period[12,161-163]. As a result, the country appears to be having success in ensuring local capacity is sufficient to ensure services are delivered in an appropriate fashion with remarkable improvements not only in service utilisation, but also quality of care.

Understanding these interactions between quality of care and health system functionality is essential in designing appropriate quality improvement initiatives to address health inequalities. In the Philippines for example, the majority of quality improvement initiatives have historically been focused on facility accreditation[144,192,193], particularly within the private sector, with the limited trial of performance based financing schemes in some areas[155,194,195]. However the results of this study suggest that it is in fact quality of care at the primary health level that is most likely to impact upon the most disadvantaged segments of the population; those who can access the higher level facilities targeted by existing quality improvement initiatives already appear to be doing so, and unless the quality of care at lower level government facilities improves it is likely that existing health inequalities will not diminish.

In contrast, Cambodian efforts to target known deficiencies at the primary health level, including insufficient remuneration of staff[162] and limited local accountability[166] have resulted in large quality gains among the poor and rural parts of the population who utilise these services. While access to EMOC in these areas remains problematic[160] and may limit the effect of these gains on health outcomes, this demonstrates the potential impact well targeted programs may have and the importance of analyses like this in exploring equity based variation in quality of care.

Indonesia provides an interesting contrast to the situation seen in Cambodia. While government policies have promoted the use of the primary health system, particularly for those covered by social insurance programs[125] , use of these facilities is extremely low, with the vast majority of Indonesian women who delivery in a facility doing so within the private sector, often in small practices with a limited number of staff. Concerns regarding the quality and availability of services at primary facilities[125,131,133] lead to women preferring to deliver elsewhere, which in the case of poor women may often involve home based delivery. This results in the somewhat counterintuitive situation whereby this facility type is associated with the highest QI scores of any SBA provider. It appears that those who use these facilities tend to be from areas where access to other facility types is limited and coverage of MNCH services is low - if primary facilities are of insufficient quality women may simply choose to deliver at home. In regions where other types of services are available, many will choose to utilise private providers.

This leads to another major theme identified in this analysis; quality of care within the private sector. Quality concerns are often cited as reasons for patients preferring private over public care globally[196], and such facilities are heavily utilised by those who can afford it[134,197]. The results of this study, suggest that in the Southeast Asian context, private providers are not generally associated with higher quality of routine care. While at first glance the assumption of higher quality appears to be borne out by the Philippines analysis, once regional variation in service use are accounted for (that is, the much greater use of private facilities in better resourced areas such as metropolitan Manila), government and private facilities appear to be of similar quality. As a counterpoint, in Cambodia private facilities are associated with much lower QI scores than public providers, despite their relatively wealthier clientele. Overprovision of care for financial incentives[20] and a desire to meet patient expectations[4,66] may potentially explain part of these findings, and it emphasises the need to monitor quality of care within the private sector and formulate policies to assist these providers in maintaining high standards of care.

While it did not prove feasible to provide an in depth analysis of quality of care across countries due to the limitations mentioned in the previous section, it is apparent that despite their similarities, Indonesia, Cambodia and the Philippines have had very different experiences with regards to quality of care following the expansion of maternal and neonatal health services. The remarkable improvements seen among disadvantaged groups in Cambodia are particularly impressive when compared to the better performing groups in Indonesia and the Philippines.

However, with the increasing focus on achieving universal health care through the expansion of pro-poor health policies in Southeast Asia[2,198], the ability to compare and contrast quality of care not only between groups within a country, but also against their counterparts in other countries, may prove to be an important tool for both policy design and advocacy well into the future.

10 Conclusions

If the health of mothers and newborns in developing countries is to improve it is essential that existing discrepancies in quality of care be identified and addressed. In the absence of good quality HIS, these efforts are reliant on the ability of large scale surveys such as the DHS to measure quality of care across many different population groups. This study has shown that not only is this method of analysis feasible, but it can provide important insights into how health system factors can influence patterns of good quality care.

In the context of Southeast Asia, the examples of Indonesia, Cambodia and the Philippines demonstrate that large increases in the coverage of maternal and neonatal services following large scale health reforms can hide considerable variation in quality of care. These variations do not always fall along expected lines – while wealth remains an important consideration, the importance of the functionality of local health systems in determining not only access to care, but also the quality of care on offer, cannot be underestimated. Quality of care in the primary health system is particularly critical due to its role in providing care to the poor and regional areas. As countries move towards UHC, it is imperative that government policies target not only financial barriers to care among disadvantaged communities, but also the quality of care available at the facilities they utilise.

