PATTERNS OF AGING IN ADULTS WITH INTELLECTUAL DISABILITIES

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By

Lilian Thorpe

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ABSTRACT

Changes in health care and increasing provision of community services have resulted in an increased number of community dwelling older adults with intellectual disabilities (ID), leading to questions about future planning for service delivery. Although selected aspects of functioning have been explored in various research studies, less longitudinal information pertaining to broad aspects of health is available to planners. This longitudinal project was designed over 10 years ago with the primary purpose of exploring individual and systemic issues in the health needs of this challenging population, leading to improved service planning.

Cross-sectional and longitudinal health data were collected from 360 adults with intellectual disabilities (ID) recruited from social services agencies from across the province of Saskatchewan. Data collection included caregiver information, chart information and directly administered tests of selected aspects of cognitive functioning. Formal data-collection occurred every second year for a maximum of four test times, and was supplemented by follow-up phone calls.

Analysis of study results showed that young, rather than older people without DS had a greater severity of health needs related to their underlying conditions, and more problematic behavioral and mental health issues. The reason for this was likely the increased survival of multiply handicapped young people, and the increasing trend for these people to be maintained in the community rather than in large institutions. This population was more likely to receive psychotropic medications, both for underlying problems such as seizure disorders, but also for difficult behaviors such as aggression.

On the other hand, adults with DS had relatively fewer problems in their younger adult years, but had increasing problems as they aged. Most aspects of functioning were decreased in the older compared to the younger cohorts, which was consistent with the

longitudinal, individual level data showing yearly declines in most measured skills. These declines were greater than those found in adults without DS. Although yearly declines were noted in most age cohorts, the largest declines were noted in the oldest age groups, 50 years and over, suggesting that, while aging related decline was present from an early age, declines severe enough to suggest a dementing process probably do not start until after middle age. Declines in visual memory appear to precede those in praxis.

Mortality was increased with age, lower baseline functioning, DS, male gender, and baseline depressive symptoms.

The use of aging programs did not change much during the course of the study, but interesting differences in service use between people with and without DS were noted. Adults with DS were more likely than those without DS to participate in generic aging services, which was thought to be due to people with DS presenting with more typical, Alzheimer type behaviors, rather than severe behaviors such as aggression.

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LIST OF ABBREVIATIONS

AAMR	American Association on Mental Retardation
AD	Alzheimer's Disease
APA	American Psychiatric Association
ABS	Adaptive Behavior Scale
ATYP	Atypical antipsychotic medication (such as risperidone)
CAMDEX	Cambridge Examination for Mental Disorders of the Elderly
CLD	Community Living Division of the Department of Community Resources and Employment, Government of Saskatchewan
CSHA	Canadian Study of Health and Aging
DCR-10	Diagnostic Criteria for Research of ICD-10
DCRE	Department of Community Resources and Employment, Government of Saskatchewan
DMR	Dementia Questionnaire for Persons with Mental Retardation
DMR-STM	Short-term memory subscale of the DMR
DMR-LTM	Long-term memory subscale of the DMR
DMR-SPA	Spatial and temporal orientation subscale of the DMR
DMR-SPE	Speech subscale of the DMR
DMR-PRA	Practical skills subscale of the DMR
DMR-MOOD	Mood subscale of the DMR
DMR-ACT	Activities and interest subscale of the DMR
DMR-BEH	Behaviour subscale of the DMR
DMR-SCS	Sum of cognitive scores subscore of the DMR
DMR-SOS	Sum of social scores subscore of the DMR
DMTS	Delayed Match to Sample
DRS	Dementia Rating Scale
DSM	Diagnostic and Statistical Manual Of Mental Disorders
DSMIIIR	Diagnostic and Statistical Manual Of Mental Disorders, third edition, revised
DSMIV	Diagnostic and Statistical Manual Of Mental Disorders, fourth edition
DSMSE	DS Mental Status Examination
DS	Down Syndrome
ICD-10	International Classification of Diseases, 10th Revision
ID	Intellectual disability
IQ	Intelligence Quotient
GDS	Global Deterioration Scale
GEE	Generalized Estimation Equations
MMSE	Mini-Mental State Examination
MRI	Magnetic Resonance Imaging
MOSES	Multi-Observational Scale for Elderly Subjects
NINCDS/ADRDA	National Institute of Neurological and Communicative Diseases and Stroke/Alzheimer's Disease and Related Disorders

	Association
NPHS	National Population Health Survey
NSAIDS	Nonsteroidal Anti-Inflammatory Drugs
PPVT-R	Peabody Picture Vocabulary Test-Revised
QOL	Quality of Life
SPSS	Statistical Package for the Social Sciences
TYP	Typical antipsychotic medication (for example haloperidol)
TYP-ATYP	Typical and atypical antipsychotic medication
WHO	World Health Organization
WISC-R	Wechsler Intelligence Scale for Children-Revised

1. INTRODUCTION

1.1 Initiation of the study

This study was prompted by community caregiver awareness and concern about the increasing numbers of adults with intellectual disabilities (ID) and dementia (especially those with Down Syndrome (DS)). Caregivers from Elmwood Lodge in Saskatoon expressed to this author that they wished to learn more about the assessment of dementia in adults with intellectual disabilities, and that they were experiencing some difficulties already in meeting care needs of their clients already suffering with dementia. They wanted to know how much the cognitively impaired population with intellectual disabilities was expected to increase in the future, as this would affect the services they would need to provide. Particular questions were raised about where services for adults with intellectual disabilities and dementia would best be provided. Choices available at the time of initiation of this study included continuing care in a facility designed for adults with intellectual disabilities, which might require modification of physical environments, or discharge to a nursing home with specialized facilities for dementia care. Prior to beginning the study, specialized day programs for older adults with intellectual disabilities were not yet available in the Saskatoon region.

The study that forms the basis for this thesis was therefore initially conceived to collect information to help with future service planning for aging adults with intellectual disabilities, particularly those with progressive, age related cognitive impairment.

1.2 Background Information and problem statement

Although the likelihood that people with childhood onset intellectual disabilities will reach old age is still reduced compared to the general population, over the last few years their life expectancy has increased throughout the western world (Janicki, Dalton, Henderson & Davidson, 1999). This has led to an increased number of people with ID and aging-related health problems such as dementia, which has resulted in changes in social and service delivery needs. Service needs for this population are further increased because of continuing deinstitutionalization of people with ID, resulting in increased community presence of people with high physical and mental morbidities.

Certain subgroups of people with ID have specific increased age-related risks, such as those with DS, who have a genetically based increased risk for dementia (Janicki & Dalton, 2000). Others, such as those with cerebral palsy (CP) have been noted to have a high risk of physical aging related deterioration, particularly relating to mobility (Strauss, Ojdana, Shavelle & Rosenbloom, 2004), sometimes starting in young adulthood (Jahnsen, Villien, Egeland, Stanghelle & Holm, 2004).

The demonstrated demographic pattern of increased longevity in people with ID points to a continued future increase in the proportion of older adults with ID, but does not adequately address the more significant changes in the prevalence of associated physical, mental and behavioural problems, as well as functional deficits in these cohorts, which will have an impact on their need for support. Even in currently older adults with ID there is a dearth of broad, linked data that would be helpful to planners, but more problematically, these cohorts may not be good models for the future extrapolation. Current older adults have lived vastly different lives than cohorts who will be the older adults of tomorrow, and these differences will very likely have a profound effect on all aspects of intellectual, emotional, medical and functional outcomes in late life. Extrapolating care requirements for older adults with ID from older adults without ID is

not appropriate, as those with ID have had more restricted life experiences, with reduced functional independence and coping skills, and generally have no adult children to assist in late life functioning.

1.3 Purpose of study

The purpose of this study was to explore biological, psychological, and functional aspects of the health of adults with ID, exploring cross-sectional predictive factors relating to birth cohort (age and diagnostic category), as well as predictive factors for individual longitudinal changes. The study also sought to study issues related to care provision and the use of psychotropic medications.

Measured health outcomes to be included were to be mortality patterns, physical and mental health symptoms, functional abilities and selected dementia related abilities (memory, dyspraxia). Potential determinants of these health outcomes were to include age, sex, cause of intellectual disability, medication use (anti-inflammatories, hormonal therapies, psychotropic medications, vitamins), baseline mental health and premorbid intellectual functioning. Aspects of care provision to be studied were the perceived adequacy of services for physical, emotional, behavioural or psychiatric problems, the frequency of psychiatric contact, and the use of generic and aging-ID specialized aging services.

The study and its hypotheses were built on the basic tenets of the biopsychosocial model, which assumes that health, disease and functional abilities are a complex interplay of basic biological processes (such as genetics), psychological factors (such as behavior, learning and cognition) and social factors (such as culture, values, support and political organization), as well as environmental factors such as life events. For example, functional abilities in adults with DS are assumed to be affected to some extent by structural and neuropathological brain factors related to trisomy 21, but also by learned

behaviours and skills, as well as social opportunities and expectations present during the past and present years for individual cohorts.

1.4 Study questions

Many questions pertaining to aging and health in adults with ID were of interest, but not all questions were feasible to answer in a small, relatively short study such as this. Specific questions of clinical interest that had a reasonably expectation of being answered were therefore elucidated, and are shown below.

Epidemiology/Mortality

- What are the determinants of mortality in adults with ID?

Physical morbidity

- What is the pattern and frequency of physical morbidity in adults with ID?

Emotional, behavioural and psychiatric morbidity

- What is the pattern and frequency of emotional, behavioural and psychiatric morbidity in adults with ID?

Functional-cognitive decline

- How do functional abilities vary across diagnostic and age groups in adults with ID?
- What are the determinants of individual level change of functional abilities in adults with ID?
- How do specific neuropsychological functions associated with dementia, such as memory and praxis vary across diagnostic and age groups in adults with ID ?
- What are the determinants of individual level change in specific neuropsychological functions associated with dementia in adults with ID ?

Service provision

- How does provision of psychiatric care vary across diagnostic and age groups in adults with ID ?

- How do perceived deficits in service provision for physical, emotional, behavioural and psychiatric needs vary across diagnostic and age groups in adults with ID ?
- How do perceived deficits in service provision for physical, emotional, behavioural and psychiatric needs impact on participant re-institutionalization (for example, to a nursing home) in adults with ID .
- How does the use of specialized and generic aging programs vary across diagnostic and age groups in adults with ID ?
- Is there a change over time (individual longitudinal change or cross-sectional comparison) in the use of aging services for adults with ID?

Psychotropic medication

- How does the use of psychotropic medication vary across diagnostic and age groups in adults with ID ?
- Is there a change over time (individual longitudinal change or cross-sectional comparison) in the use of psychotropic medication in adults with ID ?

1.5 Hypotheses

The author's clinical experience working with adults who have ID was augmented by the known literature exploring aging issues in ID (summarized in the next chapter) to develop the following hypotheses relating to the study questions:

Epidemiology/Mortality

- Male gender, older age, more severe baseline impairments in physical and mental functioning, and a diagnosis of DS will be associated with increased mortality.

Physical morbidity

- Cross-sectional data on the general health of adults with ID will reveal more typical, aging related medical problems in older compared to younger cohorts with ID, but fewer severe health conditions related to genetic, chromosomal or

birth conditions.

Emotional, behavioural and psychiatric morbidity

- Emotional, behavioural and psychiatric problems will be more common in those without DS, particularly in the youngest cohorts.

Functional-cognitive decline

- Cross-sectional data from adults with ID without DS on behavioural and functional measures will reveal better functioning in mid-age compared to younger cohorts (related to continued learning and differential community placement), but poorer scores in the functions typically affected by aging in the oldest cohorts.
- Cross-sectional data from adults with ID and DS on behavioural and functional measures will reveal a pattern of poorer scores with older age starting with the youngest age cohorts.
- Longitudinal data from adults with ID on behavioural and functional measures (using a standardized caregiver instrument) will reveal yearly decline in most functions, most noticeably in the oldest cohorts, and more in those with DS compared to those without DS. Specific functions will exhibit different rates of decline.
- Cross-sectional data from adults with ID on specific neuropsychological measures (using standardized instruments to measure dyspraxia and visual memory) will not reflect continued learning (as in the case of functional data), but will show slightly lower functioning in older age cohorts, except in the oldest cohorts with DS, where scores will be more noticeably decreased.
- Longitudinal data from adults with ID on specific neuropsychological measures (using standardized instruments to measure dyspraxia and visual memory) will reveal a small yearly decline in most functions, most noticeably in the oldest cohorts, and more in those with DS compared to those without DS. Specific functions will exhibit different rates of decline.

Service provision

- Participants will be less likely than the underlying population to have seen a psychiatrist recently, but psychiatric contact will be more likely in younger people without DS and older people with DS compared to the total study group.
- Perceived deficits in service provision for emotional, behavioural or psychiatric problems will be greater than perceived deficits in service provision for physical problems. Younger participants without DS will have greater perceived deficits in service provision for physical, emotional, behavioural and psychiatric problems than older participants without DS, but older participants with DS will have perceived deficits in service provision for physical, emotional, behavioural and psychiatric problems than younger participants with DS.
- Perceived deficits in service provision for physical, emotional, behavioural and psychiatric needs will increase the likelihood of institutionalization (for example, to a nursing home), and this will be more pronounced for younger people with behavioural unmet service needs and older people with physical unmet service needs.
- Older participants will be more likely than younger participants to use aging programs. Older participants with DS will be more likely than older participants without DS to participate in a generic (rather than a specialized ID) aging program (because their behaviours will be more typical of a generic Alzheimer service population).
- The overall use of aging programs will increase over the time of the study.

Psychotropic medications

- Overall, people without DS will be more likely to use psychotropic medications than those with DS.
- Older people without DS will be more likely than younger people without DS to use sedative-hypnotic medication but less likely to use medications such as antipsychotics to treat behavior disorders.
- Older people with DS will be more likely than younger ones with DS to use antipsychotic, sedative hypnotic, and anxiolytic medications because of the

increased prevalence of dementia.

- Antidepressant use will be most common in middle-aged females.
- There will not be much change in the individual, longitudinal use of particular psychotropic medications.
- There will be a systemic increase in the use of all psychotropic medications throughout the time of the study, consistent with underlying population trends. There will be an increase in the use of the newer, atypical antipsychotics throughout the time of this study, but this will be less noticeable than that seen in the underlying population. People with ID will be more likely to use antipsychotic medications, but less likely to use antidepressant medications than adults in the underlying population.

1.6 Anticipated significance

It was anticipated that this study would give valuable information about the longitudinal aging-related changes in adults with ID, separating cohort from individual aging effects, which would help provide planning information for changes in service needs with the aging of the ID population. It would also give helpful information about health practices and their change with time in ID, such as the use of psychotropic medications, which have been overused in the past in this population, and which are known to have significant potential adverse effects, especially in older people. Identification of subtle changes occurring prior to the development of frank dementia will help more clearly identify the course and recognition of dementia in its pre-clinical stages, which may also be relevant to dementia of the Alzheimer type in adults without ID.

2. LITERATURE REVIEW

In this chapter the published literature pertaining to the core study questions about health and health care in adults with ID is reviewed: epidemiology/mortality data in people with ID, physical morbidity data, emotional, behavioural and psychiatric morbidity, functional-cognitive decline, service provision, and the use of psychotropic medications.

2.1 Epidemiology of intellectual disabilities

The DSM-IV (American Psychiatric Association, 1994) states that mental retardation (MR) is characterized by significantly subaverage intellectual functioning (an IQ of approximately 70 or below) with an onset before 18 years, and that there are concurrent deficits or impairments in adaptive functioning. The deficits and functioning should be in at least two of the following areas: communication, self-care, home living, social/interpersonal skills, use of community resources, self-direction, functional academic skills, work, leisure, health and safety. Mental retardation is divided into four levels of severity: mild (IQ ranging from 50-55, to approximately 70), moderate (IQ ranging from 35-40 to 50-55), severe (IQ ranging from 20-25 to 35-40) and profound (IQ below 20 or 25). According to this definition, about 85% of people with mental retardation are in the mild category, 10% are in the moderate category, 3 to 4% are in the severe category, and only 1 to 2% of people are in the profound category.

The prevalence of ID varies by the age of samples studied. Children tend to be diagnosed with ID once they enter the school system, resulting in the apparent increased prevalence around this age. After school completion, prevalence figures tend to decrease again, probably reflecting decreased testing and monitoring, and possibly decreased intellectual

demand, which results in the functional requirements of the diagnostic criteria no longer being met.

There is also some variation in the published prevalence figures from around the world. Although there is some variability across the United States (Centers for Disease Control and Prevention, 1996), the mean prevalence of ID is generally assumed to be about 1% (American Psychiatric Association, 1994), whereas Canadian, Australian and Scandinavian figures are somewhat lower. For example, Bradley, Thompson and Bryson (2002) surveyed adolescents aged 14 to 20 years living in the Niagara region of Ontario, finding an overall prevalence for ID (MR) of 7.18/1000. They found a prevalence of mild mental retardation of 3.54/1000 and for severe mental retardation of 3.64/1000. Leonard, Petterson, Bower and Sanders (2003) found an Australian prevalence rate of 14.3 per 1000, 10.6 per 1000 for children with mild or moderate and 1.4 per 1000 for those with a severe level of intellectual disability. They also found a greater prevalence rate in males (with a prevalence ratio of 1.6) and in children of Aboriginal mothers (with prevalence ratio of 2.3).

2.1.1 Causes of intellectual disabilities

Intellectual disabilities can be caused by various biological or psychosocial factors, acting either alone or in combination. In a significant minority of people with ID, no clear cause for the ID can be determined. The major causes of ID (Medline Plus, 2006) are listed below.

- Trauma: Intracranial hemorrhage before or after birth, lack of oxygen to the brain, severe head injury
- Toxic: Intrauterine exposure to alcohol and other drugs, methylmercury poisoning, lead poisoning
- Infectious (congenital and postnatal): Congenital rubella, meningitis, congenital

cytomegalovirus, encephalitis, congenital toxoplasmosis, listeriosis, HIV infection

- Chromosomal Abnormalities: Errors of chromosome numbers (DS), defects in the chromosome or chromosomal inheritance (Fragile X syndrome, Angelman syndrome, Prader-Willi syndrome), chromosomal translocations and deletions (cri du chat syndrome
- Genetic and other inherited metabolic disorders: Galactosemia, Tay-Sachs disease, phenylketonuria, Hunter Syndrome, Hurler syndrome, Sanfilippo syndrome, metachromatic leukodystrophy, adrenoleukodystrophy, Lesch-Nyhan syndrome, Rett syndrome, tuberous sclerosis
- Metabolic: Reye's syndrome, congenital hypothyroidism, hyperbilirubinemia, hypoglycemia
- Environmental: Poverty, low socioeconomic status, deprivation syndrome
- Nutritional: Malnutrition

2.1.2 Changes in the age composition of people with ID

The age distribution of people with ID in most developed countries has changed throughout the last century. This can largely be attributed to changes in the life expectancy of people with childhood onset intellectual disabilities (ID). Although the likelihood that they will reach old age is still reduced compared to the general population, life expectancy has increased (Janicki, Dalton, Henderson & Davidson, 1999), leading to an increased number of older people with ID in the population. This is particularly noticeable in the community because of deinstitutionalization, as discussed later on in this chapter.

The aging of the ID population has brought with it an increased prevalence of age-related health problems, which are superimposed on early onset health problems associated with the cause of the ID (discussed in more detail later). These aging problems are very

similar to those seen in the general population, such as cardiovascular and respiratory problems and sensory impairment, although people with ID have been reported to have a reduced rate (compared to the general population) of hypertension, hyperlipidemia and adult-onset diabetes (Janicki et al., 2002). Social and service delivery systems have needed to adapt to these changes, as is discussed later in the section on service provision.

2.1.2 Mortality and life expectancy

People with intellectual disabilities are known to have higher mortality rates than the underlying population, although this has improved over the course of the last century. Increased mortality in people with ID has been related to a variety of factors, as reviewed by Sutherland, Couch and Iacono (2002). Most important is the etiology of the intellectual disability, such as DS for example, which has associated health issues such as congenital heart disease, reduced immunologic function, and an earlier aging pattern.

Epilepsy in people with ID is associated with significant morbidity and mortality. It is well-known that there is a small rate of sudden unexplained death in people with epilepsy (Lhatoo, Langan & Sander, 1999). The cause of this death may be related to falls and injuries (including drowning) from an unpredicted seizures, but sometimes no reason can be found, and cardiac arrhythmias are implicated (Sperling, 2001). Seizures can also be a secondary cause of increased mortality, as a late presentation is known to be associated with serious underlying illness, such as strokes and malignancy (Velez & Selwa, 2003), which increase mortality.

Mortality appears also to be increased among those in the general population who had a lower childhood IQ. For example, in the recent 35 year cohort study published by Patja, Iivanainen, Vesala, Oksanen and Ruoppila (2000), those with ID who had the most severe impairment were found to have significantly lower life expectancy, whereas those with mild ID had similar life expectancy to the general population. There have been

various speculations about causal mechanisms to account for lower life expectancy in people with greater disabilities (Batty & Deary, 2004), and these include associated birth complications, childhood illnesses, increased smoking, childhood socioeconomic disadvantage, poorer adult social position with increased occupational risk, and even associated lower reaction time (Deary & Der, 2005).

Residential placement has been a controversial issue, as there have been contradictory suggestions that either institutional placement or community placement might increase mortality. These contradictory findings might be explained by differing rates of underlying medical complexity in study samples. For example, those with multiple complex medical conditions may receive inadequate care in the community unless intensive supports are available, whereas those with mild disabilities may improve in the community because of decreases in institutional mediated infections and improved biopsychosocial well-being.

The role of depressive symptoms in predicting mortality has not been formally studied in people with ID, but may also be of significance based on general population data. In the general population, there is a suggestion of a relationship between depression and mortality, with a poorer outcome associated with a variety of medical illnesses if depressive symptoms and/or depressive illness are also present (see review by Wulsin et al., 1999). Causality is not always well understood in this relationship, as severe medical illness may result in depressive symptoms, but depressive disorders have also been described to have adverse effects, possibly mediated through stress mechanisms.

Other factors that have been described in the literature to increase mortality in this group are poor mobility, poor feeding skills, poor functional abilities in general, male gender and increased age. One large Australian database study has also shown decreased survival by people with ID who are of indigenous background (Bittles et al., 2002).

2.1.3 Down Syndrome (DS)

DS is believed to be the most common cause of moderate to severe mental retardation, and is of most interest to aging studies because of its association with early dementia, and possibly other early aging features. The majority of young people with clinical DS have complete trisomy of chromosome 21, but a small proportion (approximately 5%) has only partial trisomy 21 (from translocations), and about 2% has mosaicism (some cells with trisomy 21 and some without) (Nora & Fraser, 1993). Interestingly, the extra chromosome 21 may be lost with aging (Jenkins et al., 1997) in some cells, which might result in higher rates of mosaic DS (i.e. not all cells have trisomy 21) in older individuals.

The likelihood of giving birth to a DS child increases with the age of the mother, and in children of mothers with an unbalanced translocation of chromosome 21. Health Canada (2002) reports that the total birth prevalence rate of DS in Canada has remained constant over the period from 1991 to 1999, with a 9-year average at 13.2 per 10,000 total births. Most (95.2%) of infants born with DS now survive the first year of life.

The percentage of people with DS in the population decreases with age because of increased mortality rates, as discussed later. Exact prevalence figures for DS in later adulthood are not known because there is no complete Canadian register of people with intellectual disabilities. There is a current initiative to develop a register of those with DS, but this is expected to be voluntary and therefore will also not be complete.

2.2 Physical morbidity

2.2.1 Epilepsy/seizures

Epilepsy is more common in people with ID compared to the general population. Recent analysis of data from the Canadian National Population Health Survey has shown that

the self-reported epilepsy rates in the general population tend to increase with age, ranging from a low of 2.5 per 1000 in those aged 0-11 to a high of 6.9 per 1000 in those over 65, with an overall rate of 5.2 per 1000 (Tellez-Zenteno, Pondal-Sordo, Matijevic &, Wiebe, 2004).

However, epilepsy rates are higher in those with ID, and range from 18.3% to 44% (Bowley & Kerr, 2000), with rates highest in the most disabled people and in those living in institutions. People with DS have slightly lower reported rates than this (8.1 to 13.6%), and appear to have a bimodal age of onset, with the majority presenting either very early or in later decades (McDermott et al., 2005; Pueschel, Louis & McKnight, 1991).

As mentioned earlier, epilepsy is associated with increased mortality for a variety of reasons. It is also associated with increased morbidity, which may be caused by the medications used to treat epilepsy, or interactions between seizure medications and other medications. Epilepsy may also cause a restriction in the potential for independent living, because of the unpredictability of seizures and the risks associated with this. For example, people with poorly controlled epilepsy may be at risk riding a bicycle, or even bathing alone.

There is also a known link between dementia and seizures. Hesdorffer, Hauser, Annegers, Kokmen and Rocca (1996) conducted a general (non-ID) population-based case-control study in the United States and showed that in the absence of other prior neurologic injuries, dementia resulted in a sixfold increased risk of seizures when controlling for age, sex, and length of medical follow-up. The association between dementia and seizures is particularly strong in people with ID and DS (Evenhuis,1990; Lai & Williams,1989; Puri, Ho & Singh, 2001). For example, Lai and Williams (1989) have found that up to 84% of people with DS and dementia developed seizures, and conversely, late onset seizures in people with DS is associated with the development of

Alzheimer Disease (Menendez, 2005).

Mortality is known to increase in people with epilepsy and ID, and is particularly increased if seizures are frequent (Forsgren, Edvinsson, Nystrom & Blomquist,1996). For example, Forsgren et al. (1996) found a standardized mortality ratio (compared to the general population) of 1.6 for people with ID only, 5.0 for people with ID and epilepsy and 5.8 for people with ID, epilepsy and cerebral palsy.

2.2.2 Cardiac problems

Congenital cardiac problems are more common among people who have DS or Fragile X Syndrome (Sutherland et al., 2002), and in the past have caused high mortality rates in childhood. With improvements in surgical interventions for these disorders, and an increase in life expectancy for people with ID, a pattern of cardiac morbidity and hypertension more similar to the underlying population is emerging (Janicki, Dalton, Henderson & Davidson, 1999). Patterns of increased risk factors such as obesity and decreased physical activity in people with ID are anticipated to further increase cardiovascular disease in middle to old age, although some risk factors such as cigarette smoking, are notably less frequent in the ID population.

2.2.3 Respiratory problems

Transmissible respiratory infections tend to be increased in large congregate environments such as institutions, but are also more common in people whose disabilities decrease their ability to maintain personal hygiene. The prevalence of specific respiratory problems also varies depending on the cause of the ID. For example, people with DS are particularly likely to have respiratory infections and sleep apnea (Pueschel, 1990). On the other hand, people with ID secondary to cerebral palsy are

more likely to have aspiration related infections secondary to swallowing difficulties (Del Giudice et al., 1999). If the cerebral palsy is associated with significant kyphoscoliosis there may be also restriction of lung capacity.

2.2.4 Gastrointestinal problems

Constipation is very common in people with ID, especially in those residing in institutions. Bohmer, Taminiau, Klinkenberg-Knol and Meuwissen (2001) found that 69.3% of this population suffered from constipation, and 15% suffered from fecal soiling. They also found that the constipation was significantly correlated with being non-ambulatory, having cerebral palsy, using particular medications, having food refusal, or an IQ < 35. High rates of laxative use are common in this population.

The rate of gastrointestinal problems varies with the cause of the disability. Cerebral palsy is known to be associated with feeding difficulties and other functional gastrointestinal abnormalities that can lead to bowel obstruction, vomiting, and constipation (Krigger, 2006). DS is associated with hypothyroidism, which is well known to cause constipation.

2.2.5 Dental problems

Recent studies on oral health in people with ID has shown some interesting differences from the general population. For example, Scott, March and Stokes (1998) found that people with ID living in the community were more likely than the general population to see a dentist (65% versus 50% in the last 12 months), more likely to have oral mucosal pathology requiring treatment (15 per cent vs 2 per cent), more likely to have severe periodontal disease (16 per cent vs 3 per cent), and more likely to have moderate to severe malocclusion (26 per cent vs 11 per cent). People with ID who reside in less restrictive living situations, those who have milder intellectual disability and those with

DS seem to have higher rates of caries (Gabre, 2000), possibly because of greater access to sweet food, and reduced compliance with oral hygiene.

Lifshitz and Merrick (2004) interviewed families and caregivers of 108 community dwelling adults over 40 with ID, and found that 30% overall were considered to have ongoing dental problems, with even higher rates for those who lived with their families.

2.2.6 Diabetes

Diabetes is an increasing problem in the general population because of the rising prevalence of obesity, which is largely a function of excessive caloric intake for individual requirements based on physical activity levels. The Canadian Community Health Survey found that 23.1% of adult Canadians were obese, with roughly equal male-female rates, but higher rates in middle-aged (45-64 year old) adults compared to younger and older adults (Tjepkema, 2005). Specific age cohort rates were reported to be: 11% at ages 18-24, 21% at ages 25-34, 20% at ages 35-44, 30% at ages 45-54, 30% at ages 55-64, 25% at ages 65-74 and 24% for those 75 years and older.

Obesity rates are also high in adults with ID, although more restricted environments which control access to food appear to result in lower rates. As a result of this, the overall rates of obesity in adults with ID have been found to be lower than those in the general population (Moran, et al., 2005), although selected groups, for example females with DS (Melville, Cooper, McGrother, Thorp & Collacott, 2005), have been found to have greater odds of being obese (OR=2.17) compared to their matched, non-ID counterparts.

Probably because of lower overall obesity rates, diabetes rates in adults with ID have been found to be reduced compared to those in the general population (Janicki et al., 2002), with only 2% of those aged 40-49, 5% of those aged 50-59, 7% of those aged 60-

69 and 8% of those aged 70-89 years reported as having diabetes, compared to 4%, 8%, 12 %, and 14% in the equivalent age groups in the general population.

2.2.7 Thyroid problems

Thyroid problems are common in the general population, and can mostly be divided into disorders of excessive thyroid hormone (hyperthyroidism) and inadequate thyroid hormone (hypothyroidism). Spontaneous hypothyroidism occurs in 1 to 2% of the general population, increases with age, and is about 10 times as common in women as in men (Vanderpump & Tunbridge, 2002). Overt hyperthyroidism has a prevalence rate of 1.9%, which does not seem to change with age (Tunbridge et al., 1977).

Thyroid disorders are more common in people with ID, especially those with DS. Kapell et al. (1998) collected data from a random sample of adults with DS and a matched group of adults with ID not due to DS. These data were compared to population data from the National Health Interview Survey, which was conducted in 1993 in the United States. The prevalence of thyroid disorder among those aged 45 to 64 was 2.7% in the general population, 33.6 % in those with DS and 5.7% in those with ID and not DS. In those aged 65 to 74, the prevalence was 3.7% in the general population, 45.5% in those with DS, and 9.1% in those with ID, but not DS. The Standardized Morbidity Ratio was 12.5 for people with DS aged 65 to 74, and 2.2 for people with ID but not DS aged 65 to 74.

Although the data on thyroid disorders in people with ID shows an increased prevalence with age, even samples of children who have DS already show a significant prevalence of thyroid dysfunction, usually hypothyroidism (Pueschel, Jackson, Giesswein, Dean & Pezzullo, 1991).

Thyroid disorders can cause significant changes in behavior, function and cognition, and

therefore need to be carefully considered when any unexplained clinical changes occur.

2.2.8 Vision problems

Vision problems are also more common in people with ID. A very recent cross-sectional survey from the Netherlands notes that the prevalence of visual impairment ranges from 2.2% in young adults with mild ID and no DS to 66.7% in older adults with profound ID and DS, as compared to 1.4% in the general Dutch population 55 years and older (van Splunder, Stilma, Bernsen & Evenhuis, 2005). Most concerning was the authors' finding that visual impairment or blindness had remained undiagnosed in 40.6% of these. Undiagnosed vision problems have been shown to be common in a number of studies, largely because of difficulties of assessment in the most handicapped subgroup, but also possibly because of poorer general health care. This is a particular concern, as impaired vision can further decrease the functional abilities of this already compromised population, and may even give the erroneous impression of dementia.

People with DS are particularly likely to have vision problems, even as young children. Da Cunha and Moreira, (1996) have shown very high rates of the following conditions in their pediatric DS survey: astigmatism (60%), strabismus (38%), lacrimal system obstruction (30%), blepharitis (30%), retinal abnormalities (28%), hyperopia (26%), amblyopia (26%), nystagmus (18%), cataract (13%), and myopia (13%).

Surveys of older people with DS generally show a high prevalence of childhood onset visual problems with superimposed aging onset visual problems. For example, van Allen, Fung and Jurenka (1999) in their survey of 38 adults with ID living in a British Columbia residential center found acquired sensory deficits including loss of vision due to early onset of adult cataracts in 50%, recurrent keratitis in 21%, and keratoconus in 15.8%.

Other risk factors for vision problems in ID include premature birth and cerebral palsy.

2.2.9 Hearing problems

Hearing problems are also more common in people with ID. Evenhuis, Theunissen, Denkers, Verschuure and Kemme (2001) surveyed 672 people with mild to profound ID. They found that the prevalence of hearing disabilities varied by the severity of intellectual disability, by age and by diagnosis. For example, people under 50 years with mild or moderate ID who did not have DS had a 21% prevalence of hearing impairment compared to the general prevalence of 2-7% in the general Dutch population under 50. This prevalence increased sharply in people who had DS and in those over 50. Similar to the findings with vision loss, a large percentage of people with ID and hearing loss had not previously been identified.

2.2.10 Adequacy of health care in adults with ID

The adequacy of care provision for health problems in adults with ID is not well understood in Canada, although data from the United States suggests a high prevalence of poor health maintenance practices, communication difficulties with care providers, and difficulty in accessing care, especially by individuals living independently (Edgerton, Gaston, Kelly & Ward, 1994). Statistics Canada (2002A) reports that even 12.5% of the general Saskatchewan population identified themselves as having unmet healthcare needs, so based on the greater prevalence of health problems in adults with ID as well as challenges of service provision, it is likely that the prevalence of unmet needs in this population is even higher.

2.3 Emotional, behavioural and psychiatric morbidity

Behavioral problems in people with ID are known to be much more common than in the

general population. For example, a recent community survey in Massachusetts by Freedman and Chassler (2004) found that almost half of the 629 participants in their survey had self-injurious, disruptive or uncooperative behaviour problems. This increased prevalence has multifactorial roots, with etiologic factors including the underlying cause of the ID (which may have caused problems with understanding, attention, impulse control and irritability), impairments in the learning of socially appropriate behaviors, and various environmental factors such as institutionalization. The frequency of behavioral problems varies widely between different surveys, depending on the instruments used and the population studied. (Deb, Thomas & Bright, 2001) found that over 60% of people with ID had at least one behaviour disorder (18% had severe behavioural problems), and that those with more severe ID generally had more behavioral problems than those with less severe ID. Researchers exploring the association of residential placement with behaviour, such as Sigafoos, Elkins, Kerr and Attwood (1994) have found that those in institutions have more severe behavioral problems such as aggression (35%) than those in group homes (17%) or in other community settings (3%). Younger people with ID are also generally thought to have more behavioral problems than older ones, although developing dementia has also been found to be also associated with the resurgence of behavioral problems (Prasher & Filer, 1995). Different etiologies may have different patterns of behavioral pathology. For example, adults with Fragile X Syndrome appear to have higher rates of inattention, hyperactivity and explosive and aggressive behaviour to others or self (Tsiouris & Brown, 2004) , whereas people with DS may have higher rates of obsessional traits (Charlot, Fox & Friedlander, 2002), but fewer behavioural problems overall (Blacher & McIntyre, 2006).

Published prevalence estimates of mental health disorders vary widely depending on the survey (Kerker, Owens, Zigler & Horwitz, 2004). A variety of diagnostic strategies have been used to make the diagnoses, and study populations have also varied in terms of diagnostic and core age and gender distribution. Kerker's group summarizes the

following information about reported prevalences of mental disorders. The prevalence of anxiety disorder may be significantly higher in those with ID than in the underlying population (31.4% compared to 13.1-18.7 %). The prevalence of schizophrenia in ID is particularly contentious, with very high rates being reported for people with severe ID (46.7%) compared to mild to moderate ID (16.7%), or to the general population (1%). It is not clear whether this high prevalence is an accurate representation of increased prevalence of schizophrenia, or a reflection of increased abnormal behaviors related to the ID, which have diagnostic similarities to core psychotic symptoms. Depression in institutionalized adults with ID has been reported to have a similar prevalence (8.9%) to that in the general population (7%). However, published prevalences of depression in people with mild to moderate ID has been reported as high as 20%, whereas similar prevalence studies in people with severe ID have found no cases of depression. Because of the difficulties with communication in people with severe ID it is likely that depression is underdiagnosed in this population.

The prevalence of rigorously diagnosed mental disorders in individuals with DS may differ from the underlying ID population. Prasher (1995) carefully assessed 215 people with DS (mean age 40.9 for males and 43.6 for females), finding that 28.9% had a current mental disorder using DCR-10 criteria (World Health Organization, 1993). The prevalence of mental disorders was as follows: 13.4% had dementia of Alzheimer's disease, 5% had a depressive episode, 4.5% had obsessive-compulsive disorder, 4% had conduct disorder, 1.5% had general anxiety disorder, and 0.5% had phobic anxiety disorder.

2.3.1 Adequacy of care provision for emotional, behavioural and psychiatric problems

The adequacy of care provision for emotional, behavioural and psychiatric problems in adults with ID is not known. In Saskatchewan, the best general data on unmet mental health needs comes from the Canadian Community Health Survey, which found that

4.4% of the general population identified themselves as having unmet healthcare needs associated with mental health problems (Statistics Canada, 2002B). Based on the greater prevalence of mental health problems in adults with ID as well as challenges of service provision, it is likely that the prevalence of unmet needs in this group is even higher.

2.4 Functional and cognitive decline

2.4.1 Dementia in the general population

Dementia is defined in the DSM-IV (American Psychiatric Association, 1994) as progressive cognitive (including memory) decline that has reached the point of significant impairment in social or occupational functioning. It must represent a significant decline from a previous level of functioning, which differentiates it from early life cognitive disabilities such as ID. Although the key deficit in dementia is memory, the DSM-IV also requires one or more of the following cognitive disturbances: aphasia (language disturbance), apraxia (impaired ability to perform skilled motor activities despite intact motor functioning), agnosia (failure to recognize or identify objects despite intact sensory function) and disturbance in executive functioning (i.e. planning, organizing, sequencing, abstracting).

The most common type of dementia is Alzheimer's Disease (AD), which is characterized by gradual, usually insidious decline of memory and other associated cognitive functions, eventually resulting in profound disability and death. AD is associated with characteristic neuropathological changes in the brain, including cerebral atrophy, plaques and neurofibrillary tangles. The precise, causal correlation between these pathological changes and clinical changes of AD is less understood, as is the role of amyloid protein (Bishop & Robinson, 2002; Obrenovich, Joseph, Atwood, Perry & Smith, 2002).

All dementias have a profound impact on the affected individual and their family, and in addition, place a huge burden on health care resources, increasing as the severity of the

dementia increases.

In the developed world, dementia is one of the most prevalent, disabling, and expensive health conditions. The Canadian Study of Health and Aging (CSHA, 1994) found that 8.0% of all Canadian adults 65 and over had dementia. However, these rates varied by age group: 2.4% aged 65 to 74 years, 11.1% of those aged 75-84 years, and 34.5% of those aged 85 and over had dementia. AD was the most common type of dementia (5.1% overall), followed by vascular dementia (1.5%).

Multiple risk factors have been identified epidemiologically for the development of dementia in the general population, with most of the work being conducted specifically for AD. Potential pathways of causation have been summarized by Ritchie and Lovestone (2002). In brief, although increased age is clearly the most prominent risk factor, it is thought that genetic factors may increase this risk, as may female sex, infections, abnormal lipid concentrations, head injury, and even exposure to anesthetic gases. Recent work has linked untreated hypertension (Peila, White, Masaki, Petrovitch,& Launer, 2006), a history of mood disorder (Jorm, 2001; Kessing & Nilsson, 2003) and elevated plasma homocysteine (Seshadri et al., 2002) to later increased rates of AD. Potential protective factors as summarized by Ritchie and Lovestone (2002) include hormone replacement therapy, use of non-steroidal anti-inflammatory medications, moderate alcohol consumption, and high education. Other authors have added leisure activities (Verghese et al., 2003), ongoing cognitive stimulation (Wilson et al., 2002) and exercise (Laurin, Verreault, Lindsay, MacPherson & Rockwood, 2001) as potentially protective factors.

Although most patients with AD have no known familial inheritance pattern, some early onset forms of AD have been associated with genes on chromosomes 21 (genes coding for amyloid precursor protein, APP), chromosome 14 (presenilin 1), and chromosome 1 (presenilin 2). A late onset form of AD is coded for on chromosome 19 (Apo E4).

Recent gene linkage work has suggested other significant genes for AD (Schott, Fox & Rossor, 2002).

Canadian epidemiological studies of risk factors for incident cases of AD were explored recently by the Canadian Study of Health and Aging (Lindsay et al., 2002). Unlike most previous risk factor studies, which based their analyses on retrospective data, this study looked at risk factors identified prospectively in adults not initially found to be suffering with dementia. The CSHA found that the only significant risk factors for AD were increasing age, fewer years of education, and the apolipoprotein E epsilon4 allele (Apo E4). Protective factors found included the use of nonsteroidal anti-inflammatory drugs (NSAIDS), wine consumption, coffee consumption, and regular physical activity. Interestingly, this study, unlike others, did not find a statistically significant association for family history of dementia, sex, history of depression, estrogen replacement therapy, head trauma, antiperspirant or antacid use, smoking, high blood pressure, heart disease, or stroke.

2.4.2 Pattern of cognitive decline, reserve, symptom progression

The pattern of cognitive decline and the progression of characteristic symptoms of dementia is more predictable in Alzheimer disease than it is in other types of dementia, such as vascular dementia. The Global Deterioration Scale (GDS) by Reisberg, Ferris, de Leon and.Crook (1982), describes characteristic deterioration in people with Alzheimer's disease, dividing the progression into seven stages. In the first stage there are no subjective complaints of memory problems, and no abnormalities are found on clinical interview. In the second stage there are some subjective complaints of memory deficits, but these are not apparent on clinical interview. In stage three there are mild changes in a number of areas, including orientation, vocational performance, word finding, memory, and possibly concentration. In stage four there are a clear-cut deficits in knowledge about current and recent events, memory of recent personal events,

concentration (as measured by serial subtraction), orientation (as seen in the decreased ability to travel), or the ability to handle finances. In stage five, people with Alzheimer disease can no longer survive without some assistance. They may have trouble recalling their address or telephone number, names of family members, or names of the schools which they have attended. In stage six, they may forget the name of their spouse, and generally will be unaware of all recent events and experiences. They will often require help with basic activities of daily living, may become incontinent, and require assistance to undergo travel. There are frequently personality and behavioral changes such as delusions, repetitive actions, anxiety, agitation, aggression, and apathy. By stage seven, all verbal abilities are lost, and 24-hour care will be required for all activities of daily living, including feeding and toileting. Deficits in motor functioning and extrapyramidal symptoms also occur in severe Alzheimer disease (Clark et al., 1997).