These findings thus represent not only an important step forward in understanding inequity in the quality of maternal and neonatal care in Southeast Asia, but also provide an important tool to assist researchers and health policymakers globally in understanding and addressing these issues within their own local contexts. Through measuring and understanding variation in quality of care, we may help to ensure a healthier and more equitable future for women and neonates worldwide.

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12 Appendices

12.1 Appendix 1 – Published Work Relating to Thesis

Sections of early drafts of Chapters 2 and 3 including preliminary methodology and results from the Indonesia 2012 dataset were published in the Peer-Reviewed journal PLOS ONE in 2016. There have been substantial revisions to both methodology and results since the time of publication, and as a result it is not included here as part of the thesis.

All authors contributed to the design of the project, with Hebe Gouda, Andrew Hodge and Eliana Jimenez Soto acting as members of Zoe Dettrick's supervisory team. Zoe Dettrick was the primary contributor to the methodology and conducted the analysis, Hebe Gouda assisted with the final drafts. The full citation is:

Dettrick Z, Gouda HN, Hodge A, Jimenez-Soto E. Measuring Quality of Maternal and Newborn Care in Developing Countries Using Demographic and Health Surveys. PLOS ONE. 2016;11(6):e0157110. doi: 10.1371/journal.pone.0157110.]

And the paper may be found online at
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0157110

12.2 Appendix 2 – Results from Random Sampling

Table 12.2.1 PCA derived Variable Weights from 10 Random Subsamples of Indonesia 2012 dataset

Indicators		**All**	**Random Samples**										**Range**
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
ANC visit in 1st Trimester		**0.164**	0.159	0.168	0.167	0.161	0.158	0.169	0.160	0.167	0.167	0.160	0.011
ANC visit in 2nd Trimester		**0.150**	0.147	0.154	0.151	0.149	0.147	0.154	0.154	0.147	0.150	0.151	0.007
ANC visits in 3rd Trimester	1	**-0.012**	-0.009	-0.015	-0.012	-0.012	-0.011	-0.013	-0.012	-0.012	-0.013	-0.010	0.006
	2	**0.186**	0.185	0.187	0.187	0.185	0.185	0.187	0.190	0.182	0.185	0.187	0.007
	None	**-0.174**	-0.177	-0.172	-0.175	-0.173	-0.174	-0.174	-0.178	-0.171	-0.172	-0.177	0.007
Weight measured during ANC		**0.171**	0.170	0.171	0.167	0.174	0.168	0.173	0.174	0.167	0.174	0.168	0.007
Height measured during ANC		**0.186**	0.180	0.192	0.184	0.188	0.192	0.181	0.182	0.190	0.185	0.187	0.011
Blood Pressure measured during ANC		**0.155**	0.154	0.155	0.154	0.155	0.150	0.159	0.156	0.153	0.157	0.153	0.009
Urine sample taken during ANC		**0.196**	0.195	0.197	0.197	0.195	0.202	0.191	0.195	0.197	0.200	0.192	0.011
Blood sample taken during ANC		**0.166**	0.165	0.166	0.165	0.166	0.168	0.163	0.173	0.158	0.169	0.163	0.015
Stomach examined during ANC		**0.122**	0.121	0.122	0.119	0.125	0.118	0.125	0.122	0.121	0.124	0.119	0.007
Consultation during ANC		**0.190**	0.188	0.192	0.189	0.192	0.191	0.189	0.192	0.188	0.191	0.189	0.004
Received MNCH book during ANC		**0.197**	0.198	0.196	0.199	0.195	0.200	0.194	0.199	0.195	0.199	0.195	0.005
Iron Supplementation during pregnancy	Full (270+ days)	**0.020**	0.019	0.020	0.020	0.020	0.022	0.018	0.020	0.020	0.020	0.019	0.004
	Partial (1-269 days)	**0.200**	0.203	0.197	0.203	0.197	0.198	0.202	0.198	0.202	0.197	0.203	0.007
	None	**-0.220**	-0.222	-0.218	-0.223	-0.216	-0.220	-0.219	-0.217	-0.222	-0.218	-0.222	0.006
Tetanus Immunisation	Full	**0.206**	0.201	0.210	0.202	0.209	0.206	0.205	0.206	0.204	0.198	0.213	0.015