Subtle changes in frontal/executive functions may occur very early in the disease (Reid et al., 1996), but are frequently not evident on commonly used tests of cognition such as the Mini-Mental state examination.

The age of initial presentation and the rate of progression through these stages is not uniform, which is probably related to the heterogeneous etiology of this disease. For example, Alzheimer disease associated with presenilin 1 and presenilin 2 genetic variants presents at earlier age than Alzheimer disease associated with ApoE-4, which is associated with later onset forms of dementia. More severe deficits in various psychological functions, such as in attention span, working memory and praxis have also been found to be more prevalent in early onset disease (Reid et al., 1996).

The rate of progression of Alzheimer's disease has been found to be faster in people who have an early onset of their Alzheimer disease (Jacobs et al., 1994). The severity of functional decline in people with AD has also been found to be greater in those who have psychotic symptoms, or who are treated with antipsychotic medications (Lopez,

Wisniewski, Becker, Boller & DeKosky, 1999). Increased cognitive reserve may defer the onset of AD, but then result in faster decline once compensatory abilities are lost. This is supported by research published by Andel, Vigen, Mack, Clark and Gatz (2006), who found that patients with AD who had a life of higher occupational complexity declined faster when controlling for age, gender, native language, and dementia severity.

2.4.3 Cognitive decline and dementia in people with ID

Although most knowledge about dementia has come from the general rather than the ID population, over the last 20 years the growing number of older adults with ID has precipitated an increasing interest in cognitive decline with age in this group. Within this population, the increased prevalence of dementia in people with DS has been clearly established, with evidence coming from neuropathological studies, neuroimaging, cross-sectional clinical studies and longitudinal clinical studies. Most studies have found no change or a decreased prevalence in people with ID who do not have DS (Zigman et al., 2004), although at least one large study has made contradictory claims (Cooper, 1997).

Of potential significance to health outcomes in ID, including late life intellectual decline is the Intelligence Quotient (IQ). In a number of clinical populations, measures of early adulthood pre-morbid functioning, such as lower IQ, have been linked to later aging related progressive decline, although there have also been some contradictory findings (Bush & Beail, 2004).

2.4.4 Neuropathological studies of adults with DS

Morphological, postmortem studies have shown that the frontal lobes of people with DS appear to be underdeveloped prior to the development of dementia (de la Monte & Hedley-Whyte, 1990). However, age-related changes in older people with DS, which are similar to those shown in people with Alzheimer disease in the general population, are

even more striking. There is a large literature, most clearly beginning with groundbreaking research by Wisniewski, Wisniewski and Wen (1985) that has clearly established that typical neuropathological changes of AD are found by midlife in almost all of the brains of adults with DS, and recently Bush and Beail (2004) have reviewed this topic in more detail. These changes include neuritic plaques formed by extracellular beta-amyloid protein, and intracellular neurofibrillary tangles. Pathological studies show that the deposition of β amyloid occurs in children with DS as early as eight years of age (Leverenz & Raskind, 1998).

2.4.5 Neuroimaging studies of adults with DS

The advent of sophisticated neuroimaging has allowed for detailed investigations of brain morphology and functioning without the availability of postmortem tissue. For example, computerized tomography was used by Lawlor, McCarron, Wilson and McLoughlin (2001), to analyze the CT scans of 10 adults with DS and functional decline, using temporal lobe-oriented views. All of those with dementia showed significant medial temporal lobe atrophy, which is a known pathological finding in AD.

Magnetic resonance imaging has been a more recent development, but has demonstrated the ability to give more detailed data about the brain. MRI studies of older adults with DS also confirms changes in areas of the brain that are typically involved in AD. For example, Aylward et al. (1999) used MRI imaging in 25 adults with DS (eight of whom had dementia) and 25 cognitively normal adults who were individually matched on age, sex, and race to show that the hippocampus was disproportionately small in individuals with DS, and significantly decreased in those with DS over the age of 50. However, MRI data suggest that, not only the allocortex, in which deficits are typically associated with Alzheimer disease, but also the neocortex is impaired in people with DS prior to the diagnosis of dementia. For example, Teipel et al. (2004) recently published magnetic resonance imaging data on 27 Down's syndrome adults without dementia (average age

41.1 years) that showed grey matter volume decreases over time in cortical areas including the parietal cortex bilaterally, the frontal cortex bilaterally with left-sided predominance and the left occipital cortex, among others. Supporting evidence about the early involvement of the neocortex has also been published by others such as Kesslak, Nagata, Lott and Nalcioglu (1994). Early cortical impairment in people with DS is consistent with clinical data, presented later, suggesting early frontal behavioral changes in older people with DS.

Positron emission tomography provides the most sophisticated information about functioning of the brain, but is also less available and more expensive, so there are fewer studies in this area. One available study using this technology is by Schapiro, Haxby and Grady (1992), who used positron emission tomography in older DS adults with dementia, and found identical patterns of abnormal glucose metabolism as those known to occur in AD.

2.4.6 Genetic studies in adults with DS (APOE4)

Apolipoprotein E 4(APOE4) previously been mentioned as a risk factor or Alzheimer disease in the general population. APOE4 has also been studied in a DS population, where it has been linked t to an increased risk for dementia (Schupf et. al., 1996) as well as early life language deficits, which are thought to modulate later life dementia (Alexander et al., 1997). Consistent with this, the epsilon2 allele has been found to confer a protective effect (Lai et al., 1999) in the development of dementia.

2.4.7 Neurological findings in aging adults with DS

Core neurological symptoms known to be associated with dementia in the general population, have also been studied in DS. Many clinical studies have noticed an

increased prevalence of seizures in older people with DS, particularly in those noted to have functional deterioration with age (Wisniewski, Dalton, McLachlan, Wen & Wisniewski, 1985; Lai & Williams, 1989; Evenhuis, 1990; Collacott, 1993; Brodtkorb, 1994; Van Buggenhout et al., 1999; Puri, Ho & Singh, 2001). Olfactory dysfunction is also more common in Alzheimer disease in the general population because of the geographic proximity between the olfactory and the limbic systems. Consistent with the increased rate of dementia in DS, olfactory impairment has been found to increase in older, but not younger people with DS (Nijjar & Murphy, 2002; Zucco & Negrin, 1994; McKeown et al., 1996). Poorer odour identification has also been associated with adults who have DS and an APOE4 allele (Sliger, Lander & Murphy, 2004).

An increased prevalence of primitive reflexes, known to be associated with advanced Alzheimer disease in the general population, has been found in clinical studies with older adults who have DS (Wisniewski, Howe, Williams & Wisniewski,1978; Lott & Lai, 1982; Sand, Mellgren & Hestnes, 1983; Thase, Tigner, Smeltzer & Liss,1984; Vieregge, 1991; Haw, Barnes, Clark, Crichton, & Kohen,1996; Nelson, Orme, Osann & Lott, 2001).

2.4.8 Neuropsychological studies in aging adults with DS

A variety of studies with older adults who have DS have addressed increased deterioration (compared to younger adults with DS or similarly aged adults with ID but not DS) in core symptoms of dementia, such as memory, aphasia, apraxia, agnosia and executive functioning. Deficits related to memory functioning are of particular interest in Alzheimer's disease, and these declines may occur long before the identification of functional decline (Devenny, Zimmerli, Kittler & Krinsky-McHale, 2002), especially in individuals who have low environmental demands placed upon them. Unfortunately, complicating the evaluation of memory deficits as a symptom of dementia in people with DS are pre-existing problems with verbal memory, which are found even in children and

young people with DS (Carlesimo, Marotta & Vicari, 1997; Jarrold, Baddeley & Hewes, 2000; Lanfranchi, Cornoldi & Vianello,2004), making the interpretation of later disabilities more complex. For example, differences found in cross-sectional comparisons of older persons with DS with age matched controls without DS (Thase, Liss, Smeltzer & Maloon,1982; Zigman, Schupf, Lubin & Silverman, 1987) might not indicate aging related pathology as much as pre-existing deficits. However, various studies have reported increased deficits in memory functioning in older compared to younger persons with DS (Wisniewski, Howe, Williams & Wisniewski,1978; Haxby, 1989; Das, Divis, Alexander, Parrila & Naglieri, 1995; Alexander et al., 1997; Brugge et al., 1994), which may, more accurately, represent deterioration of memory (and related functions) with age in DS, although there are still potential problems with cohort effects.

Longitudinal studies of memory deterioration are best designed to assess true aging changes. Some published studies using this methodology, especially those without significant numbers of older participants, or those excluding participants with existing decline have not found significant age related differences in the rate of individual memory decline in adults with DS (Burt et al., 1995; Devenny et al., 1996; Burt et al., 2005). This negative finding may be explained by an true lack of difference in age related decline in people with DS, but it may also be explained by instruments relatively insensitive to early decline, a population too young to have started to decline significantly, or a population already over-selected against those who have early decline.

Other longitudinal studies have found greater decline in older compared to younger people with DS: but not in the area of memory, rather in frontal lobe pathology such as apathy and behavioural change (Holland, Hon, Huppert &. Stevens, 2000). This study is supported by the work of Nelson, Orme, Osann and Lott (2001), who also found that the earliest longitudinal declines in people with DS and suspected Alzheimer's Disease were in emotional domains and in apathy. They noted that their findings were consistent with neuropathological findings of increased amyloid deposition in the frontal cortex of adults

with DS.

Most consistent with available neuropathological evidence are larger scale longitudinal studies with adults who have DS, which show individual declines in memory, most prominently in the oldest cohorts (Dalton, Mehta, Fedor & Patti, 1999), with other neuropsychological functions, such as praxis affected later. Some authors such as Devenny, Krinsky-McHale, Sersen, and Silverman, 2000 also found this decline in memory, but noted that clinical dementia in DS should not be universally expected, and that when it does occur, the age of onset may be later than previously expected. Longitudinal declines in memory in older people with DS were also found by Hawkins, Eklund, James and Foose (2003), in their complex, multilevel modeling study, and in this ten year study, short term memory declined throughout the lifespan, whereas long-term memory did not show noticeable declines until after age 45.

Age-related declines in language are also a key part of the dementing process. Language plays a very interesting role in people with DS and dementing disorders, as pre-existing language/linguistic impairment has been well described in healthy children with DS (Chapman & Hesketh, 2000), appears to be increased in people with DS and APOE4 (described earlier), and has also been found to be one of the earliest (early adulthood) predictors of later onset of dementia in the general population, as described by Snowdon, Greiner and Markesbery (2000). In this, now famous "Nun Study", linguistic ability in early life was associated with the severity of Alzheimer's disease pathology in the brain many years later, after the sample had aged. This has been a fascinating finding to researchers in the area of DS and aging, has many raised many interesting questions about the role of language in the production of intellectual decline.

Possibly because of this association between early language ability and risk for Alzheimer's disease, language functions such as aphasia in adults with DS have not always been associated with age cohort differences once initial levels of disability were

adjusted for. However, in a well-designed longitudinal study, individual changes are more likely to be apparent. Oliver, Crayton, Holland, Hall and Bradbury (1998), in their four-year prospective study of age-related cognitive change and adults with DS, assessed aphasia and agnosia by asking participants to name 14 pictures of everyday objects and identified pictures following a verbal instruction. The authors found that aphasia (as well as other symptoms of severe cognitive deterioration) was more common in older subjects with DS, and that the rate of deterioration increased with age and the degree of pre-existing cognitive impairment. They also found that the deterioration of memory related functioning occurred before deficits in aphasia , agnosia and apraxia.

Another core symptom of dementia is apraxia. This was defined by Yesavage, Brooks, Taylor and Tinklenberg (1993) as the "inability to carry out purposive or skilled acts due to brain damage but not due to other reasons such as failure to comprehend, weakness, paralysis or sensory losses which may result in imperfectly executed movements". These researchers studied 127 adults with Alzheimer's Disease (not ID), and found that Alzheimer's Disease patients with apraxia had a more rapid decline, based on scores on the Mini Mental State Examination (MMSE).

Complicating any cross-sectional comparison of praxis in adults with DS compared to adults without DS is the fact that even children with DS have been noted to have dysfunctions in praxis (Fidler, Hepburn, Mankin & Rogers, 2005). This limits studies such as that by Thase, Liss, Smeltzer and Maloon (1982), who explored praxis (no definition given) in their cross-sectional comparison study of institutional adults with and without DS, matched for age and IQ . The authors found that people with DS were more frequently apraxic (40% compared to 10% of controls), but because of cross-sectional methodology it was not possible to separate pre-existing changes from aging changes.

Oliver, Crayton, Holland, Hall and Bradbury (1998) also assessed apraxia (by asking

participants to carry out simple action such as clap their hands) in their four-year prospective study with adults who had DS. As in the section on aphasia, the authors found that apraxia was more common in older subjects with DS, and that the rate of deterioration increased with age and the degree of pre-existing cognitive impairment.

Soininen et al (1993) studied praxis in their cross-sectional comparison group of adults with DS, adults with probable Alzheimer's disease and age matched controls. They explored simple movements, kinesthetic basis of movement, optic-spatial organization, dynamic organization of motor activity, oral praxis and ideomotor praxia. Although DS patients were overall less impaired than Alzheimer patients in praxis, in people with DS, age was significantly related to decline in praxis.

Burt et al (2005) found weak evidence of increased decline in fine motor tasks in adults with DS compared to those without DS.

Changes in executive functioning over time are also a key part of the diagnosis of dementia.. Many instruments designed to measure aspects of core cognition in dementia, such as the MMSE, do not adequately measure deterioration of executive dysfunction (Stokholm, Vogel, Gade & Waldemar, 2005), although these symptoms are frequently a key source of distress to caregivers and families.

2.4.9 Clinical diagnosis and prevalence of dementia in aging adults with DS

Whereas some findings, such as neuropathological evidence of plaques and tangles, are relatively reproducible and "objective", the ascertainment of specific symptoms such as memory or apraxia (described above) necessarily involves more subjectivity, with resulting variability of results, as it depends more on assessment approaches as well as vissicitudes of the testing process. The diagnosis of dementia in people with DS is even more fraught with rater subjectivity, as it is dependent on individual rater factors, current

patterns of clinical beliefs about dementia in this population, and understanding of the typical biological, psychological and sociocultural issues in the DS population.

It is also inherently a very difficult clinical task, as its symptoms progress gradually, with no one, obvious cut-point at which the gradual decline can be suddenly called "dementia". By the DSMIV (American Psychiatric Association, 1994), there must be significant decline from previous functioning, and this is in the final analysis a value judgement based upon clinical observation of meaningful change in people. The choice of "cut-point" therefore involves a fair amount of arbitrariness, which can significantly affect prevalence rates.

The practical assessment of dementia in people with ID is further limited by baseline deficits in functioning, including poor language skills, physical and mental comorbidity, impoverished social opportunities for learning, floor effects of on instruments designed to measure cognition in the general population, and a lack of universally applicable instruments to make this diagnosis (Aylward, Burt, Thorpe, Lai & Dalton, 1997).

In spite of the uncertainties listed above, there is some general agreement on the issue of DS and dementia. Firstly, the well-established Alzheimer type pathology (by the age of 35) in the brains of people with DS is not accompanied by the expected, equally early clinical development of dementia, but by a more delayed clinical process, whose details are still under debate. Secondly, it is generally agreed upon that the overall prevalence of clinically diagnosed dementia in people with DS is increased compared to those without DS. Still under debate is whether all people with DS will eventually get Alzheimer's disease, and what protective factors help some individuals age so well into very old ages.

Some clinical awareness of the increased risk of dementia in people with DS was already apparent in the literature from over a hundred years ago, when Fraser and Mitchell (1876) published their article on "precipitated senility" in people with DS. It was not until 1948,

however, when Jervis published his seminal article in the American Journal of Psychiatry (Jervis, 1948), that the formal association between DS and dementia was more widely recognized.

A variety of methods (cross-sectional versus longitudinal, prospective versus retrospective, descriptive versus clinical trial, direct assessment versus caregiver information) and diagnostic criteria were used in early studies of cognitive decline in people with DS, accounting for a wide variation in prevalence figures. Not all of these were able to publish age-based prevalence figures, many had no appropriate controls and many of these had small numbers of study participants. Most early studies also did not assess sensory impairment, and many were based on primarily institutional samples, which may not be representative of the general population of people with DS. Even more problematic is the fact that many of the studies were based on nonrandom populations, often clinical samples, giving rise to large sources of potential bias.

Increased complexity of the study population and differences in study methodology have resulted in widely varying results for the prevalence of dementia, as was summarized by Zigman, Schupf, Haveman and Silverman (1997). Cross-sectional record reviews of the prevalence of dementia, as published by Haveman, Maaskant and Sturmans (1989) are particularly problematic in assessing true outcomes because of the lack of ability to assess comorbidities that may be contributing to decline. Some of the key studies addressing the prevalence of dementia are summarized below, but full details are available in the references publications.

Lai and Williams (1989) studied a group consisting of 73 institutionalized and 23 community-based adults with DS. Neurological assessments were performed and treatable causes of dementia were explored. Electroencephalograms and CT scans were performed in almost all patients who had dementia. Some longitudinal data were available, and autopsies were available on 12 participants. Dementia was defined as a

decline in one or more of the assessed skills. The authors reported that about half of their population of 96 DS individuals over the age of 35 had dementia, with an average age of onset being 54.2 ± 6.1 years. They found that dementia occurred in 2 of 25 subjects between ages 35-49 years, 11 of 20 between 50-59 years, and 6 of 8 over 60.

Evenhuis (1990) studied all 17 patients with DS who died after the age 40 and older from an institution for mentally retarded persons, attempting to obtain both clinical and neuropathological data. She found that 15 of 17 of these had a clinical diagnosis of dementia, largely based on diagnostic criteria of the DSM-III-R (American Psychiatric Association, 1987), and that their symptomatic decline was similar to that seen in AD of people without DS.

Franceschi, Comola, Piattoni, Gualandri and Canal (1990) examined 50 community dwelling adults with trisomy 21 (verified by chromosomal examination). Neurological examinations were performed on all of the sample, and further imaging studies were performed on a subgroup. Functional and behavioral information was obtained from caregivers, and the diagnosis of dementia was made according to an adaptation of National Institute of Neurological and Communicative Diseases and Stroke/Alzheimer's Disease and Related Disorders Association (NINCDS/ADRDA) criteria (McKhann et al., 1984). Dementia was found in18% of patients aged 20-52 years, with an age-related increase in prevalence apparent in this sample: the prevalence was 0 in the 20-29-year-old group, 33% in the 30-39 year-old group, and 55% in the 40-52-year-old group. Neuroimaging findings were consistent with clinical findings.

Roeden and Zitman (1995) assessed 71 adults with chromosomally verified DS (45 from an institution and 26 from group homes) using a variety of direct and caregiver based measures over a period of up to 4 ½ years. Experimental measures included tests of adaptive functioning, assessment of intelligence, assessment of functioning as measured by the Dementia Questionnaire for Person with Mental Retardation (DMR) by Evenhuis

(1992), assessment of motor function, and medical examination, including assessment of sensory abilities. The diagnosis of dementia was made using modified DSM-III (American Psychiatric Association, 1987) criteria, and depression was carefully ruled out. Ten individuals met the criteria for dementia (aged based prevalence could not be assessed from the sample), and all of these came from the institutional subgroup.

Devenny et al. (1996) studied 91 adults with DS and 64 adults with ID, but not DS, who worked in a community workshop, were older than 30, had an IQ greater than or equal to 35, had no uncontrolled seizures or recent development of seizures, no significant, uncorrected sensor impairments, and no pre-existing suspicion of decline in their functioning at the time of entry to the study. IQ scores were obtained from the most recent standardized assessments in their records. Diagnoses of DS was made on the basis of phenotypic characteristics, although many of these also had chromosomal testing available. There was no mention of specific medical assessment to rule out concurrent medical illnesses in the group as a whole, although participants who developed dementia were assessed by specialists in more detail later. Participants were followed for up to five years, and given an annual test battery consisting of the IBR Evaluation of Mental Status (Wisniewski & Hill, 1985), as well as modified forms of the Selective Reminding Test (Buschke, 1973) and the Visual Memory Test (Devenny, Hill, Patxot, Silverman & Wisniewski, 1992). The Block Design, Digit Span and Coding subtests of the Wechsler Intelligence Scale for Children- Revised (Wechsler, 1974) were also administered. The diagnosis of dementia was made on the basis of declines in functioning in everyday memory and current disorientation. Statistical analysis used hierarchical linear modeling.

Results showed that scores on the mental status examination were stable over repeated evaluations, with no effect of age or diagnosis. However, participants without DS improved more over repeated testing than did those with DS. Among participants with DS, older participants showed a small decline in performance over test times, whereas

younger participants tended to improve. However, tests for the slopes were not significant on the longitudinal measures. Only four out of 91 people with DS were thought to have a diagnosis of AD. The authors concluded that adults with DS and mild to moderate ID had a lower risk for dementia in their fourth and fifth decades than previous studies had suggested.