	Partial	**-0.020**	-0.018	-0.022	-0.022	-0.018	-0.024	-0.016	-0.022	-0.018	-0.015	-0.025	0.011
	None	**-0.186**	-0.183	-0.188	-0.180	-0.191	-0.182	-0.189	-0.184	-0.187	-0.183	-0.188	0.011
Pregnancy complication Advice	Symptoms only	**0.000**	0.000	0.000	0.001	0.000	0.000	0.000	0.001	-0.001	-0.001	0.001	0.003
	Symptoms and Help	**0.263**	0.263	0.263	0.263	0.263	0.263	0.262	0.260	0.265	0.262	0.264	0.004
	None	**-0.263**	-0.262	-0.263	-0.263	-0.262	-0.263	-0.262	-0.262	-0.264	-0.261	-0.264	0.003
Discussed place of delivery during pregnancy		**0.210**	0.214	0.206	0.215	0.206	0.208	0.212	0.210	0.210	0.211	0.209	0.009
Discussed transportation to place of delivery during pregnancy		**0.246**	0.248	0.244	0.245	0.247	0.250	0.242	0.244	0.248	0.246	0.246	0.008
Discussed who would assist delivery during pregnancy		**0.198**	0.199	0.197	0.200	0.197	0.195	0.202	0.195	0.201	0.201	0.195	0.007
Discussed payment for delivery during pregnancy		**0.207**	0.208	0.207	0.210	0.204	0.209	0.205	0.202	0.213	0.208	0.206	0.011
Discussed possible blood donor during pregnancy		**0.103**	0.100	0.107	0.102	0.105	0.109	0.098	0.105	0.102	0.105	0.102	0.010
Baby was weighed at birth		**0.153**	0.150	0.155	0.155	0.150	0.151	0.154	0.155	0.150	0.154	0.151	0.005
Baby was breastfed within 1 hr of birth		**0.030**	0.029	0.031	0.034	0.026	0.023	0.037	0.031	0.029	0.029	0.032	0.014
Maternal postnatal check	<2hrs	**0.140**	0.139	0.141	0.137	0.143	0.138	0.142	0.135	0.145	0.141	0.139	0.011
	3+ hrs	**0.009**	0.012	0.005	0.006	0.011	0.010	0.007	0.012	0.005	0.007	0.010	0.007
	None	**-0.148**	-0.151	-0.146	-0.143	-0.154	-0.147	-0.149	-0.146	-0.151	-0.147	-0.149	0.012
Neonatal postnatal check	<2hrs	**0.133**	0.135	0.131	0.136	0.130	0.135	0.131	0.133	0.134	0.132	0.135	0.006
	3+ hrs	**0.045**	0.051	0.040	0.040	0.051	0.046	0.045	0.050	0.041	0.049	0.042	0.011

	None	**-0.179**	-0.186	-0.171	-0.176	-0.181	-0.181	-0.177	-0.182	-0.175	-0.181	-0.176	0.015
Postpartum Vitamin A within 2 months of delivery		**0.154**	0.155	0.153	0.156	0.152	0.154	0.154	0.158	0.150	0.149	0.159	0.009
Rho		**0.202**	0.202	0.202	0.202	0.202	0.197	0.207	0.204	0.200	0.204	0.200	

12.3 Appendix 3 – Testing of Regression Model, Indonesia 2012

Multiple regression relies on several assumptions if the resulting model is to be considered as an appropriate predictor of the dependent variable; that independent variables are normally distributed and exhibit a linear relationship with the dependent variable, that there is limited multicollinearity between independent variables and that there is constant error variance across all predicted values [69] Unfortunately, due to the use of weighted regression to produce appropriately representative results, and the use of categorical variables, many statistical tests used to identify issues relating to issues such as heteroscedasticity (non-constant variance in error) are unavailable.

Figure 12.3.1 shows a plot of residuals against predicted values in the regression: while the overall shape of the data does not contradict an assumption of linearity, it does appear to potentially have issues relating to normal distribution and potentially heteroscedasticity. A density plot of residual scores shown in Figure 12.3.2 shows that while the residuals appear close to normal distribution they also exhibit notable kurtosis – a Shapiro-Wilk W test for normality rejected the assumption that residuals were normally distributed (p=0.00).

This echoes the distribution of the underlying QI score, which while standardised similarly has a calculated Kurtosis of 2.68. Similarly, the distinctly non-random distribution of residuals in the top right of the graph suggests that the assumption of constant error variance is not met.