One of the most cited population dementia prevalence studies among adults with DS was performed by Holland, Hon, Huppert, Stevens and Watson (1998). Seventy-five people from the Cambridge Health District in the UK were included in the study group. Authors used the informant interview of the Cambridge Examination for Mental Disorders of the Elderly (CAMDEX: Roth, Huppert, Tym & Mountjoy, 1988), but also compared it with other diagnostic criteria including the DSM-IV(American Psychiatric Association, 1994) and the ICD-10 (World Health Organization, 1992). Whenever possible, laboratory investigations were also conducted. Final diagnoses were determined by consensus between the research psychiatrist and the research psychologist. Using the CAMDEX criteria, this study found the following prevalence rates of dementia: 3.4% in the 30-39 year-old age group, 10.3% in the 40-49 year-old age group, and 40% in the 50-59 year-old age group. Researchers did not find that there was a relationship between the level of intellectual disability and dementia, although the most severely impaired individuals were more likely to be given a diagnosis of frontal lobe dementia.

Prasher, Chung and Haque (1998) studied age-related changes in adaptive behavior in 128 adults with DS (mean age 43.44 years) using annual assessments over a 3-year period. Detailed physical examination as well as laboratory examination was performed, medication use reviewed, caregiver information obtained using the standard instrument, the DMR (Evenhuis, 1992), and data on adaptive behavior collected using the Adaptive Behaviour Scale (Nihira et al., 1974). Diagnoses were made using the Diagnostic Criteria for Research (WHO, 1993) , and dementia was only diagnosed when there was

deterioration of adaptive behavior in cognitive and behavioral features for a minimum of two years. There was a significant decline in the overall group, as measured on part I of the ABS, and a DCR-10 diagnosis of dementia was made in 26 out of 128 (20%) adults. Authors did not find an association for decline with gender, sensory loss, severity of mental retardation, or place of residence. Their study did suggest caution in interpreting individual decline to dementia because of a high rate of physical and mental comorbidity.

Schupf et al. (1998) studied a community-based sample of 111 adults with cytogenetically confirmed DS, making a diagnosis of dementia (based on a caregiver interview and review of medical records), and carrying out APOE genotyping. 23% of males and 14% of females were found to have dementia, but 43.5% of those with APOE 3/4 and 4/4 genotypes had dementia. The authors also found that males and those with an APOE epsilon4 allele had an earlier onset of AD, and speculated that this might be due to different gender variation in hormonal function in adults with DS compared to those in the general population.

Tyrrell et al. (2001) studied 285 people with DS, making a diagnosis of dementia using modified DSMIV criteria, and administering the Down's Syndrome Mental Status Examination (Gedye, 1995), the Test for Severe Impairment (Albert & Cohen, 1992) and the Daily Living Skills Questionnaire (National Institute on Aging, 1989). The overall prevalence of dementia was found to be 13.3%, and occurred at a mean age of 54.7 years.

2.5 Service provision for people with ID

2.5.1 Review of Saskatchewan service changes over the last century

Lorne Elkin (1976) published a review of care issues for people with intellectual disabilities in Saskatchewan, illustrating changes over the last century, particularly the

transition from institutional to community care. This section of the thesis draws extensively on this publication, as very little information on care issues in Saskatchewan is otherwise available.

Around the turn of the last century and for many years afterwards, documented attitudes to people with intellectual disabilities appear astonishingly devaluing and dehumanizing. Elkin excerpted parts of a document issued by the Bureau of Social Research Governments of Manitoba, Saskatchewan and Alberta in 1916. This document addressed the problem of the "mental defective", whose "childish mind in his adult years inevitably brings him into conflict with laws, customs and rules of conduct...". Regarding education, the document stated that "the mentally defective, not only are retarded, but they retard the whole class and, not infrequently, cause endless trouble in the school." Furthermore, the government document warned, "mental defectives are here in hundreds: they are multiplying rapidly: more are coming in every shipload of immigrants." After setting the stage for increased fear and resentment for those with intellectual disabilities, the document then recommended stricter immigration laws, amended marriage laws, and special protection, including supervision, sterilization or segregation. Of course, as has been well publicized by court actions in recent years, eugenic policies such as involuntary sterilization did then become publically acceptable and very common. According to Elkin, it continued to be advocated by the government in Saskatchewan until the 1940s.

What little organized care was provided for those with intellectual disabilities was provided by the Department of Health in the same settings as care for people with mental illnesses: (i.e., preferentially large institutions). In Saskatchewan, these were originally located in North Battleford and in Weyburn. It was not until 1947 that 700 people with intellectual disabilities were moved from the mental hospital in Weyburn to temporary, but specialized facilities at the Weyburn airport. Once the new, permanent facility (the Saskatchewan Training School) for people with intellectual disabilities was opened in

Moose Jaw in 1955, the Weyburn residents were moved there, joining residents from other parts of the province.

The training school was initially seen as a major improvement in care for people with intellectual disabilities. Its design involved the construction of 18 separate cottages for residents with underground tunnels connecting them. Along with the recreation and therapy facilities, laundry, hospital, worship facilities, school, workshop and administrative areas, the centre became a self-contained community, proving jobs and economic prosperity to a large percentage of Moose Jaw citizens. At its highest occupancy, 1,150 people resided in this training facility. Unfortunately, as Elkin documents, the new building was filled to capacity rapidly, and because of crowding and staff shortages, individualized care was generally not possible. Education and vocational training was only provided to the highest functioning residents, and lower functioning residents had minimal custodial care only.

Pressure was taken off the Moose Jaw facility by the opening in 1961 of the new satellite centre in Prince Albert: the Prince Albert Training School. However, soon after its opening, the drive for community care gained strength, with much of this emphasis driven by advocacy organizations representing parents of intellectually disabled children.

Up until this point, care for people with intellectual disabilities was provided under the auspices of the Department of Health. However, there was much popular demand for a new government agency that would be responsible for those with intellectual disabilities, so in 1972, Core Services, under the Department of Social Services, was established, and took over this mandate from health.

Core Services took the position that the community should take a large role in developing and providing services, and thus instigated and supported the development of community boards, which administrate independently run services. These services

include small to large group living facilities, workshops and other supportive programs, and have now sprung up in small, medium and large centers throughout the province.

There has been much improvement in the provision of education to people with intellectual disabilities. In the earlier part of the century, the education act allowed schools to exclude children with intellectual disabilities. Fortunately, in 1971, after much effort by advocates, Bill 122 made the provision of education mandatory for all children. Initially, the emphasis was on the provision of special schools, or special classrooms within general schools for children with intellectual disabilities. One of the last such schools built was the John Dolan school in Saskatoon. However, the predominant force was now for mainstreaming children into the regular school system, and this has gradually become the generally accepted policy over the last 40 years, with most children with ID now participating in regular school programming.

Unfortunately, there are still difficulties with children who have severe or multiple handicaps. Assessment and intervention programs for these children had to be developed. The best-known of these is the Alvin Buckwold Center, part of the Royal University Hospital in Saskatoon, which opened in 1975, led by a trained child psychiatrist, Dr. Witold Zaleski. The Alvin Buckwold Center provided, and still does provide various assessment and treatment services for children throughout the province, using a multidisciplinary model and outreach services as well as office based care. Staff are actively involved in teaching and research as well.

In contrast to these services for children, services for adults with intellectual disabilities and severe multiple handicaps are less well developed. In particular, although originally at the Saskatchewan Training School, a psychiatrist provided clinic leadership, and there are some behavioral therapists in the province hired by the Community Living Division of social services (now called the Department of Community Resources and Employment), there are currently no formal, specialized psychological or psychiatric

services for adults with intellectual disabilities in Saskatchewan. Generic mental health services only incompletely meet the needs of this challenging population.

Valleyview Center, previously called the Saskatchewan Training School, has over time decreased the number of people living there to 362, as noted in its last updated web site, as reviewed on August 31, 2005 (Saskatchewan Department of Community and Employment, 2005). A major goal of administrators is to discharge the remaining residents, and almost no new admissions take place now. Adults with intellectual disabilities and highly challenging physical and mental health issues have been dispersed throughout the province, for the most part with apparent success. However, some have continued to have challenging needs, such as significant behavioral problems, which have not been well met in a community setting. As a result of this, and because of the aging of this population, some have eventually moved into another institution, such as a nursing home (see later section on transinstitutionalization), which may pose even greater concern to quality of life issues such as autonomy and participation in meaningful activity.

Increases in the community dwelling, aging population with intellectual disabilities have also prompted the gradual development in Saskatchewan of modified community work situations, day programs for older adults, and even the potential for retirement. Although many smaller localities do not yet have access to these services, there has been significant growth in this area, which is continuing at this point in time.

2.5.2 Institutionalization

Although the development of institutions specialized for people with intellectual disabilities was an improvement over institutionalization in facilities designated for people with mental illness, increased attention to the adverse impact of institutionalization itself has resulted in service changes throughout the Western world,

similar to those discussed above for Saskatchewan.

Much has been written about the adversities of institutionalization, but a recent review from the American Association on Mental Retardation (AAMR, 2004) summarizes the issues well. Abuse and neglect are thought to be more likely and more difficult to detect in institutions because of the common experiences of crowding and depersonalization. There may be a "wall of silence" protecting abusers among institutional staff, and frequently there is also inadequate staffing and a lack of other resources that could contribute to improvements in the quality of life. Provision of care to large numbers of people in one site may also contribute to dehumanization, or the regarding of institutionalized people without human dignity and respect. Segregation and isolation from the surrounding community decreases involvement of the person with their family of origin, friends, and other normalizing organizations. Institutionalization, including restriction to a facility without adequate access to challenge or appeal also constitutes a loss of human and civil rights. Residents have little individualization in their services, and are often deprived of privacy, choice and control in their lives. They also often have less access to education and the opportunity to increase their own skills, leading to excessive dependency.

Aside from these psychosocial issues, large, congregate living situations contribute towards higher prevalence of certain infections, such as hepatitis and Helicobacter pylori (Wallace, 2004). There may also be increased mortality of those in institutional settings compared to community settings, although there is some disagreement on this, and differences may depend on the medical complexity of the pre-existing developmental disability. For example, Shavelle, Strauss, and Day (2005) analyzed data from over 2000 people transferred from institutional to community care in California, finding a 47% increased mortality in those who were deinstitutionalized.

2.5.3 Deinstitutionalization

The recent trend to deinstitutionalization of people with intellectual disabilities in Saskatchewan was described earlier. This trend is consistent with trends across Canada and the Western world, particularly in the USA, where there has been a striking depopulation of institutions, as reviewed by Anderson, Lakin, Mangan and Prouty (1998) and Coucouvanis, Polister, Prouty and Lakin (2003).

Many published studies have shown positive outcomes in people with intellectual disabilities who are moved from the institution into the community. These studies have recently been reviewed in depth by Kim, Larson and Lakin (2001), who concluded that there is good evidence that deinstitutionalization usually results in improvements in daily living skills, community participation, contact with community family members and others in the community, greater choice, and satisfaction. This of course, depends on the degree of community resources available, and selected changes may therefore not always be apparent. For example, the use of psychotropic medications for behavioral problems may not necessarily decrease (Nottestad & Linaker, 2003), especially not in the short term, as the learning of new, more adaptive behaviors, requires skilled staff supports and time.

There may be cost benefits also, in moving people from institutions to the community, and this has been described in a number of scholarly publications such as that by Spreat, Conroy and Fullerton (2005). Unfortunately, without considerable advocacy, cost savings may be realized by the provision of cheaper and less appropriate community resources, possibly resulting in poor care and quality of life, particularly for those with high needs.

The greatest challenge lies in meeting the needs of those people who have the most severe, comorbid medical and mental disabilities, and Canadian data does suggest that there is considerable physical and mental morbidity after deinstitutionalization (Fotheringham, Abdo, Ouellette-Kuntz, & Wolfgarth, 1993). Quick mobilization of

additional staff from a larger environment in responding to severe aggressive behaviors may be able to achieve and maintain safety for the person and others without the administration of regular, higher dose, tranquilizing medications. However, the same severe behavior in a small group home with only one staff on at night, may necessitate much higher doses of ongoing sedation, and possibly transfer to an inpatient psychiatric facility, where restraining medications will very likely also be increased. The needs of people with serious medical problems such as refractory seizure disorders may also outstrip the resources of caregivers and medical staff in the community. This is exacerbated by the deficits in training opportunities in ID in Canada, which are discussed elsewhere.

Other concerns that have been raised about deinstitutionalization (especially that occurring rapidly without adequate provision of community resources) include fears for community safety by the public, suspicion that deinstitutionalization is a vessel for decreasing public expenditures rather than increasing the quality of life of people with ID (Holden, 1992), lack of community resources with potentially inappropriate and revolving door psychiatric admissions and trends to transinstitutionalization to facilities for the aging and correctional institutions. There is also data suggesting that increased contact with non-developmentally delayed persons in the community may be less likely than had been hoped (Fotheringham et al., 1993).

2.5.4 Transinstitutionalization.

Transinstitutionalization is a term reflecting the move from one institution, only to ultimately end up in another one. Some adults with intellectual disabilities who are discharged from an institution for people with ID, accompanied by others whose mental and physical needs outstrip community resources, are eventually placed in nursing homes. The full magnitude of this pattern in Saskatchewan is not well understood, as there is no roster of adults with intellectual disabilities, and statistics on their treatment

in the long-term care system are not uniformly available. Some nursing homes, such as Parkridge Center in Saskatoon, have responded to this clinical need by designating specific areas of the nursing home for those with intellectual disabilities, aiming to enrich the daily environment in a developmentally appropriate way, but also to enable staff to streamline and improve the care provided.

The general provision of care to people with intellectual disabilities in nursing homes is not a new phenomenon, and has been described from around the world. For example, Lakin, Hill and Anderson (1991) found significant numbers of older people with intellectual disabilities in nursing homes in the United States, with some variation between States. Hand (1994) and Hand and Reid (1996) found that 13% of older people with intellectual disabilities in New Zealand lived in rest homes, presumably designed for the generic older adult population. Major legislative changes were made in the USA regarding nursing facilities in 1987, resulting in decreases in the proportion of those with ID who lived in this type of environment. Prouty, Smith and Lakin (2005) published a major review of residential trends for persons with developmental disabilities in the USA and found that about 5.9% of people with ID or developmental disabilities (DD) receiving services were in nursing home facilities in the USA, which had decreased by 13.4% since 1970.

For the most part, nursing home institutional care has allowed for closer proximity to families of origin, and blending with generic, not intellectually disabled populations. However, nursing homes are still institutions, and suffer from a variety of issues common to this care setting such as rigid institutional routines, nosocomial infections and lack of resident autonomy. Furthermore, unlike the situation in institutions such as Valleyview Center, where staff developed considerable expertise with intellectual disabilities, most staff in nursing homes are not familiar with the mental and physical needs of this group. There is also frequently a lack of developmentally appropriate programming, and those with intellectual disabilities are often not well accepted by the

generic, aged population. Lastly, prescribing of psychotropic medications may not be improved in nursing homes. For example, Spreat and Conroy (1998) found that over 30% of people with mental retardation admitted to a nursing home were given antipsychotics, and raised concern over this type of placement.

Transinstitutionalization is not always to a nursing home. Among people with borderline to mild intellectual disabilities, another possibility is transinstitutionalization to the correctional system. This form of transinstitutionalization has been well described for people with mental illness (Morrissey & Goldman, 1986), particularly after closure of large psychiatric institutions. It is also known that the correctional system houses many people with intellectual and learning disabilities, and that these probably do not receive appropriate services (Barron, Hassiotis & Banes, 2002) and have high recidivism rates. People with FAS and Fetal Alcohol Effects (FAE) are particularly at risk for entering the correctional system (Streissguth et al., 2004) because of impulse control problems which are difficult to manage in open settings without sufficient structure. Unfortunately, FAS and FAE are still not optimally identified in correctional systems (Burd, Selfridge, Klug & Bakko, 2004).

Transinstitutionalization can result in an apparent decrease in the institutionalization of adults with intellectual disabilities, yet actually represent another form of institutional care that may be even less appropriate.

2.5.5 Psychiatric care

Psychiatric services to adults with ID are generally supplied by general adult psychiatrists with no special training in ID, and no special mandate (or financial incentive) to supply services to people with ID. There is no formal mandatory training in ID within Canadian psychiatric training programs, nor a subspeciality training stream, unlike in other countries, such as the UK. The clinical training that is available in

Canada is fragmented, variable and thought to be suboptimal (Lunsky & Bradley, 2001; Leichner, 1977; Leichner,1987). Although some interest has been expressed recently in establishing additional training in this area, the process to achieve this at the level of the Royal College is anticipated to be lengthy, and will be limited by the shortage of academic psychiatrists trained in ID. Issues related to reimbursement are also problematic, as adults with ID generally have complex presentations of psychiatric illness resulting in diagnostic challenges, increased time requirements for a full assessment, and increased need for on-site evaluation (as environmental and staff factors are frequently instrumental to the clinical presentation). Fee-for-service models, which reimburse consultations irrespective of complexity and penalize outreach and intensive team involvement, serve to deter full, multifactorial assessment of the adult with ID and complex emotional, behavioral or psychiatric needs.

In Saskatchewan, 2.5 % of the general population receives some formal mental health care (defined as a visit with a psychiatrist or a psychologist) each year (Vasiliadis, Lesage, Adair & Boyer, 2005). The extent, intensity and adequacy of psychiatric care of adults with ID is not known. Although the increased prevalence of behavioural problems would suggest increased psychiatric contact compared to the general population, Canadian research findings that less privileged people have reduced frequency of psychiatric contact (Steele, Glazier & Lin, 2006) would suggest decreased psychiatric contact. It is likely that people with ID are more likely to see a psychiatrist in consultation occasionally for significant mental health problems, but that they also receive less frequent, continuing services such as psychotherapy.

2.5.6 Aging related care issues: day programs, retirement, long-term care

Special service development for older people with intellectual disabilities is fairly recent, in response to the increased community prevalence of older adults within this population, as discussed earlier. However, as early as in 1987, published reports indicate

that many generic aging services were supplying services to older adults with intellectual disabilities, and that in some of these services at least 10% of the clientele had intellectual disabilities (Seltzer, Krauss, Litchfield & Modlish, 1989). Seltzer (1988) performed a telephone survey of staff in Massachusetts exploring service use by older people with ID. He found that there was an increased number of older people with ID in the population, that these required an increased number of services, and that they were frail. Problems with integrated ID services that provided care for older adults were lack of provision of appropriate age related activities. The practical provisions made for older people with ID to retire was another problem noted. On the other hand, Seltzer also noted difficulties with providing services to people with ID within generic aging systems, because of a lack of appropriate available programming geared to this group.

Janicki and Dalton (1997) performed a very large scale mail survey of 4028 individual residence and the service settings in the state of New York. As well as ascertaining rates of suspected dementia, they also surveyed the use of various programming, finding that 19.26% of people with ID resided in nursing facilities (7.09% with DS and 25.62% without DS). This survey ascertained that only 1.63% of study participants were involved in retirement activities (0.37% with DS and 2.29% without DS), and only 7.3% attended senior centers (4.85% with DS and 8.22% without DS).

Cooper (1997) found that older adults with ID in Leicestershire, England, received less day care and less respite care than younger people with ID, which is likely similar in Saskatchewan.

Because of concerns that generic aging facilities for people with ID may not always be developmentally appropriate for or desired by the intellectually disabled population, a second alternative, therefore, is to enrich existing programming for people with intellectual disabilities so that older people can “age in place” (i.e., maintain familiar environments and the friendships while they age, rather than disrupt their lives by

making major changes when they need more care). There are also challenges to this approach because age related problems may increase the complexity of care required. Modifications to day programming are needed to adapt to increasingly frail clients, and staffing adjustments may be needed to allow for the possibility of total retirement from day work programs. In the case of dementia clients, secure wandering areas are required, and increased training for staff to manage dementia specific behaviourial changes.

A third alternative is to develop separate and specialized programming for older people with intellectual disabilities. This could involve a separate residential facility, or just attendance at a special day program specialized for older adults with intellectual disability, for example. These specialized facilities will likely only be feasible in larger urban centers.

2.6 Use of psychotropic medications

A long-standing issue of concern has been a high, and not necessarily appropriate use of psychotropic medications among people with intellectual disabilities (Kiernan, Reeves & Alborz, 1995; Singh, Ellis & Wechsler, 1997; Spreat, Conroy & Jones, 1997; Holden & Gitlesen, 2004; Sachdev, 1991; Stone, Alvarez, Ellman & White, 1989). A high prevalence of the use of antipsychotics in particular, has been reported from most of these studies. This is of concern for two main reasons. Firstly, these medications were initially developed and approved for psychotic disorders, yet are more frequently used in people with intellectual disabilities to suppress undesirable behaviors (Matson et al., 2000), for which behavioral interventions are thought to be more appropriate. Secondly, there are well-established, significant adverse short and long-term effects of antipsychotics, including adverse effects on motor domains, cognition and learning and even life expectancy.

Although some surveys have suggested that the use of antipsychotics in adults with

intellectual disabilities is decreasing with time (Hancock, Weber, Kaza & Her, 1991), the prevalence is still higher in adults with ID than in the general population. Hopes had been high that deinstitutionalization would result in individual reductions in the use of antipsychotics, but unfortunately, longitudinal studies have generally not shown an individual pattern of change (Thinn, Clarke & Corbett, 1990, Nottestad & Linaker, 2003), unless special medication reduction strategies are put in place (Radouco-Thomas et al., 2004). In fact, some surveys have suggested that community dwelling people with intellectual disabilities might even have an increased rate of use of antipsychotics (Pary, 1993).