Figure 12.3.1 Plot of residuals vs predicted values, linear regression, Indonesia 2012

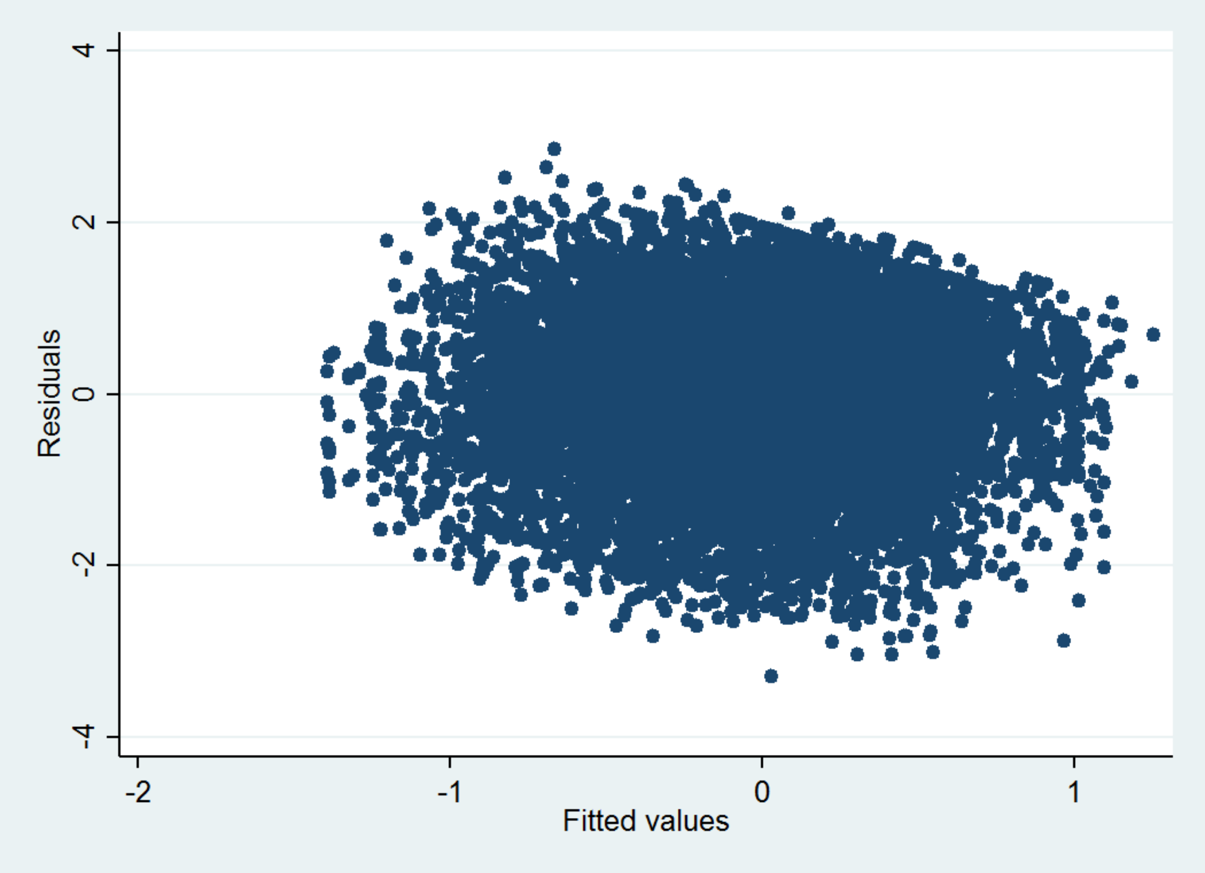
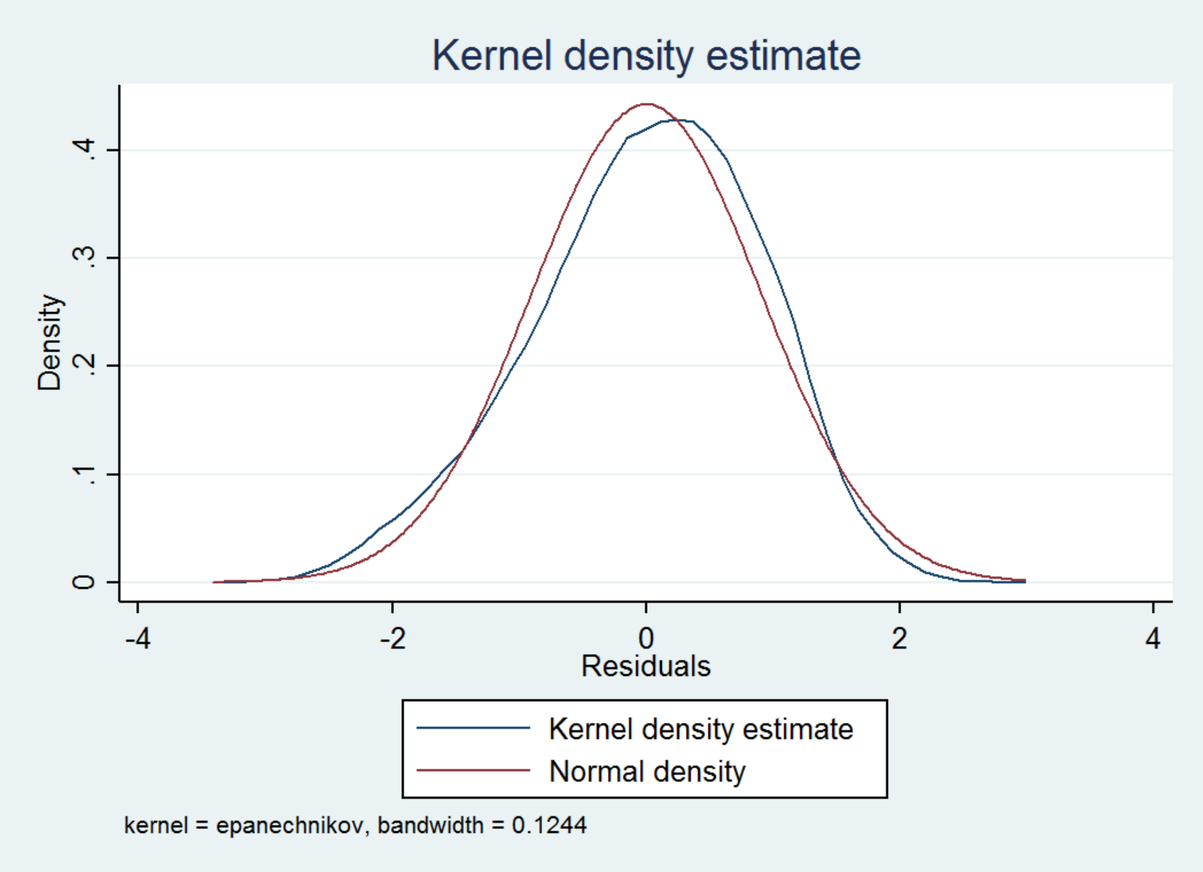