Whereas there has been a historical pattern of overuse of antipsychotics in people with intellectual disabilities, it is thought that there has been a correspondingly low use of antidepressants, in spite of a substantial prevalence of depression in this population (White, Chant, Edwards, Townsend & Waghorn, 2005) when it is carefully screened for. This is probably the result of difficulties in diagnosing depressive disorders in people with significant cognitive impairment, especially if there is a severe communication disorder. Recent pharmacological reviews have suggested that the rate of antidepressant use is increasing (Spreat, Conroy & Fullerton, 2004), although it is clear that the knowledge base pertaining to the prevalence and treatment of mood disorders in this population is still not optimal (Davis, Judd & Herrman, 1997).

2.7 Summary

A number of broad conclusions can be drawn from the published literature, as summarized in this chapter. The proportion of people with ID surviving into old age is increasing, with a number of disparate factors affecting mortality. Physical morbidity is higher in those with ID than those in the general population, with specific morbidities in younger ages most closely tied to the underlying cause of the ID, whereas age related changes are fairly similar to those seen in the general aging population. Sensory deficits

may be particularly common, especially in DS, contribute to functional impairment and are not always well identified. Emotional, behavioural and psychiatric morbidity is very common in people with ID, especially in younger ones and in those with specific diagnoses (such as Fragile X), although there appears to be a resurgence of problems in older ages, which is associated with cognitive decline. Functional and cognitive decline with age is accelerated in those with DS (compared to those with ID but without DS) , although the actual diagnosis of dementia is less frequent than suggested by neuropathological data. Service provision for people with ID has undergone major changes in the forty years, particularly in the shift from institutional to community focus, and the impact on health and quality of life has mostly been positive, although large challenges remain. The use of psychotropic medications in people with ID remains a concern, with a high frequency of use of sedative or tranquilizing medications to treat behaviours, but a sub-optimal (but improving) treatment of mood disorders.

The methodology described in the next chapter was designed to obtain information on the above aspects of health and health care in community dwelling Saskatchewan adults with ID, with the understanding that this information may differ from the published literature, mostly because of differences in service patterns and health care delivery, and may therefore impact future needs.

3. METHODOLOGY

This chapter presents information on methodology (data collection and specific instruments used), and statistical analysis (how data were analyzed and why particular methods of analysis were chosen).

3.1 Data collection and instruments

3.1.1 General challenges of data collection

As cognitive decline in adults with DS had been the predominant concern voiced by caregivers of adults with ID in the health region, this was the initial defined goal of the study. A full literature search had been performed to explore assessment instruments and protocols for age related intellectual decline in adults with ID, particularly those with DS. Details of this are reported more fully in the literature review chapter.

One outcome of this search was that there was a lack of universally acceptable instruments for use in this population. The biggest reason for this was that this population is highly heterogeneous in multiple domains, including baseline intellectual functioning (IQ), medical comorbidity, and various psychosocial factors.

In particular, baseline IQ ranges from extremely low scores in those who are profoundly impaired (no independent functioning, no language, no other form of reliable communication) to almost normal scores (community dwelling, engaged in gainful employment and fully verbal). This means that instruments designed to discriminate between abilities at the higher IQ ranges can not be administered to those at the lowest

ranges, and that the more basic instruments designed to measure core functioning at the lowest ranges would have severe "ceiling effects" for those with higher IQ scores.

Also found to be important was significant medical heterogeneity of adults with ID. Some have few medical problems, but others have ID secondary to major chromosomal syndromes or neonatal injuries. These often have related other serious and pervasive medical challenges, including sensory deficits and refractory epilepsy requiring high doses of anticonvulsant medications. Some of the most severe medical problems might impair the ability of assessors to accurately measure cognition.

Cognitive and behavioural functioning may also be affected by lifetime experiences and learning. Adults with ID have had widely varying exposures to these experiences, some due to geographic availability of resources, some due to societal belief systems about those with ID, and some due to their own families' wishes. Those who have resided much of their life in institutions have had particularly different experiences, but may also have been highly selected for having more profound intellectual disabilities, or more severe challenging behaviour, such as aggression. There is a also a potential cohort effect present in this regard, as those born with ID in the last twenty to thirty years or so in Saskatchewan have had greatly increased early medical, social and educational interventions. They have also been gradually more integrated into the mainstream society, with continuing decrease in institutionalization and increase in community living, even among those with very severe and profound disabilities. This may have had positive effects on individual adult cognitive functioning, yet, may have paradoxically decreased the mean intellectual functioning of this community dwelling younger adult ID cohort.

3.1.2 Protocol development

Instruments that were considered for the study were to be readily and freely available,

easy and efficient to administer, and ideally have acceptable published psychometric data. Participants should also consider the tests acceptable and not too stressful to perform. To help in planning the protocol for the study, the lead investigator attended a variety of international meetings about aging in adults with ID, and participated in a panel to develop guidelines for the assessment of cognitive decline in those with ID. Potential participants, as well as clinical and administrative staff involved in the care of people with ID were also consulted about the development of protocol for the larger study. These included administrative staff from the Department of Social Services, and a number of direct service workers. Consultation meetings were then held with the provincial advocacy organization, the Saskatchewan Association of Community Living, so that community and family concerns could be included, and ethical issues related particularly to incomplete competency to consent to research could be addressed.

To deal with the concern about heterogeneity of baseline intellectual functioning, medical comorbidity, and various psychosocial factors, it was decided that only community dwelling adults would be enrolled. To minimize bias and maximize generalizability it was also decided that the study population would not be selected from a clinical population, which would be expected to have higher rates of pathology. Ideally the sample would be selected randomly from all community dwelling adults with ID in Saskatchewan. Unfortunately, there was no register of all people with ID in Saskatchewan. As a result, the decision was made to recruit from those using community services designated for adults with ID, and the Division of Social Services responsible for those with ID (Community Living Division) agreed to supply the addresses and main contact names for these. It was likely that this population would not include those with the lowest IQ or those with the most challenging medical comorbidities (who might still reside in institutions for those with ID), and might also miss those with the most severe aging related deterioration, such as dementia, who might have moved into nursing homes and thus left the Social Services register. Conversely, this recruitment strategy might also miss those with the highest functioning, who might

not require any services from social services.

It was also decided that an appropriate comparison group for the adults with DS would be required. The group most likely to have similar psychosocial experiences was thought to be a group of adults with ID but who did not have DS, so the decision was made to recruit a sample of adults with ID who had a variety of diagnoses, including DS. This would allow for later comparison (cross-sectional and longitudinal) of functioning in various domains.

Instruments to be used in the study to assess the health outcomes of interest were chosen using the criteria described in section 3.1.2, and involved a combination of direct and indirect sources, including direct cognitive tests, caregiver reports and chart review. The outcomes of interest as defined in the introduction were dementia related abilities (including memory, orientation, aphasia, apraxia and executive functioning), functional abilities, physical and mental health and mortality. Instruments designed to best measure these outcomes reliably are described in more detail later.

This study also set out to assess care issues in this population, choosing to focus specifically on the use of psychotropic medications and the use of aging services. This information was to be obtained from caregiver reports and chart review.

The consensus among the various agencies involved in preliminary discussions regarding consent was that those people with ID who clearly understood the process of the study would provide their own consent. If a person was not able to comprehend the study process, the person who normally consented to health care interventions would be asked to provide consent for the person's participation. If there was partial or unclear competence to consent, both the person and their usual medical decision maker would be asked for their consent. In all cases, it was attempted to obtain the participant's assent. No participants would be included whose family or immediate caregivers were not

supportive of the study.

Appropriate authorization for the whole study was then obtained as required from the University of Saskatchewan Ethics Committee (see appendix A for ethics approvals). Procedures followed were in accordance with the ethical standards of the Helsinki Declaration of 1975, as revised in 2000 (World Medical Association, 2000).

3.1.3 Participant inclusion criteria

Participants were to be community dwelling adults, who were considered by service ID care providers as having childhood onset ID, and who could provide appropriate assent and consent. People without DS as well as those with DS would be recruited.

3.1.4 Recruitment and follow-up

Participants were recruited from a list (supplied by the Community Living Division of the Department of Social Services) of all residential homes and workshops for adults with ID in Saskatchewan. Letters were sent out to the administrator of each home and workshop, informing them of the study, explaining the consent procedure, and the inclusion criteria. Consent forms were included in the mailed package, and were returned by the administrator after appropriate consent had been obtained for each participant. Phone follow-ups were made by research personnel to further explain the study, and in some cases additional information about aging and ID was sent.

Study assessments were planned for two year intervals, for a maximum of four assessments. Enrollment commenced in summer 1995 and continued until summer 1997. Last clinical assessments occurred in summer of 2001, but phone contact was made with all caregivers of remaining participants in Spring of 2003 and in summer 2005. Only data on whether the participant had deceased, along with dates of death

were coded at the last two phone contacts. Appropriate consents were obtained at all stages of entry into the program. Information on all participants' health and functioning was collected from caregivers. For those who were able and willing to be interviewed by research personnel, cognitive and functional tests were administered for a maximum of three times, and an interview addressing quality of life issues was administered.

No financial reimbursement was given to participants, but at each wave of data collection a printed certificate of participation was presented.

3.1.5 Data collection and study instruments

3.1.5.1 Demographics and general health

Basic demographic and health information was collected at each wave from caregivers on a standard form. It was expected that caregivers would not be able to give detailed information about the presence and severity of most health problems. However, of almost equal interest was the degree of caregiver awareness about various problems, such as sensory loss, which could then be compared to known rates established by others directly. Problems were described in the lay terms most likely to be understood by caregivers, as these were known to come from varied, and sometimes impoverished educational backgrounds. For example, mental health problems were described as emotional, nervous, behavioural or psychiatric problems, as these terms are all more widely understood than the formal diagnostic categories in the DSMIV.

Caregivers were asked to rate other health problems as follows:

0. Never a problem as far as you know
1. Previously a problem, but not any more
2. Still a problem, but generally well controlled, and minimal effect on life
3. Intermittently a significant problem, but not at this time
4. Currently a significant problem

3.1.5.2 Seizure disorders and epilepsy

The primary data on participant seizure history were based on caregiver answers to the following question: Does he/she have a history of seizures?

0.	No	3.	Yes, one to four per month
1.	Yes, but none for over a year	4.	Yes, two to six per week
2.	Yes, less than one per month	5.	Usually daily or more

As detailed neurological assessments of epilepsy status were not available, participants were considered to have epilepsy at baseline if their caregiver stated that they had experienced a seizure in the past, and medication records indicated that they were taking an anticonvulsant at the time. "New seizure" was coded positive if the participant was assessed by the caregiver as never having had a seizure at the first assessment, but subsequently had at least one seizure documented.

3.1.5.3 Intelligence Quotient (IQ) and level of intellectual functioning

Historical IQ data were sought from all study participants, prioritizing the earliest IQs performed after age 18. It was expected that IQs performed later in life might be a less accurate measure of early functioning as they might potentially also reflect superimposed decline, such as that caused by dementia.

Because it was anticipated that measured IQs would not be available for all participants, care staff were asked to estimate the level of the premorbid intellectual disability based on their information of the participant's best functioning in early adulthood. A functional definition of this level of disability was used based on the supplementary description in the Diagnostic and Statistical Manual of Mental Disorders, fourth Edition (APA, 1994):

Premorbid impairment: Caregiver rating of best functioning in early adulthood

1. Borderline normal (*a slow learner but fully functional in all areas*)

2. Mildly disabled (*social/vocational abilities sufficient for self-support, but requires guidance in complex situations*)

3. Moderately disabled (*only basic communication skills, requires help for self care, may perform unskilled work)*

4. Severe - profoundly impaired *(Minimal communication, major impairments in all areas, full care required)*

This information was expected to be dependent on how well and how long the caregiver knew the participant, and less an accurate estimation of formally established IQ than an estimate of known functional abilities. Plans were to compare this caregiver assessment with known IQ data in the subset of participants with available IQ testing.

3.1.5.4 Dementia Questionnaire for Persons with Mental Retardation

Standardized caregiver rated instruments sent out included Evenhuis' Dementia Questionnaire for Persons with Mental Retardation (Evenhuis, 1992). These were filled out by the direct caregiver who declared him/herself most knowledgeable about the participant's health and functioning.

The DMR is one of the most widely known and translated, as well as the most easily used caregiver rated instrument designed for the evaluation of cognitive and functional decline in those with ID. This standardized 50 item instrument is based on the dementia criteria in the DSMIII-R (American Psychiatric Association, 1987), but was adapted to allow for easier scoring in those with baseline intellectual disabilities. Higher scores on the DMR (based on behaviour over the last three months) indicate more impairment. Subscales of the DMR include short-term memory (STM), long-term memory (LTM), spatial and temporal orientation (SPA), speech (SPE), practical skills (PRA), mood

(MOOD), activity and interest (ACT) and behavioural disturbance (BEH). These subscales are of interest as they may illustrate different patterns of functional and cognitive change over time. Individual subscale scores at baseline may also differentially predict outcomes such as mortality.

Specific items included in each sub-scale can be viewed in the original publications of the DMR, and selected questions appear in Appendix B. The subscales themselves have been summed to derive two major sub-scales: the Sum of Cognitive Scores (SCS), which have a score range of 0 to 44, and the Sum of Social Scores (SOS), which has a range of 0 to 60.

Sum of Cognitive Scores	Number of items	Score range
1. short-term memory (STM)	(7 items)	0 -14
2. long-term memory (LTM)	(8 items)	0 -16
3. spatial and temporal orientation (SPA)	(7 items)	0 -14

Sum of Social Scores	Number of items	Score range
4. speech (SPE)	(4 items)	0 - 8
5. practical skills (PRA)	(8 items)	0 -16
6. mood (MOOD)	(6 items)	0- 12
7. activity and interest (ACT)	(6 items)	0 -12
8. behavioural disturbance (BEH)	(6 items)	0 -12

The preferred use of the DMR in the screening for dementia is by analyzing longitudinal score changes, as the baseline IQ affects most of the items in the DMR. However, Evenhuis' manual (Evenhuis, Kengen & Eurlings, 1991) published criteria for single completion as well, which have cutoffs for the screening of dementia that take into account the baseline intellectual functioning of the person. These are shown below, with SOS cutoffs for severe ID not listed, as they have not yet been developed.

Level of ID	IQ	SCS cut-off	SOS cut-off
Mild	55-70	7	10
Moderate (high range)	45-55	15	15
Moderate (lower range)	35-55	25	15
Severe	25-35	34	

Evenhuis' published criterion for a positive dementia screen on the basis of longitudinal score changes is either an increase of the SCS of 7 points or more and/or an increase of the SOS of 5 points or more.

The inter-rater reliability of the DMR ranges from 0.44 to 0.94, with only the subscale "behavioral disturbance" showing a low correlation between two different raters (0.44). Individual items within subscales have good internal consistency. Sensitivity and specificity for the detection of dementia based on longitudinal score changes (see later) have been shown by Evenhuis, Kengen and Eurlings (1991) to vary with the cohort studied. For older people with intellectual disability but without DS aged 70 years and over, the sensitivity is 100% and the specificity is 73%. For people with DS the sensitivity is 100% in the specificity is 75%. The DMR is not sufficiently sensitive in people with the most severe intellectual disability, or in those with significant other disabilities such as hearing loss.

Sensitivity and specificity for the detection of dementia based on single completion of the DMR is significantly lower, with particularly low specificity in older adults without DS, who have probable early vascular dementia.

The practical utility and validity of using the DMR in tracking cognitive and functional changes is widely accepted, and is supported by literature published by authors other than Evenhuis. For example, Thompson (2003), showed measurable aging changes over short periods of time (six months) in subscores such as Sum of Social Scores.

3.1.5.5 Dyspraxia Scale

Along with memory impairment, one of the symptoms of Alzheimer's Disease in the general population is apraxia, as discussed earlier in the literature review. Despite its presence in the diagnostic criteria for Alzheimer's Disease in the DSMIV, apraxia is not formally assessed as often as is core memory loss, although work linking apraxia to more rapid decline (Yesavage, Brooks, Taylor & Tinklenberg, 1993) makes its measurement in the early cognitive impairment of DS particularly important.

The Dyspraxia Scale (Dalton & Fedor, 1998) is a directly administered, standardized test with good psychometric properties, designed to assess dyspraxia in adults with DS. Test-retest reliability of this scale was excellent, with a correlation coefficient of r= 0.96. The split half reliability analysis of this scale was found to have a reliability coefficient of r=0.98. Cronbach's Alpha values ranged from 0.94 to 0.97. Developers of this instrument found significant longitudinal deterioration of praxis in older adults with DS, most noticeable in the oldest subgroup. This clinical pattern was consistent with the pattern of decline published in a variety of other studies of older people with the DS, suggesting a high degree of face validity.

The Dyspraxia Scale has three subscales:

- Part 1- Psychomotor skills (20 items, maximum score 80)
- Part 2- Apraxia (20 items, maximum score 80)
- Part 3- Body parts/coin task. (22 items, maximum score 88)

Each item (listed in Appendix B) has a detailed scoring guide, and the total maximum score is 248. The Dyspraxia Scale was administered (starting in the second wave when it became available to the investigator) to all participants in this study who consented to direct testing and who were capable of following the testing protocol. Testing was

performed by trained researchers either in the participant's own home or the sheltered workshop.

Research assistants performing the testing were asked to code problems that they believed had limited the test administration process as:

	No problem	Problem	
Hearing	0	1	
Language development	0	1	
Second language	0	1	
Attentional problems	0	1	
Compliance problems	0	1	
Other problems	0	1	(details written in)

3.1.5.6 Dalton/McMurray Visual Memory Test (DMTS)

The Dalton/McMurray Visual Memory Test (Dalton, 1992), also called the Delayed Matching to Sample (DMTS) Test, is also a directly administered, standardized test with good psychometric properties, designed to assess various aspects of memory in adults with ID. This instrument is useful for adults with ID who may not be verbal enough to be tested with other, more language based instruments. It requires the use of a computer with a colour monitor. A variety of shapes and coloured pictures are presented, followed by variable length pauses, and then the participant is prompted to point at the image just seen, choosing it out of a few selections that include the original. Results are automatically entered into the computers that are equipped with a touch-screen, or manually entered by an assistant with a keyboard if no touch-screen is available. Scoring includes separate results for coloured pictures and shapes. The process is simple to administer, and participants generally enjoy the testing.

This test was administered (starting in the second wave when it became available to the

investigator) to all participants who consented to direct testing and who were capable of following the testing protocol. As with the Dyspraxia test, testing was performed by trained researchers either in the participant's own home or the sheltered workshop, and test administration problems were coded as noted earlier.

3.1.5.7 Chart and medical records review

Full trisomy 21 is fairly easily recognized clinically, but translocations and mosaicism may result in heterogeneous clinical presentations, and may not be identified correctly without cytogenetic testing. Therefore, confirmatory medical information about IQ testing, chromosomal testing for DS and other significant health history was sought from medical records at the Royal University Hospital. It was anticipated that a sizable percentage of study participants would have had at least one assessment there, either through medical genetics or through the Alvin Buckwold Centre (for children with ID).

The preferred time of chromosomal testing was felt to be childhood, so that increased mosaicism occurring in later adulthood would not obscure the earlier developmental impact of trisomy 21. However, it was known that the results of chromosomal testing in childhood would not be universally available for participants, so testing at the time of the study was considered. This testing was eventually not included in the study because of concerns about the invasiveness of this component, which was of particular concern because of the participants' perceived vulnerability to abuse, and also because some of the potential participants were known to "hate needles".

Plans were therefore made to explore the validity of using caregiver assessment instead of formal chromosomal tests to establish a diagnosis of DS. Available chart data on chromosomal testing were to be compared with the diagnosis recorded by caregivers. If there was strong agreement between the caregiver information about DS diagnosis and the available chromosomal reports, caregiver reports would be used as a valid surrogate

for chromosomal testing.

3.1.5.8 Baseline data on Community Living Division program participants.

To establish the representativeness of the initial sample, baseline 1995 service provision data were obtained (total numbers as well as severity and age distribution) from the division of the Department of Social Services responsible for people with ID, the Community Living Division (CLD).

3.1.5.9 Service issues

Caregivers were asked whether the participant had seen a psychiatrist within five years of the study visit, and whether he/she had any physical, mental or emotional problems that were difficult to deal with using existing resources. They were also asked about the use of aging related services (such as seniors' day programs), and if used, whether the programs were geared to intellectually disabled people or whether they were designed for the general older population. Finally, they were asked whether in their opinion the aging process was causing increased difficulty with care.

3.1.5.10 Medication use

A complete listing of medications taken by each participant was collected at each assessment, with a plan to explore the use of psychotropics in particular detail. Medication use was to be explored both as an independent variable that might predict cognitive, behavioural and functional deficits, but also as a dependent variable that might vary depending on other factors such as diagnosis, age and sex.

3.1.6 Data verification, cleaning and storing

All data were initially recorded on paper except the DMTS, which was directly coded into the computer at the time of testing. Hard copies were later printed out and stored with the primary file. All primary data were stored in a locked hospital filing cabinet with access only to the designated research assistants. Data entry into a database program was performed by hired assistants. Prior to data analysis, ten percent of electronic data were compared to the original source data by a separate researcher to establish accuracy of data entry. Data entry errors of over 5% in some participant files resulted in the decision to review every electronic data point with the source data in all files. The final, corrected data set had less than 0.1% data entry errors in randomly chosen files (10% of the total).