Figure 12.3.2 Density plot of residuals, linear regression, Indonesia 2012



Given the known relationships between education, wealth, age and place of residence, there is considerable scope for this model to be affected by multicollinearity between the variables. Variance inflation factors (VIF) measure the extent to which the estimated regression coefficients for an independent variable are inflated due to linear dependence on other independent variables [69]. Table 12.3.3 shows the VIF calculated for each of the variables in the model - the majority of variables have VIFs less than 2, suggesting that multicollinearity is not a substantial problem in this model.

Table 12.3.3 VIF for Independent Variables in Linear Regression Model, Indonesia 2012

Variable	**VIF**	**1/VIF**	**Variable**	**VIF**	**1/VIF**
RURAL-URBAN			REGION		
Urban	1.38	0.725437	Aceh	1.35	0.742154
Rural			North Sumatera		
AGE			West Sumatera	1.35	0.741806
<25 yrs			Riau	1.45	0.68826
25-34yrs	1.88	0.530804	Jambi	1.2	0.835017

35+ yrs	2.15	0.465485	South Sumatera	1.57	0.638938
EDUCATION			Bengkulu	1.11	0.902131
Primary or Lower			Lampung	1.55	0.64378
Some Secondary	1.57	0.637208	Bangka Belitung	1.11	0.898603
Completed Seconday	1.88	0.530664	Riau Islands	1.15	0.872013
Higher Education	1.88	0.531277	Jakarta	1.79	0.5599
WEALTH			West Java	3.54	0.282579
Poorest			Central Java	3.09	0.32397
Poorer	2.04	0.489809	Yogyakarta	1.24	0.804433
Middle	2.32	0.431914	East Java	3.5	0.28544
Richer	2.72	0.367616	Banten	1.77	0.565924
Richest	3.23	0.309548	Bali	1.3	0.770345
SBA PROVIDER			West Nusa Tenggara	1.51	0.662417
Home SBA			East Nusa Tenggara	1.32	0.7585
Public Hospital/Clinic	1.56	0.641846	West Kalimantan	1.27	0.790038
Public Non-Hospital/Clinic	1.42	0.70364	Central Kalimantan	1.15	0.867666
Private Hospital/Clinic	1.89	0.529672	South Kalimantan	1.26	0.7931
Private Non-Hospital/Clinic	2.06	0.484702	East Kalimantan	1.26	0.79387
Other	1.02	0.981647	North Sulawesi	1.14	0.874619
PARITY			Central Sulawesi	1.16	0.860351
1	4.38	0.228399	South Sulawesi	1.46	0.684658
2	3.3	0.302932	Southeast Sulawesi	1.14	0.880442
3	2.1	0.475163	Gorontalo	1.07	0.934901
4+			West Sulawesi	1.05	0.955907
			Maluku	1.07	0.936004
			North Maluku	1.05	0.951954
			West Papua	1.05	0.955804
			Papua	1.1	0.909372
Mean VIF		**1.72**			

12.4 Appendix 4 – Country Results using EW Core Indicator QI

Table 12.4.1 Mean QI Scores using Core DHS Indicators and EW, Indonesia 2012

Indonesia	Mean	SE	95% CI	
Urban	0.090	0.012	0.066	0.114
Rural	-0.102	0.014	-0.129	-0.075
15-19	-0.199	0.050	-0.298	-0.100
20-24	-0.081	0.021	-0.123	-0.040
25-29	0.011	0.017	-0.023	0.045
30-34	0.030	0.018	-0.006	0.066
35-39	0.071	0.022	0.027	0.115
40-44	-0.025	0.035	-0.095	0.044
45-49	-0.004	0.090	-0.181	0.172
No education	-0.360	0.102	-0.559	-0.161
Incomplete primary	-0.321	0.036	-0.392	-0.250
Complete primary	-0.041	0.022	-0.084	0.002
Incomplete secondary	-0.056	0.018	-0.091	-0.020
Complete secondary	0.066	0.016	0.035	0.097
Higher	0.168	0.022	0.124	0.211
Poorest	-0.242	0.022	-0.285	-0.198
Poorer	-0.049	0.021	-0.089	-0.009
Middle	-0.032	0.020	-0.071	0.006
Richer	0.104	0.019	0.066	0.142
Richest	0.220	0.020	0.182	0.259
Home SBA	-0.302	0.017	-0.336	-0.268
Public Hospital/Clinic	0.069	0.021	0.028	0.111
Public Non-Hospital/Clinic	0.407	0.031	0.347	0.468
Private Hospital/Clinic	0.049	0.020	0.009	0.089
Private Non-Hospital/Clinic	0.135	0.017	0.102	0.169

Other	-0.390	0.140	-0.664	-0.116
Aceh	-0.328	0.046	-0.418	-0.238
North Sumatera	-0.978	0.034	-1.045	-0.912
West Sumatera	-0.073	0.045	-0.161	0.014
Riau	-0.592	0.041	-0.672	-0.513
Jambi	-0.280	0.059	-0.395	-0.164
South Sumatera	-0.434	0.045	-0.523	-0.345
Bengkulu	0.005	0.056	-0.105	0.115
Lampung	-0.056	0.045	-0.144	0.031
Bangka Belitung	0.053	0.050	-0.044	0.151
Riau Islands	-0.340	0.055	-0.447	-0.232
Jakarta	0.480	0.031	0.418	0.541
West Java	0.231	0.040	0.152	0.310
Central Java	0.410	0.039	0.333	0.487
Yogyakarta	0.850	0.043	0.766	0.933
East Java	0.228	0.039	0.152	0.303
Banten	0.297	0.041	0.217	0.378
Bali	0.241	0.038	0.167	0.316
West Nusa Tenggara	0.685	0.048	0.592	0.779
East Nusa Tenggara	0.709	0.054	0.604	0.814
West Kalimantan	-0.515	0.047	-0.607	-0.423
Central Kalimantan	-0.041	0.061	-0.161	0.078
South Kalimantan	0.231	0.052	0.128	0.333
East Kalimantan	0.207	0.054	0.101	0.312
North Sulawesi	-0.241	0.050	-0.338	-0.144
Central Sulawesi	-0.178	0.057	-0.289	-0.066
South Sulawesi	0.145	0.050	0.048	0.242
Southeast Sulawesi	-0.259	0.059	-0.374	-0.143
Gorontalo	-0.363	0.055	-0.470	-0.256
West Sulawesi	-0.116	0.067	-0.247	0.015
Maluku	-0.535	0.066	-0.665	-0.405
North Maluku	0.098	0.067	-0.034	0.230