3.2 Statistical data analysis

3.2.1 General data management and approaches to model building

Full data were available from four formal data-assessment waves, and limited data were available from two telephone follow-up surveys. Descriptive results of the data were organized into tabular and graphic forms, and then predictive models were built for various outcomes of interest using appropriate statistical techniques. The independent variables to be included in the models were:

- Demographic variables (DS diagnosis, age and sex)
- Standardized measures of functional abilities at baseline (continuous DMR subscale scores at entry to the study)
- Core health problems that were thought to have face validity for potential contributions to increased mortality (and for which accurate information could be obtained)
- Use of psychoactive medications and nonsteroidal anti-inflammatory medications.

The initial baseline model for all outcomes was to include DS diagnosis, sex, age at entry to the study, and the age-DS interaction term. The age-DS term would be entered into all models initially, as early data exploration and graphing had strongly suggested that aging patterns for many of the dependent outcomes were different in those with or without DS.

Many biological functions are also known to have a non-linear relationship with age. Incorrectly assuming a linear relationship with age can obscure clinical findings, as, for example, the age relationship with an outcome may be U-shaped in real life, but appear non-significantly related if approximated as a straight line. Data transformation, whenever necessary, of the available age variables is therefore useful to increase the validity and usefulness of the analysis. In analyses presented in subsequent chapters, data exploration includes the assessment of a variety of possible relationships between each dependant variable and age by the means of curve analyses, available through SPSS. Curve analysis then suggests the form of the age variable to be included, such as, for example, age^2 for quadratic relationships, rather than the linear age variable alone.

In model building, independent variables were initially to be explored as univariate (unadjusted) contributors to each outcome, and results tabulated. The initial plan was to add these variables one at a time to the baseline model if their initial bivariate significance level was p 0.25. However, some of these additional independent variables showed positive interactions with baseline variables, even when the univariate association was highly insignificant. Therefore, variables were added individually, one at a time, and then with the interaction term with each baseline variable, regardless of univariate significance. The model was to be re-run after each addition, and the significance of the contribution of each variable to the overall model was to be tested with the likelihood ratio test. Variables left in the final model would include all those with statistical significance at the $p<0.05$ level, as well as those almost significant at this level (with 0.05 $p<0.1$) but which had potential significance based on existing information.

Three main methods were used to analyze the data:

1. Cross-sectional analysis of outcome variables at entry to the study, with the main focus being differences between age and diagnostic cohorts.
2. Longitudinal analysis of changes in the outcome variables.
3. Survival analysis to explore risk factors for the occurrence of particular discrete outcomes, such as death, over the course of the study.

3.2.2 Cross-sectional analysis

The cross-sectional approach was expected to provide descriptive clinical information, which could be useful to providers of services to community dwelling adults with ID. Differences in cross-sectional results at different times of data collection may also suggest changes in patterns of service delivery and care. For example, an increased percentage of participants taking an antidepressant in more recent years and a decreased percentage of participants taking an antipsychotic would be a positive finding in this population. The statistical analysis of this type of cross-sectional data was simpler than for the longitudinal data analysis, and was conducted using SPSS version 11.5 (SPSS, 2002) for descriptive statistics and graphical representation of the raw data, as well as logistic and linear regression. Models were built using SPSS to predict various outcomes for a specific cohorts.

3.2.3 Longitudinal analysis

The longitudinal assessment of the individual pattern of change is more useful for the assessment of aging because of large variations in baseline functioning in this very heterogeneous population. However, greater practical challenges are to be expected in this approach, not only in data management (because of the length of followup, inconsistences in data gathering and anticipated data loss), but also in the methods of

statistical analysis.

One possible way to analyze the longitudinal data is to utilize the Generalized Estimating Equations (GEE) methodology by Zeger and Liang (1986). This method is based on the multivariate quasi-likelihood theory, which can handle the complexities of longitudinal studies, e.g. repeated observations for each subjects and data missing completely at random. In interim data analyses, marginal models to predict various outcomes using the GEE approach were fitted using SAS version 8.2 (SAS Institute, 2000) procedure PROC GENMOD. The average annual yearly decline for each participant was then calculated using these predicted scores. However, examination and discussion of these predicted scores with subsequently calculated annual yearly declines suggested that even this method of calculating decline was highly contingent on baseline raw scores, which were known to be subject to significant cohort effects. It was decided that, whenever possible, a preferred approach to data analysis would be to use individually observed yearly changes rather than raw scores, in any model building process.

As an alternate approach that focuses on analyzing change over time rather than predicting raw scores and then calculating predicted change, it was therefore decided to use the two-stage model introduced by Wishart (1938), which is based on the well-known least squares method (Colton, 1974). The two stage model is a particular case of random effects models. In the first stage, this method can be used to calculate a separate slope for each individual representing change over time in a particular test. Slope is calculated for each participant by the following formula:

$$Slope_i = \sum_{i=1}^{n} \sum_{j=1}^{3} (x_{ij} - \bar{x}_i)(y_{ij} - \bar{y}_i) \,/\, \sum_{i=1}^{n} \sum_{j=1}^{3} (x_{ij} - \bar{x}_i)^2$$

In this equation, for n participants who had 3 tests each, y_{ij} represents the outcome for the ith participant at the jth time, and x_{ij} is the independent variable for the ith participant at the jth time. y_i represents the mean outcome for the ith particpant, and x_i represents the mean value of the independent variable for the ith participant.

In the second stage, this slope can then be used as an outcome variable in the model building process to predict yearly change at various levels of individual independent variables.

However, for measures that were directly obtained from participant testing, an additional challenge was the research assistant finding of improved participant cooperation on the second and third tests compared to the first one, at which many participants appeared hesitant to answer questions, less confident and less comfortable with the test process. Possibly as a result of this, participant scores at the second testing were generally improved, and research assistants felt that this was not necessarily related to improvement in the person's abilities. Of course, an additional learning effect, defined as the improvement of a score on a test, not related to an overall change in the abilities of the participant, but related to a specific practice effect, may also have been present, although the two year interval between tests made this less likely.

Methods of statistical analysis that pool data from all repeated tests of an individual participant (such as the least squares method) and do not take into account this poorer performance on the first test, may miss significant aging changes. For example, if there are only three tests available, and the apparent improvement (related to improved compliance) from test 1 to test 2 in a particular participant is equivalent to the aging deterioration from test 2 to test 3, the slope calculated from this formula will be zero, and indicate that there has been no aging related deterioration, whereas the actual deterioration between time 1 to time 3 might have been quite important.

Because of this problem, it was decided that for directly measured longitudinal data, aging effects would be assumed to be the change in individual scores from the second test onwards, and that the first testing would be considered the "run in phase" similar to the process in experimental drug studies.

3.2.4 Survival analysis.

Survival analysis was used to assess differential mortality during the course of the study. Participants were followed for varying lengths of time, with some (very few) leaving the study prematurely, and some dying prior to the last scheduled assessment. For most participants the last contact was a scheduled phone contact after the formal data collection of the study was completed. Cox's proportional hazards modeling technique (Kleinbaum,1996) was used to assess differential mortality, as it allows for the analysis of mortality rates based on different lengths of followup, adjusting for various independent variables in the regression model. Variables were added to the Cox regression model in the same manner as variables were added to the linear regression models.

4. DATA SET AND GENERALIZABILITY

This chapter presents baseline participant data including regional participation, demographics, genetic testing, and intelligence quotient (IQ). The experimental data are compared with 1995 service data, which were obtained from the division of the Saskatchewan Department of Social Services that has responsibility for people with ID.

4.1 Participation data

360 participants entered the study, and 215 (60%) of these had four complete waves of caregiver data available. Followup time (including phone follow-ups after the completion of the four main waves of data collection) ranged from 0 to 8.49 years, with a mean time of 6.41 years. 276 (77%) people participated in individual interviewing and testing. Table 4-1 shows the number of participants completing each test.

Table 4-1. Number of participants (percentage of total sample) completing test

Type of test	Test number		1	2	3	4
Caregiver mail-out survey (supplemented by chart review)	Demographics		360(100)	348(97)	309(86)	222(62)
	Health problems		360 (100)	348(97)	309(86)	222(62)
	Medications		360 (100)	348(97)	314(87)	215(60)
	DMR		360 (100)	349(97)	310(86)	220(61)
Standardized instruments administered	Dyspraxia Scale		276(77)	250(69)	191(53)	*
	DMTS test	Shapes	264(73)	236(66)	166(46)	*
		Colours	266(74)	243(68)	179(50)	*

* Test only available in three waves as described in methods

Participants came from all areas of the province except for the area north of Prince Albert, with the largest number originating from the areas around Saskatoon and the Battlefords. The geographic distribution is tabulated in Table 4-2.

Participant living situations included Community Living Division group homes, private care homes, mental health approved homes, assisted living facilities, independent dwellings, family homes, and one large congregate living site (Elmwood Lodge in Saskatoon). No participants were solicited or entered from Valleyview Centre, which is the one remaining institution designated for people with ID in Saskatchewan.

Table 4-2. Place of residence at the first assessment (Number and percentage of total)

Nearest town	Number(%)	Nearest town	Number(%)
Admiral	1(0.3%)	Moose Jaw	25(6.9%)
Battlefords	20(5.6%)	Moosomin	1(0.3%)
Biggar	1(0.3%)	Naicam	1(0.3%)
Carrot River	1(0.3%)	Outlook	3(0.8%)
Delisle	2(0.6%)	Porcupine Plain	8(2.2%)
Gravelbourg	4(1.1%)	Prince Albert	3(0.8%)
Gull Lake	1(0.3%)	Redvers	23(6.4%)
Hague	6(1.7%)	Regina	15(4.2%)
Hepburn	3(0.8%)	Rosetown	15(4.2%)
Herbert	2(0.6%)	Saskatoon	99(27.5%)
Hudson Bay	1(0.3%	Shaunavon	10(2.8%)
Humboldt	1(0.3%)	Swift Current	9(2.5%)
Kindersley	7(1.9%)	Theodore	1(0.3%)
Kinistino	6(1.7%)	Wadena	14(3.9%)
Lloydminster	3(0.8%)	Waldheim	25(6.9%)
Macklin	1(0.3%)	Weyburn	20(5.6%)
Meadow Lake	1(0.3%)	Wilkie	6(1.7%)
Melfort	9(2.5%)	Yorkton	11(3.1%)
Melville	1(0.3%)	Total	360(hundred percent)

4.2 Demographics and comparison with CLD service population

Basic demographics of study participants are shown in Table 4-3.

Table 4-3. Demographics of participants

	Non-DS			DS			All Diagnoses		
Age	Male	Female	Total	Male	Female	Total	Male	Female	Total
<30	24	16	40	13	7	20	37	23	60
30-39	42	32	74	22	19	41	64	51	115
40-49	39	26	65	19	17	36	58	43	101
50-59	21	16	37	8	7	15	29	23	52
60-69	7	10	17	2	2	4	9	12	21
70-79	8	2	10	0	0	0	8	2	10
80-89	1	0	1	0	0	0	1	0	1
Total	142	102	244	64	52	116	206	154	360
Mean	43.17	42.91	43.06	39.73	40.48	40.07	42.10	42.09	42.09
(SE)	(1.18)	(1.23)	(0.85)	(1.27)	(1.35)	(0.92)	(0.91)	(0.94)	(0.65)
Range	17-83	20-71	17-83	20-61	20-61	20-61	17-83	20-71	17-83

More males than females entered the study (female to male ratio: 1:1.34), and the DS group was about three years younger on average than the non-DS group ($p<0.05$ using independent samples t-test). Males and females were not significantly different in age. Age distribution of the study population is presented graphically in Figure 4-1.

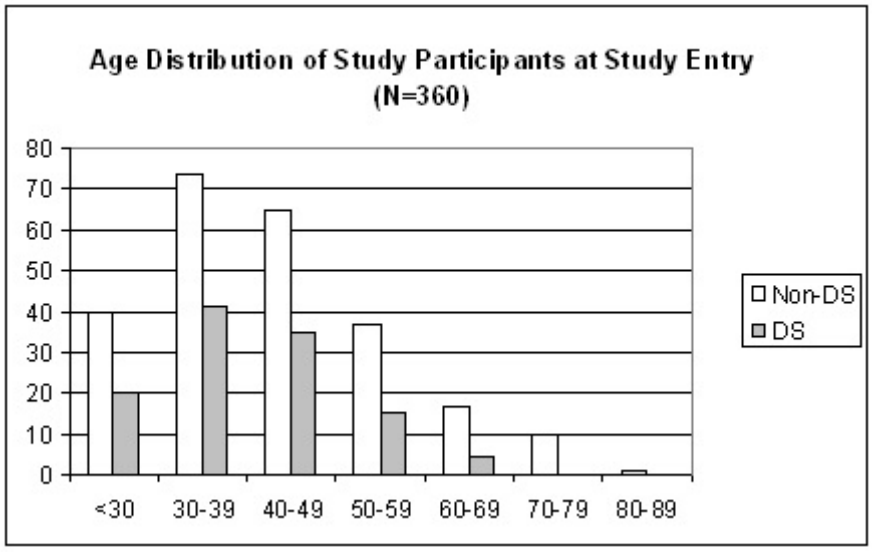


Figure 4-1. Age distribution of study participants at entry to the study

As all of the study participants were recruited through Community Living Division (CLD) service agencies, participant data were compared to the overall service population data recorded by the Community Living Division of the Department of Social Services in 1995 (B. West, personal communication, February 26, 2005). The age distribution of this service group (compared to the study population at baseline) is shown in Figure 4-2, and details of service needs are shown in tabular form in Table 4-4. The levels of clinical-service need (profiles) are defined in Appendix C. It should be noted that these care profiles are based on both the level of intellectual disability as well as on the difficulties of care due to various comorbidities.

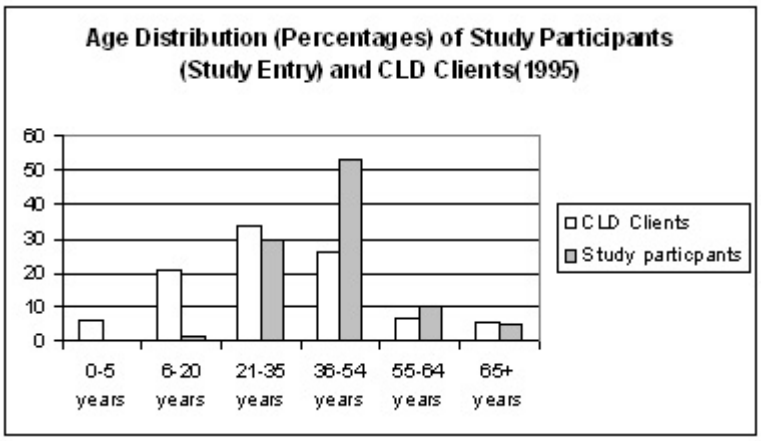


Figure 4-2. Age distribution of CLD clients in 1995 and baseline study population

Table 4-4. Service and demographic profile of CLD Clients, March 1995

	Community living division profiles, March 31, 1995						
Age	Level	Level 1	Level 2	Level 3	Level 4	Level Unknown	Total
0-5	72	2	18	32	73	7	204
6-20	72	83	85	123	298	14	675
21-35	55	217	265	268	272	11	1088
36-54	26	141	217	296	156	5	841
55-64	10	42	47	79	39	1	218
65+	6	38	42	75	26	1	188
Total	241	523	674	873	864	39	3214

3214 people with ID (879 of these 20 years and younger) received services from CLD in 1995. Their care needs varied considerably, using the definition of care profiles described in Appendix C, with the smallest proportion coming from the lowest needs groups. The age distribution was very similar to that of the study population, other than in the youngest groups, which were not included in the study.

Making the assumption that almost all of the study participants were also on the CLD caseload at entry to the study, an estimation was made of the percentage of the service population that was captured in various age groups of the study. Figure 4-3 illustrates this, suggesting that a sizable percentage of the general adult population was captured. For example, in the age range of 36-54, about a fifth of the active service population may have been captured .

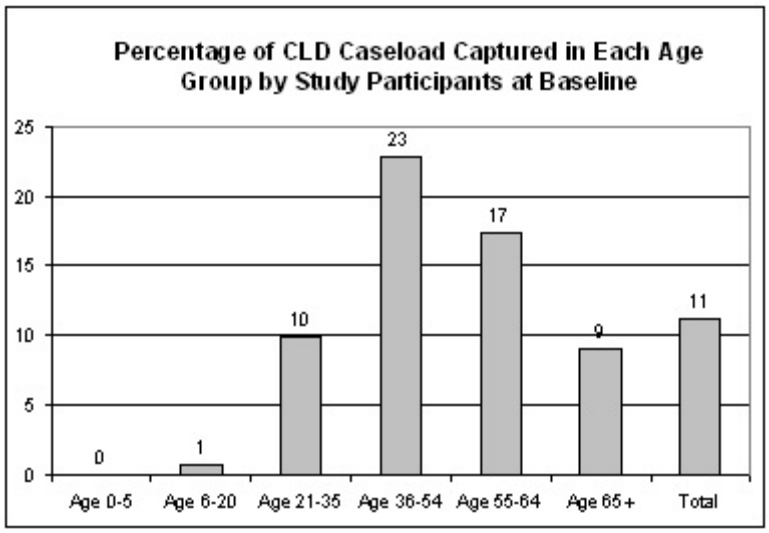


Figure 4-3. Percentage of CLD caseload captured by study participants at baseline.

The definitions of care needs that CLD used were not equivalent to the best levels of intellectual functioning that caregivers provided, yet the second highest impaired groups in both populations had the greatest representation within the overall group.

4.3 Genetic testing

Of 116 participants with caregiver identified DS, 18 had available chromosomal reports (all dating back to either childhood or young adulthood). All 18 of these had full trisomy 21. No participant identified by their caregiver as not having DS was found to have genetic tests indicating that they did have DS. It was therefore decided to accept caregiver reports of the diagnosis of DS as a reasonable alternative to repeated testing.

4.4 Intelligence Quotient (IQ)

After comprehensive searching of records, only a small proportion of participants (75/360 or 21%) had available IQs, and even fewer (61/360) had an IQ available that had been obtained prior to age 30. Mean IQ for those 61 adults was 42.95 (SD: 2.18). DS females in this group had a particularly low IQ, as can be seen in Table 4-5, below.

Table 4-5. Descriptive data for subgroup with available IQs (performed prior to age 30)

Diagnostic Group	Number	Mean age (SE)	Mean IQ (SE)
Non-DS males	30	35.56 (1.17)	42.73 (3.42)
Non-DS females	15	37.38 (2.53)	48.27 (4.60)
DS males	10	30.24 (2.37)	40.80 (3.02)
DS females	6	39.95 (4.25)	32.67 (3.63)

The subgroup with available IQ scores prior to age 30 was used to explore potential independent contributors to the IQ score. These included age, sex and diagnosis. The final multivariate regression suggested that none of the variables were significant predictors of IQ, although the interaction between DS diagnosis and age was almost significant at $p=0.07$.

Table 4-6. Results of linear regression analysis for IQ in subgroup (N=61)

Parameter	$\hat{\beta}$ (SE)	P value	95 % CI for $\hat{\beta}$
DS	28.48 (19.89)	ns	-11.35 - 68.32
Sex	3.42 (4.65)	ns	-5.91 - 12.74
Age (baseline)	0.28 (0.33)	ns	-0.38 - 0.94
DS* Age	-1.03 (0.56)	<0.1	-2.14 - 0.09

The reference category for DS is Non-DS and the reference category for sex is male.

4.5 Discussion

The study population represented a broad subgroup of adults with intellectual disabilities from across the province, with the greatest numbers coming from areas close to Saskatoon and the Battlefords. Research assistants felt that the main factor determining participant involvement was the support of the administrator of the group home or work-shop, and if this person was supportive, many individual families and/or competent participants tended to complete consent forms. Of those administrators who were not supportive and would speak to the research assistants, some cited excessive workload involved in form completion, and others appeared concerned about information gathered about them, as the government body instrumental in their funding was one of the original advisors to the research, and was listed as such on the information forms.

Anecdotally, informal community contacts of those homes who had refused all contact with the study occasionally stated concerns about the adequacy of these homes. It is possible that these homes had a higher than usual use of psychotropic medications, or less adherence to mandated restraint policies, which might have decreased their comfort with research participation. If this was indeed the case, it is possible that study conclusions about the use of psychotropic medications underestimated their true use, and other measurements might also have been non-randomly impacted.

Group homes or organizations whose staff was familiar with the primary investigator were particularly likely to support the research project, and this resulted in not only the

most challenging clients (who had received services) obtaining consents, but also the other, less challenging clients receiving consents. This was fortunate, as the intent of the study was to approximate as much as possible a population study, minimizing possible sources of non-random error, which would have occurred if only those with the greatest difficulties had entered the study.

The geographic distribution of the study sample was probably related to greater ease of interaction between group home/workshop and researchers in the sites closer to Saskatoon, as well as to relationships of trust between staff and the primary investigator which were discussed above. However, the second largest centre in the province, Regina, was particularly difficult to recruit from, in spite of numerous attempts, and in spite of being considerably closer than some of the smallest, rural workshops. Research assistants were unable to ascertain the reason for this, but wondered whether the proximity to a university had already resulted in some "research burnout".

As the participants had been selected from the CLD service population, it was not surprising that their age distribution was similar. Their needs distribution also appeared similar, in spite of the fact that the definitions that were used in the two populations were slightly different. The gender distribution of the sample reflected known gender distribution of adults with intellectual disabilities, with more males represented than females. It is therefore likely that the study population was a reasonable representative population of adults with intellectual disabilities in the community, especially in the mid range of the age spectrum.

Missing from the study population were two major groups of adults with ID. The first group included those who were initially in institutions of any kind (Valleyview Centre, nursing homes, correctional facilities), and these would be expected to have more advanced physical and mental health challenges, resulting in the failure of community placement. Balancing out this tendency to exclude participants with greater difficulties,

was a second group that was largely missed from the study, consisting of mildly disabled people with ID who did not required any formal services. As this group with ID who receives no formal services has been described by others as being a very significant group (Morris, 2003), the current study likely under represented this group far more than it did those with greater challenges. Conclusions about decline might then have also been over-estimated.

The lack of laboratory confirmation of DS diagnosis in most participants was unfortunate, but as the caregiver assessment of DS diagnosis conformed closely to independent laboratory testing in the subgroup analyzed, the use of caregiver diagnoses was probably reasonable. However, this method of assessment of DS might have mis-classified some people with small translocations as well as those with mosaicism to the non-DS group, decreasing potential differences between the DS and the non-DS group.

IQ testing was not available on the majority of the participants. This meant that IQ was not able to be included in the multivariate analysis of other age-related declines later. This was unfortunate, because of known information (summarized in the literature review), showing an association between early life deficits and later life cognitive impairment. It would have been interesting to study whether lower IQ scores in early life actually increased individual level decline in later years, or whether it merely decreased the baseline measures in cross-sectional analyses.

Because IQ was not significantly predicted in multivariate analyses that adjusted for levels of other key factors such as sex, age, and diagnosis (which are significant to a variety of age related declines), it was less likely that the validity of later analyses would be compromised. However, the numbers of available IQ scores were low, and the non-significance of the multivariate analysis, especially for females with DS (whose trend was to lower scores) might well have been due to power issues. If there had been a true association between lower functioning and females with DS, this might have further

increased their decline in old age, assuming their aging had been similar to that of the general population.

5. MORTALITY

This chapter explores crude and adjusted mortality rates in the study population, including all data gathered from caregiver mail-in forms, direct assessments, and follow-up phone calls.

5.1 Deaths among study participants

As of the spring of 2005, forty three people died during the course of the followup, 33 males (16.1% of all male participants) and 10 females (6.5% of all female participants). Stratified into diagnostic groups, 27 participants without DS (11.1% of the non-DS group) died, and 16 participants with DS (13.8% of the DS group) died. Table 5-1 illustrates this information in more detail, showing also that deceased participants with DS were about three years younger at baseline than those without DS ($p<0.05$ on the independent samples t-test).

Table 5-1. Number (%) of the baseline cohort that was deceased at last contact.

Diagnosis	Male	Female	Both sexes	Mean baseline age (SE)
Non-DS	20(14.1)	7(7.0)	27(11.1)	43.1(0.9)
DS	13(20.4)	3(5.8)	16(13.8)	40.1(0.9)
All	33(16.1)	10(6.5)	43(12.0)	42.1(0.7)

5.2 Age at death

In spite of the higher percentage of males who died during the study, the mean age at death was lower in females (54.9 years) than in males (58.0 years). There was a greater gender disparity in the age at death of participants with DS (males 55.4 years, females

48.8 years) compared to the age at death of participants without DS (males 59.7, females 57.6). Table 5-2 lists mean scores and standard errors in diagnostic and gender categories, while Figure 5-1 illustrates this graphically.

Table 5-2. Mean age at death (SE) in cohorts, stratified by diagnosis and sex.

Diagnosis	Male	Female	Both sexes
Non-DS	59.7(3.3)	57.6(4.6)	59.1(2.7)
DS	55.4(2.2)	48.8(1.9)	54.2(1.9)
All	58.0(2.2)	54.9(3.5)	57.3(1.9)

Figure 5-1. Mean age at death of participants who died during the study

Linear regression on the dependent variable, age at death, including core independent variables DS diagnosis, sex and age at baseline, disclosed a small and almost significant ($p=0.0819$) three-way interaction term between DS diagnosis, baseline age and sex. This interaction resulted in the mean age at death among the youngest participants being very similar in the four diagnostic-age cohorts (DS males, DS females, non-DS males and non-DS females), but the mean age of death in the oldest cohort being highest in non-DS males, but progressively lower in non-DS females, DS males and then DS females. The interaction term was left in the final model because of potential clinical significance. This model is shown in Table 5-3, and graphic representation of the predicted values are shown in Figure 5-2.

Table 5-3. Linear regression analysis of the dependent variable, age at death.

Parameter	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
DS	3.2186 (2.0720)	ns	-0.9759 - 7.4132
Sex	-0.3280 (0.8635)	ns	-2.0760 - 1.4200
Age at baseline	1.0058 (0.0271)	<0.0001	0.9510 - 1.0606
DS*Age*Sex	-0.0583 (0.0326)	<0.1	-0.1243 - 0.0077

The reference category for DS is Non-DS, and the reference category for sex is male

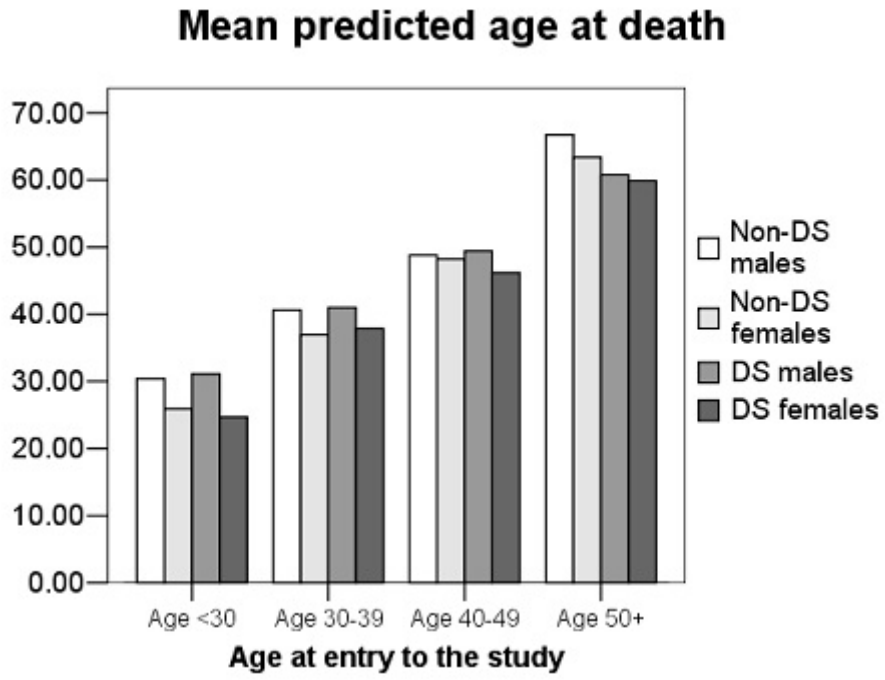


Figure 5-2. Mean predicted age at death in participants

5.3 Mortality

Multivariate assessment of mortality is best done using Cox proportional hazards models, which allow for the separate investigation of the potential contribution to mortality by numerous independent variables. The calculation incorporates the length of time followed for each participant, and a coding for whether the end of follow-up was due to death or withdrawal (i.e. censoring) of the participant for other reasons.

5.3.1 Univariate approach to mortality calculation

Univariate Cox regression using independent variables with potential biological significance to mortality was planned to give an initial indication of variables that should be included in the model building process. These variables included diagnosis of DS, baseline age (in units of 10 years to simplify understanding of odds ratios), sex, baseline history of epilepsy, new development of seizures, baseline functional abilities from the DMR and the use of psychotropic medications. It was not possible to include an early adult IQ (not available for most participants), or baseline medical health, as unfortunately the caregiver data did not provide adequate accuracy in this area.

Results of the initial univariate (unadjusted) analyses using Cox proportional hazards models to examine the odds of mortality for each independent risk factor are available in Appendix C. This analysis suggested that increased age, male sex, and deficits on all DMR subscales (except speech deficits) each separately increased mortality when the other factors were not adjusted for. The development of a new seizure during the study was almost significant at p=0.085, and appeared to double mortality.

5.3.2 Multivariate approach to mortality calculation.

The final model was developed using the methodology for model building described in chapter three, and is shown in Table 5-4. Significant predictors for increased mortality in this model are DS diagnosis (HR 2.53, 95% CI 1.30-4.93), male sex (HR 2.41, 95% CI 1.17-4.99), age at study entry in units of ten years (HR 1.93, 95% CI 1.57-2.38), DMR-Baseline practical skills deficits (HR 1.13, 95% CI 1.04-1.22), and DMR baseline mood deficit score (HR 1.19, 95% CI 1.05-1.36). Approximately parallel graphs of the Log-Minus-Log functions for DS, Sex, age (divided into four categorical groups), DMR-mood (divided into three categorical groups), and DMR-practical skills (divided into two categorical groups) suggested that the proportionality assumptions were met for all these

independent variables. There were no interactions between any of the final independent variables.

Table 5-4. Multivariate Cox regression analysis of mortality.

Parameter	P value	HR (95% CI)
DS diagnosis	<0.01	2.532(1.300-4.931)
Sex (reference: females)	<0.05	2.411(1.165-4.992)
Age (units of ten years at baseline)	<0.001	1.931(1.567-2.379)
DMR Practical skills deficits-baseline	<0.005	1.126(1.043-1.216)
DMR Mood symptoms-baseline	<0.01	1.192(1.047-1.357)

In summary, the adjusted odds of participants dying during the followup period were 2.53 times higher (p=0.006) for those with DS compared to those without DS, 2.41 times as high (p=0.018) for males compared to females, and almost doubled (p<0.001) for each 10 years increase in age. There were also small but significant increases in mortality for increased baseline deficits in practical skills (p=0.002) and baseline presence of depressive symptoms (p=0.008). Graphic representations of mortality based on the above Cox regression model are shown in Figures 5-3A to 5-3C.

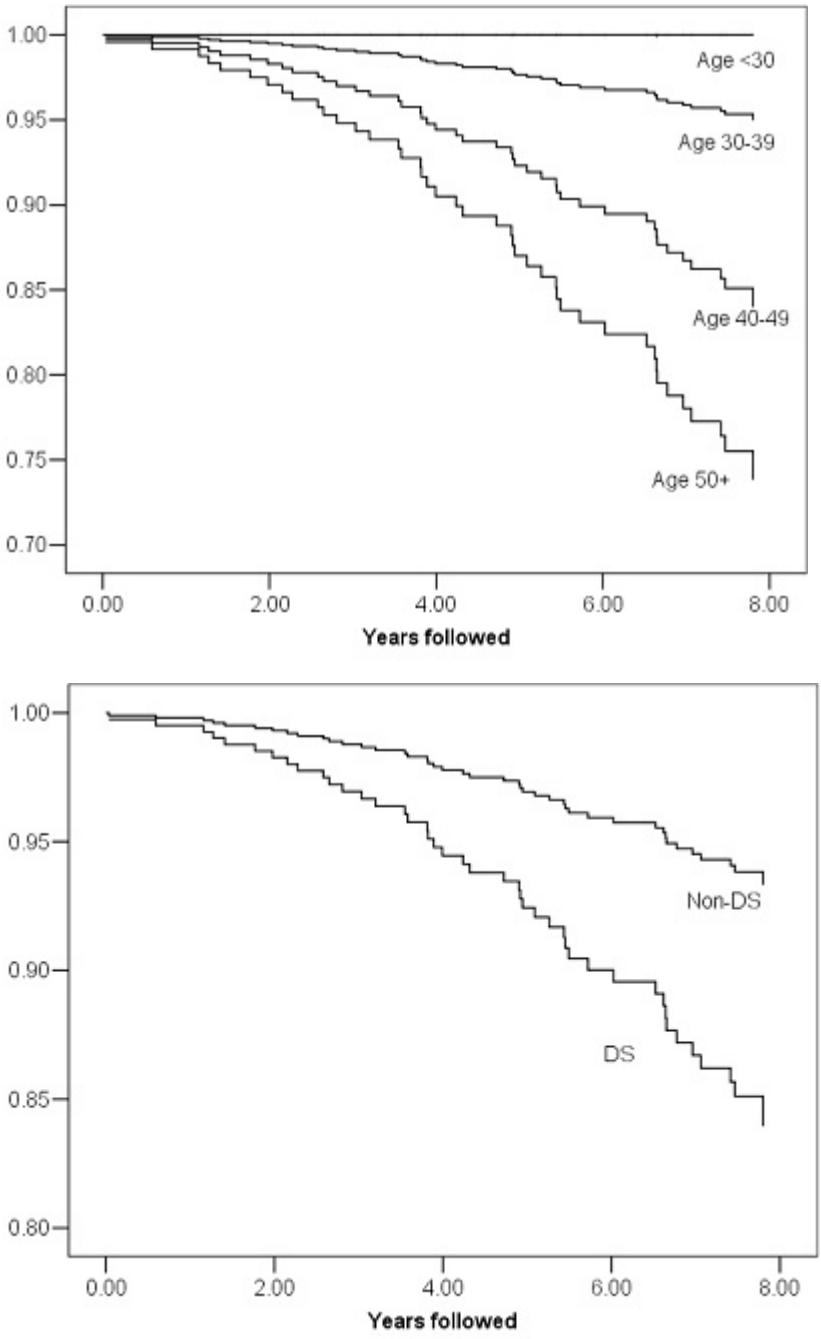
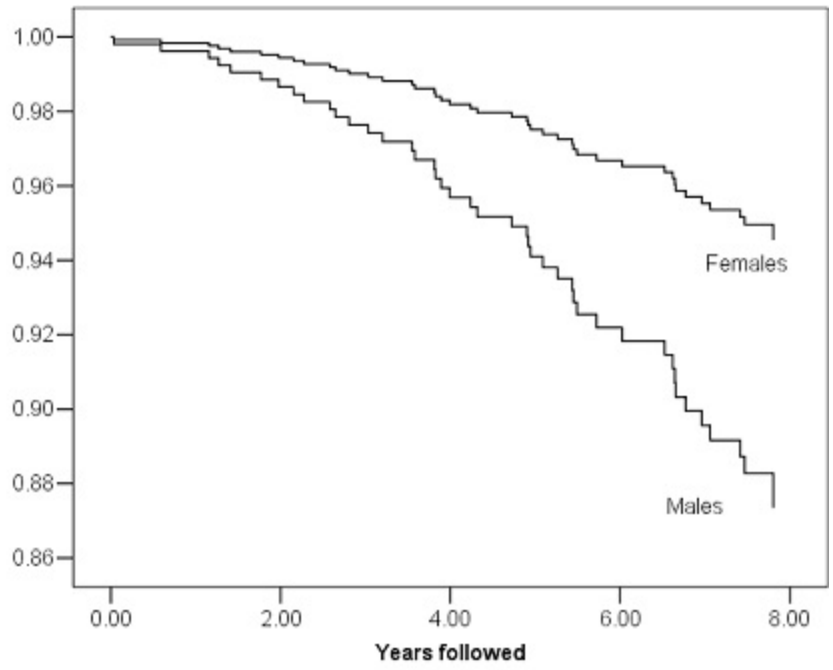


Figure 5-3A. Survival curves for 360 participants (Age and DS)



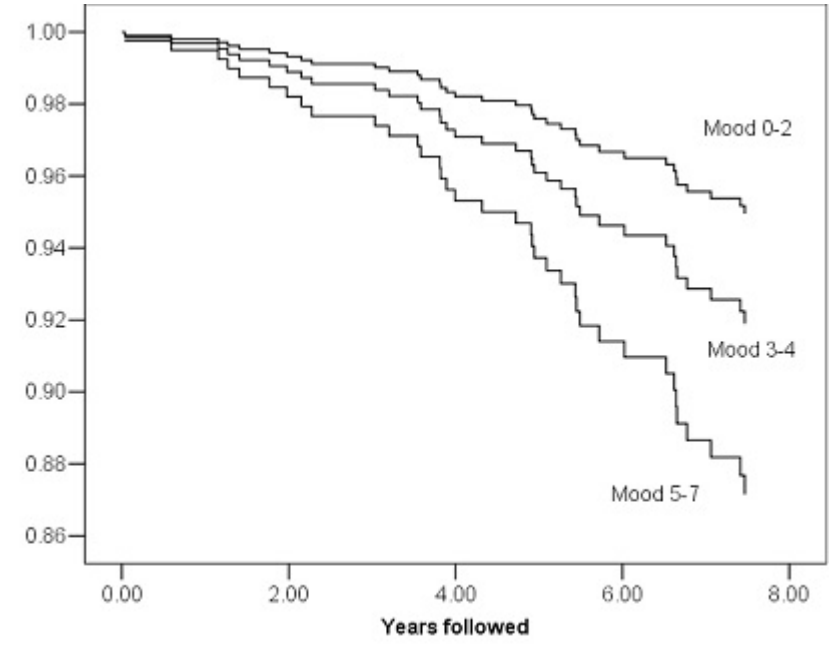


Figure 5-3B. Survival curves for 360 participants (Sex and Mood). (Mood 0-2 represents the least mood problems and Mood 5-7 the greatest problems.)

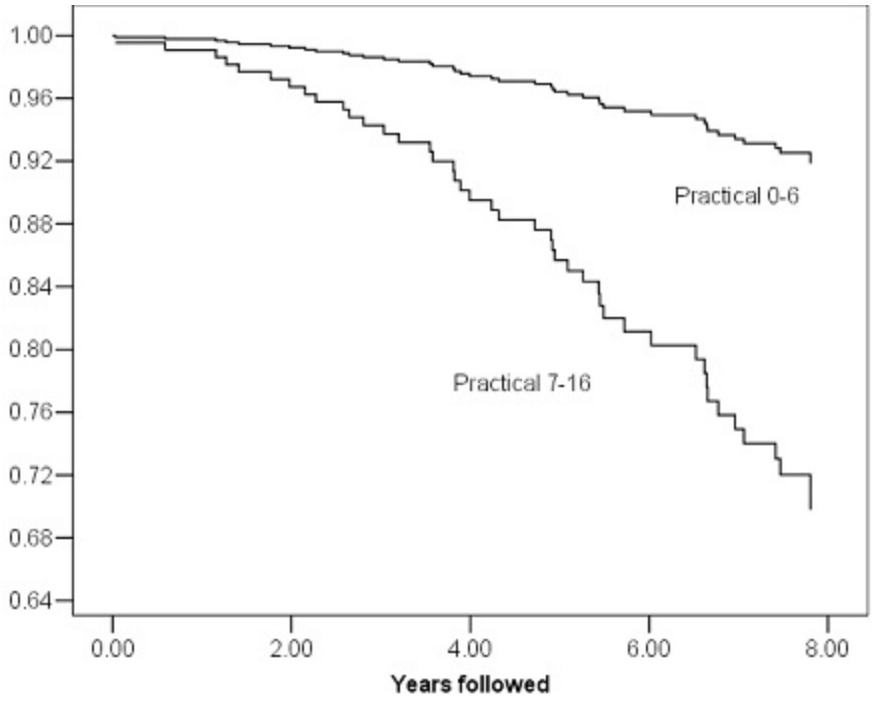


Figure 5-3C. Survival curves for 360 participants (Practical Skills). Practical 0-6 represents the least practical skills deficits and Practical 7-16 the greatest deficits.

5.4 Discussion

The adjusted mortality model developed by Cox's proportional hazards regression showed that older people were more likely to die than younger ones (mortality almost doubled every 10 years), which is not surprising. A little more surprising was that, even when adjusted for baseline functional deficits, men had more than twice the odds of dying than women, and that those with DS were more than twice as likely to die as those without DS. One of the limitations of the study is that there was no access to death certificates. Consequently, the causes of death are unknown, and would have been interesting to ascertain in this group.

There was a significant ($p<0.005$) association between the degree of baseline deficits in practical skills and increased mortality. Practical skills had been defined by the DMR

questionnaire as: the ability to dress and/or undress, daytime and/or night-time continence, ability to wash him/herself, ability to get into and out of his/her bed, ability to use familiar objects correctly (eg comb, scissors, toothbrush), and to toilet him or herself.

Deficits in these areas might have been due to premorbid, childhood onset developmental handicaps, or to later developing health changes. Both early-onset conditions causing functional losses and age related conditions that have caused decline might account for increased mortality. For example, chromosomal abnormalities which caused severe, childhood onset functional deficits are also more likely to have caused structural abnormalities in organ systems, such as cardiac malformations, which increase the likelihood of death. Cerebral palsy, also present from birth, is often associated with swallowing difficulties, causing aspiration and pneumonia, and epilepsy, which independently increases mortality by more complex mechanisms. On the other hand, functional decline that occurred later in life is commonly associated with conditions such as dementia, strokes and Parkinson's Disease, each of which independently increases mortality.

Items from the DMR that contributed to the mood subscale were weepiness, lack of being spontaneously helpful, sleep disturbance, gloomy or sad mood, tendency to be easily upset, and excessive physical complaints. The DMR manual makes no claim about these symptoms predicting depressive disorder, and in this data set it was also not possible to determine whether there was a true depressive disorder, or whether the symptoms might have been associated with other problems such as physical disorder or psychosocial stressors.