West Papua	-0.271	0.059	-0.387	-0.156
Papua	-0.147	0.078	-0.301	0.006

Table 12.4.2 Mean QI Scores using Core DHS Indicators and EW, Philippines 2013

Philippines	Mean	SE	95% CI	
Urban	0.116	0.022	0.072	0.159
Rural	-0.107	0.023	-0.153	-0.061
15-19	-0.340	0.070	-0.476	-0.203
20-24	-0.099	0.035	-0.167	-0.031
25-29	0.090	0.033	0.025	0.154
30-34	0.085	0.032	0.022	0.148
35-39	0.066	0.041	-0.014	0.146
40-44	-0.073	0.062	-0.195	0.048
45-49	-0.181	0.116	-0.408	0.047
No education	-0.755	0.238	-1.221	-0.288
Incomplete primary	-0.161	0.076	-0.309	-0.013
Complete primary	-0.248	0.060	-0.366	-0.130
Incomplete secondary	-0.220	0.042	-0.303	-0.137
Complete secondary	-0.028	0.027	-0.081	0.026
Higher	0.215	0.025	0.167	0.264
Poorest	-0.211	0.043	-0.295	-0.127
Poorer	-0.107	0.035	-0.176	-0.038
Middle	0.012	0.034	-0.054	0.078
Richer	0.052	0.034	-0.016	0.119
Richest	0.261	0.034	0.194	0.327
Home SBA	-0.594	0.047	-0.685	-0.502
Public Hospital	0.055	0.023	0.009	0.101
Public Health Centre	0.101	0.040	0.022	0.180
Private Hospital/Clinic	0.208	0.032	0.146	0.271

Other	-0.033	0.071	-0.171	0.105
National Capital Region	0.431	0.035	0.362	0.500
Cordillera Admin Region	0.278	0.070	0.139	0.416
I - Ilocos Region	-0.481	0.065	-0.608	-0.354
II - Cagayan Valley	-0.180	0.079	-0.334	-0.026
III - Central Luzon	-0.228	0.048	-0.323	-0.134
IVA - CALABARZON	-0.216	0.047	-0.307	-0.125
IVB - MIMAROPA	0.104	0.092	-0.076	0.284
V - Bicol	-0.506	0.080	-0.663	-0.349
VI - Western Visayas	0.380	0.061	0.260	0.499
VII - Central Visayas	0.109	0.062	-0.013	0.231
VIII - Eastern Visaya	0.167	0.085	-0.001	0.334
IX - Zamboanga Peninsula	-0.133	0.070	-0.271	0.004
X - Northern Mindanao	0.106	0.082	-0.055	0.266
XI - Davao	0.281	0.062	0.158	0.403
XII - SOCCSKSARGEN	-0.170	0.079	-0.326	-0.014
XIII - Caraga	-0.021	0.066	-0.150	0.107
ARMM	-0.918	0.120	-1.152	-0.683

Table 12.4.3 Mean QI Scores using Core DHS Indicators and EW, Cambodia 2010

Cambodia 2010	Mean	SE	95% CI	
Urban	0.182	0.024	0.135	0.228
Rural	-0.099	0.019	-0.137	-0.061
15-19	0.094	0.079	-0.062	0.249
20-24	0.021	0.031	-0.039	0.081
25-29	0.059	0.025	0.009	0.109
30-34	0.015	0.034	-0.052	0.082
35-39	-0.137	0.047	-0.229	-0.044
40-44	-0.200	0.064	-0.326	-0.075
45-49	-0.279	0.132	-0.539	-0.020

No education	-0.292	0.047	-0.385	-0.199
Incomplete primary	-0.106	0.024	-0.152	-0.060
Complete primary	0.052	0.047	-0.041	0.144
Incomplete secondary	0.152	0.026	0.101	0.203
Complete secondary	0.417	0.064	0.292	0.542
Higher	0.491	0.077	0.339	0.643
Poorest	-0.223	0.042	-0.305	-0.141
Poorer	-0.180	0.040	-0.258	-0.101
Middle	-0.048	0.035	-0.117	0.022
Richer	-0.017	0.032	-0.079	0.045
Richest	0.241	0.025	0.191	0.291
Home SBA	-0.558	0.033	-0.623	-0.492
Public Hospital	0.218	0.027	0.165	0.272
Public Health Centre	0.122	0.024	0.076	0.168
Private Hospital/Clinic	0.089	0.038	0.015	0.163
Other	-0.502	0.217	-0.928	-0.077
Banteay Mean Chey	0.028	0.063	-0.095	0.151
Kampong Cham	-0.661	0.061	-0.781	-0.542
Kampong Chhnang	0.317	0.051	0.217	0.416
Kampong Speu	0.491	0.056	0.381	0.601
Kampong Thom	0.056	0.064	-0.069	0.181
Kandal	-0.194	0.063	-0.318	-0.070
Kratie	-0.354	0.058	-0.468	-0.240
Phnom Penh	0.509	0.048	0.415	0.604
Prey Veng	0.183	0.067	0.052	0.314
Pursat	0.347	0.066	0.217	0.477
Siem Reap	0.674	0.046	0.583	0.764
SvayRieng	-0.090	0.062	-0.211	0.031
Takeo	-0.132	0.060	-0.250	-0.015
Otdar Mean Chey	-0.070	0.060	-0.188	0.047
Battambang & Pailin	-0.136	0.072	-0.277	0.005
Kampot & Kep	-0.532	0.073	-0.676	-0.388

Preah Sihanouk & Kaoh Kong	-0.148	0.066	-0.278	-0.018
Preah Vihear & Steung Treng	-0.356	0.070	-0.494	-0.218
Mondol Kiri & Rattanak Kiri	-0.617	0.062	-0.737	-0.496

Table 12.4.4 Mean QI Scores using Core DHS Indicators and EW, Cambodia 2014 (No Vitamin A)

Cambodia 2014	Mean	SE	95% CI	
Urban	-0.064	0.025	-0.113	-0.016
Rural	0.028	0.017	-0.005	0.061
15-19	-0.471	0.081	-0.630	-0.312
20-24	-0.005	0.028	-0.060	0.050
25-29	0.061	0.024	0.014	0.108
30-34	0.060	0.026	0.008	0.111
35-39	-0.047	0.047	-0.139	0.044
40-44	-0.171	0.083	-0.334	-0.009
45-49	-0.326	0.168	-0.656	0.005
No education	-0.128	0.047	-0.219	-0.036
Incomplete primary	-0.049	0.024	-0.095	-0.002
Complete primary	0.047	0.042	-0.035	0.128
Incomplete secondary	0.047	0.024	0.000	0.093
Complete secondary	0.110	0.056	0.000	0.219
Higher	0.168	0.062	0.046	0.291
Poorest	-0.035	0.036	-0.106	0.036
Poorer	0.005	0.034	-0.063	0.072
Middle	0.037	0.033	-0.028	0.102
Richer	0.080	0.030	0.020	0.139
Richest	-0.058	0.025	-0.108	-0.009
Home SBA	-0.581	0.075	-0.728	-0.435
Public Hospital	-0.007	0.025	-0.056	0.043

Public Health Centre	0.125	0.019	0.088	0.163
Private Hospital/Clinic	-0.158	0.033	-0.223	-0.092
Other	-1.201	0.267	-1.724	-0.678
Banteay Mean Chey	-0.228	0.054	-0.335	-0.122
Kampong Cham	-0.367	0.065	-0.494	-0.239
Kampong Chhnang	0.706	0.039	0.628	0.783
Kampong Speu	-0.171	0.050	-0.269	-0.073
Kampong Thom	0.820	0.042	0.737	0.903
Kandal	-0.104	0.065	-0.232	0.023
Kratie	-0.173	0.062	-0.294	-0.053
Phnom Penh	-0.409	0.050	-0.507	-0.312
Prey Veng	0.307	0.056	0.197	0.417
Pursat	0.379	0.055	0.272	0.487
Siem Reap	0.040	0.056	-0.070	0.151
SvayRieng	-0.035	0.062	-0.157	0.086
Takeo	0.242	0.057	0.130	0.354
Otdar Mean Chey	0.248	0.057	0.136	0.359
Battambang & Pailin	0.045	0.060	-0.073	0.162
Kampot & Kep	-0.321	0.067	-0.452	-0.191
Preah Sihanouk & Kaoh Kong	0.184	0.057	0.073	0.295
Preah Vihear & Steung Treng	-0.138	0.063	-0.261	-0.015
Mondol Kiri & Rattanak Kiri	-0.857	0.048	-0.952	-0.762