These depressive symptoms had not been expected to be significant to mortality, and had been left in the initial model as a matter of routine to adjust for baseline behavioural functioning in a variety of areas. It was therefore most interesting to find this significant ($p<0.01$) association (when adjusted for age, baseline deficits in practical skills, sex and

diagnosis of DS) with later mortality, as this finding has not been found in published literature conducted on people with ID.

There is, however, now a literature on the association between depression and increased mortality in general (Schulz, Drayer & Rollman 2002; Penninx et al.,1999) and older (Blazer & Hybels, 2004) populations, even when adjusted for underlying medical illness. Mechanisms for this association are not well understood, but probably involve biopsychosocial mechanisms that exert their effects in various interacting ways. For example, depression may cause direct biological, stress-mediated changes at a microscopic level resulting in increased cell death and decreased immunity, as well as result in grosser changes such as weight loss (which may reduce reserve) and decreased sleep which might decrease alertness and the general ability to deal with the environment, such as driving safely. Depression may also decrease healthy behaviours such as exercising and eating well, resulting in obesity, hyperlipidemia and immobility, all of which may themselves increase mortality. Health care seeking and compliance may also decrease in depressed people, whereas unhealthy behaviours such as smoking and other substance use disorders tend to increase.

On the other hand, depressive symptoms may be caused by an underlying medical disorder that itself increases mortality. An example of this is pancreatic cancer, which is a fairly lethal disorder which frequently presents with depressive symptoms before it is diagnosed (Carney, Jones, Woolson, Noyes & Doebbeling, 2003), especially if the cancer originates in a "silent" area not resulting in early physical symptoms. Another example is atherosclerosis and arteriolar sclerosis, a common cause of increased mortality, which may also cause vascular cognitive impairment from either larger strokes or from widespread microvascular damage to the brain, with secondary mood lability (such as easy crying) and apathy, both of which may be misdiagnosed as depression. Finally, dementia has been well-established to increase mortality, and the symptoms of dementia typically overlap with those of depression in domains such as sleep loss, weight loss and

decreased interest.

In this study it was not possible to fully adjust for medical comorbidity due to lack of precision in the caregiver data. However, somewhat similar to Blazer's study with older adults referred to above, who adjusted for functional status using the Rosow-Breslau functional health scale (Rosow, 1966), the practical skills subscale of the DMR was used to adjust for functional status, which may be a reasonable marker of general health. Even with this adjustment, the mood subscale association with later mortality was significant.

6. PHYSICAL, EMOTIONAL, BEHAVIOURAL AND PSYCHIATRIC MORBIDITY

This chapter provides descriptive data on general health and care issues in the study population, and presents more detailed analysis on the use of psychotropic medications. Statistical analyses were not performed on general health and care issues because of imprecision of the caregiver ratings, but medication data were assessed to be more accurate and were thus analyzed using standard statistical methods. Medication analyses were performed in three ways:

1. Cross-sectionally at the time of entry to the study (participants entered over the years 1995-1999)
2. Comparatively between the four discrete waves of data collection
3. Longitudinally as the individual participant progressed through the study.

6.1 Physical morbidity

Detailed data on all the health problems which caregivers identified are tabulated in Appendix C, and graphic presentation appears in Figures 6-1A,6-1B and 6-1C. Demographics of participants with available baseline health data were tabulated in Table 4-3.

6.1.1 Epilepsy/seizures

Epilepsy (defined as a history of seizures and ongoing treatment with anticonvulsant medications) was much more common in participants without (rather than with) DS, and within this group was commonest in the youngest cohort. There was no noticeable age

cohort pattern in participants with DS. The age and diagnostic association with active seizures (rather than epilepsy) at baseline was very similar to this. Figures 6-1 and 6-2 illustrate the patterns graphically.

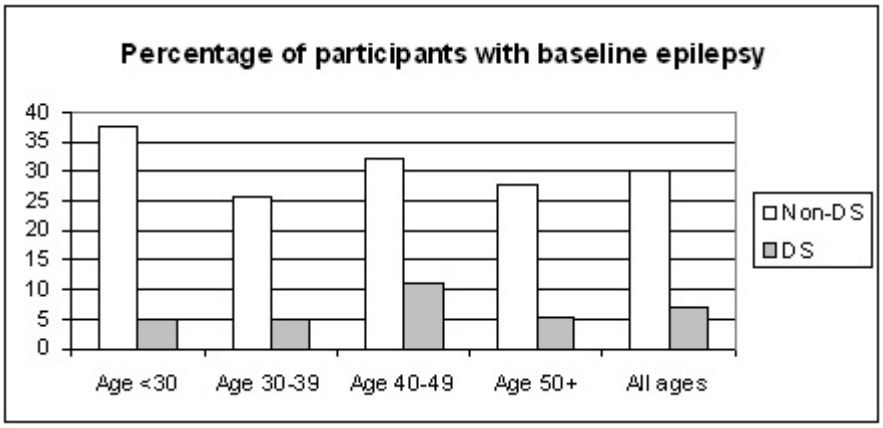


Figure 6-1. Percentage of participants with baseline epilepsy

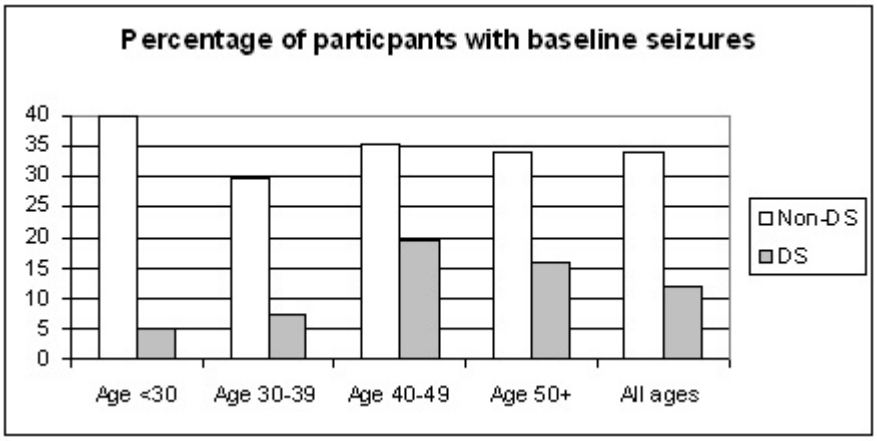


Figure 6-2. Percentage of participants with baseline seizures

6.1.2 Heart or blood pressure problems at baseline

Current heart or blood pressure problems tended to be more frequent in older than younger non-DS cohorts cohort, as would be expected in the general population. However, consistent with the known rate of congenital cardiac problems in DS, participants with DS appear to have an early onset of problems, with expected additional

aging changes across the older cohorts.

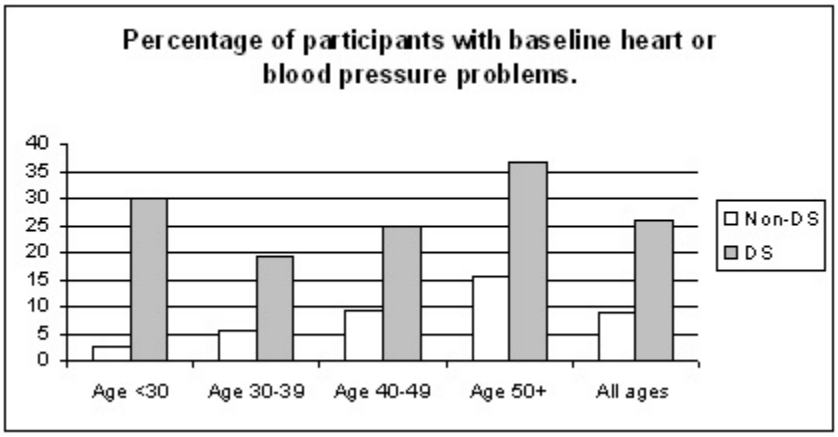


Figure 6-3. Percentage of participants with baseline heart or blood pressure problems

6.1.3 Breathing problems at baseline

Current breathing problems at baseline were more common in people with DS in all age cohorts except for the oldest one. There was no clear age association with breathing problems.

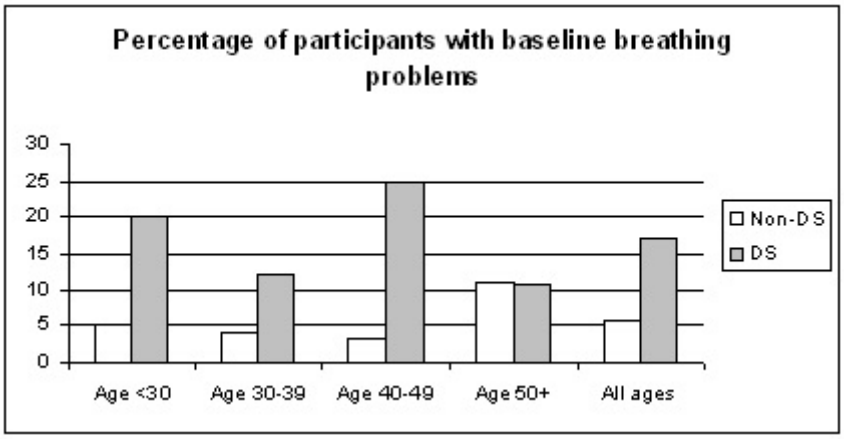


Figure 6-4. Percentage of participants with baseline breathing problems

6.1.4 Stomach, bowel or liver problems at baseline.

Participants with and without DS appear to have an overall similar rate of baseline stomach, bowel or liver problems, although in the oldest cohort those with DS may be more frequently affected than other diagnostic and age cohorts.

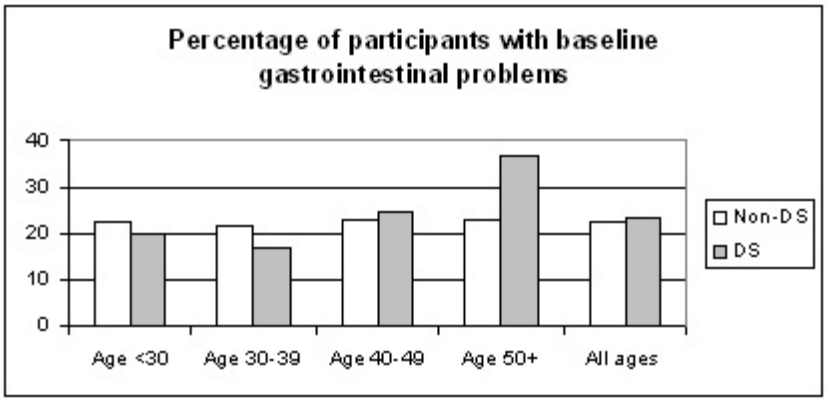


Figure 6-5. Percentage of participants with baseline gastrointestinal problems

6.1.5 Dental problems at baseline.

Baseline current dental problems were identified frequently by caregivers in all cohorts, but most frequently in older people with DS.

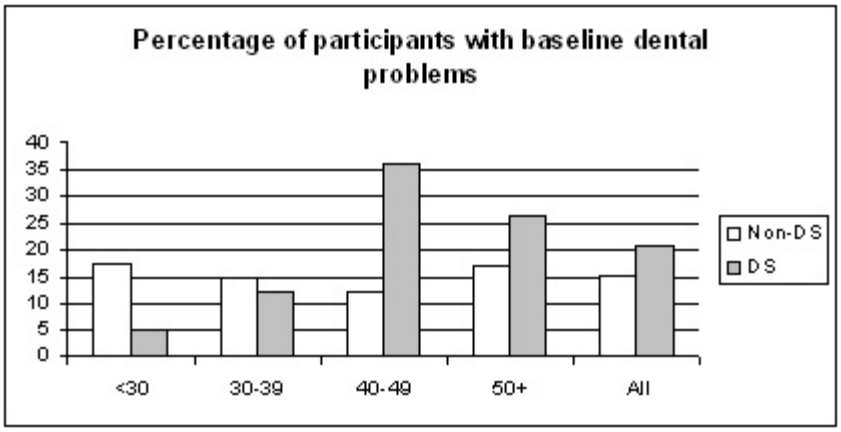


Figure 6-6. Percentage of participants with baseline dental problems

6.1.6 Diabetes at baseline.

Current diabetes was uncommon overall, but was more frequent in older compared to younger cohorts without DS. Only one participant with DS had diabetes, and this person was in the 40-49 year age cohort.

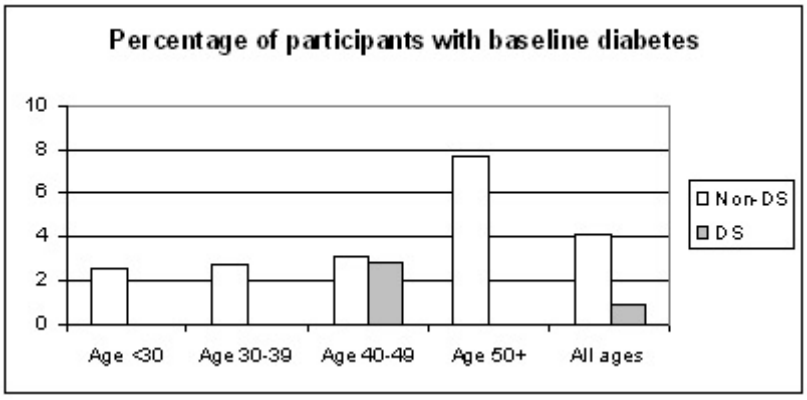


Figure 6-7. Percentage of participants with baseline diabetes

6.1.7 Thyroid problems at baseline.

Current baseline thyroid problems were identified much more frequently in participants with than without DS.

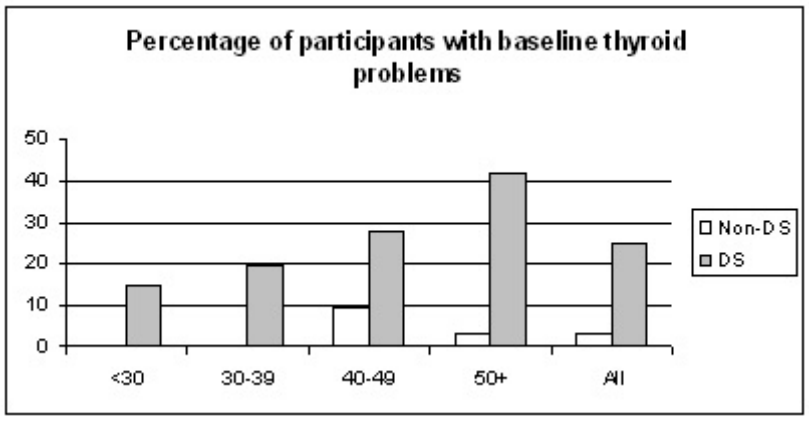


Figure 6-8. Percentage of participants with baseline thyroid problems

6.1.8 Visual problems at baseline.

Current baseline visual problems were identified very frequently by caregivers in all cohorts, but slightly more frequently in those with DS.

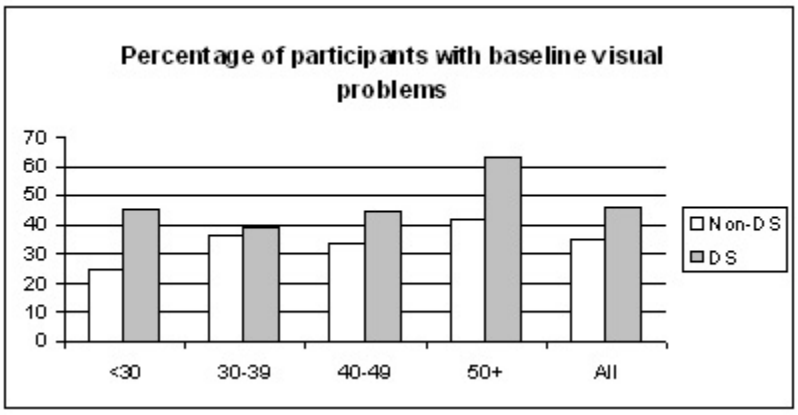


Figure 6-9. Percentage of participants with baseline vision problems

6.1.9 Hearing problems at baseline.

Baseline hearing problems were identified more frequently in participants with DS, and particularly frequently in the oldest DS cohort.

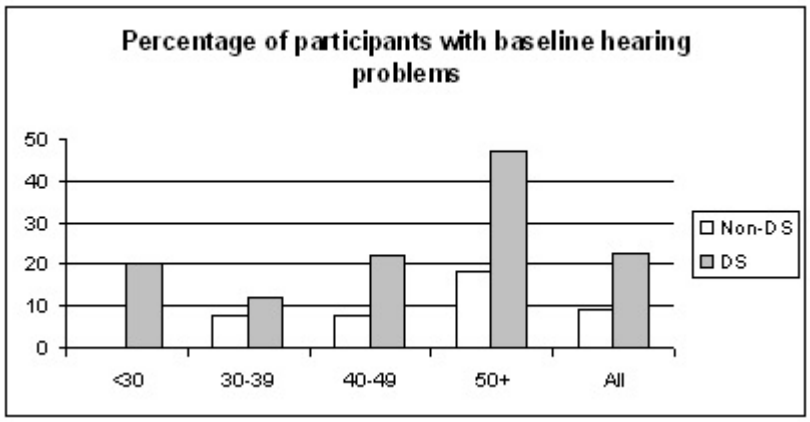


Figure 6-10. Percentage of participants with baseline hearing problems

6.1.10 Other medical problems at baseline.

Baseline "other" medical problems were identified frequently by caregivers in all cohorts, but generally more frequently in those with DS.

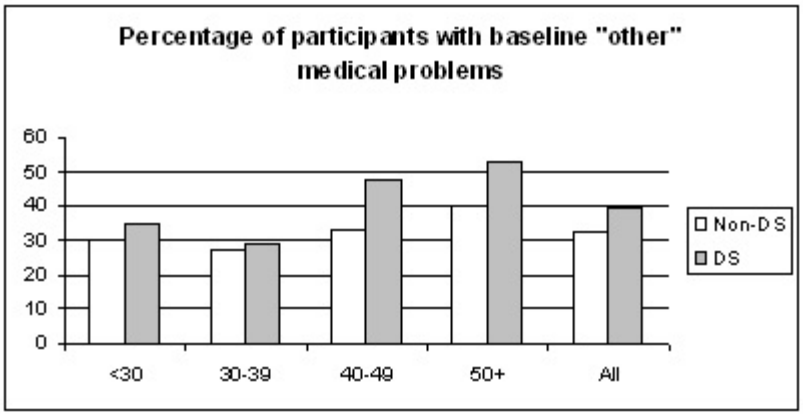


Figure 6-11. Percentage of participants with baseline medical "other" problems

6.2 Emotional, behavioural and psychiatric morbidity

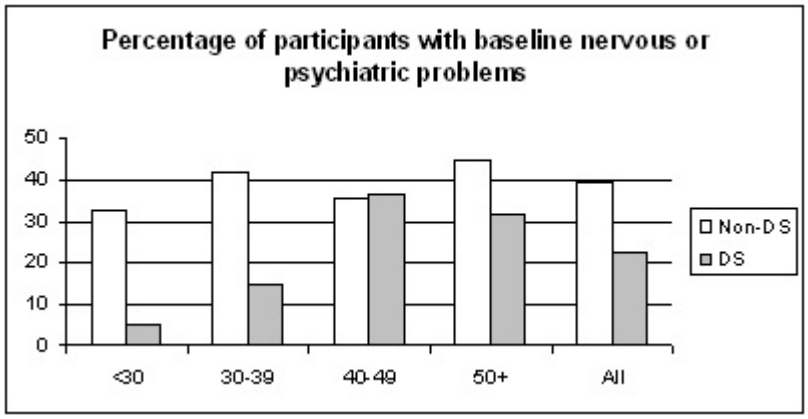


Figure 6-12. Percentage of participants with baseline nervous or psychiatric problems

Baseline nervous or psychiatric problems were identified more frequently overall by caregivers of those without DS. Participants with DS had a higher rate of baseline nervous or psychiatric problems reported in the two oldest cohorts compared to the

younger cohorts.

6.3 Discussion

Caregivers described patterns of health problems in the study population that were fairly consistent with previously published research. For example, they described heart problems as being more common in younger people with DS compared to younger people without DS, but described typically increasing rates of health problems with age in people without DS. This is consistent with the known prevalence of congenital heart disease in DS, and the known increase of hypertension and ischemic heart disease with age in the general population.

Baseline breathing problems were more frequently described in participants with DS than in participants without DS, which might have been a reflection of higher rates of obstructive sleep apnea.

The prevalence of diabetes increased with age in participants without DS, but was very rare in participants with DS. This finding might have been a reflection of a younger, and fairly small DS group. Baseline visual problems were identified more commonly in participants with DS, which was probably due to the known increased rates of cataracts in DS. Hearing problems were also more frequently identified in participants with DS compared to those without DS, and at rates similar to those described by direct examination in the literature. This was encouraging, as significant, unidentified hearing problems may contribute towards apparent cognitive decline. An increased rate of thyroid problems in people with DS (compared to those without DS) was also found in the study population, again suggesting that the study population was fairly representative of the overall adult population with ID. Dental problems were particularly common in those with DS compared to those without DS.

In general, participants without DS were more likely than participants with DS to have emotional, behavioural or psychiatric problems. The rate of these problems did not increase with the age of the cohort in participants without DS, whereas those who did have DS had an higher rate of both nervous and psychiatric problems with older cohort age. These findings are consistent with other research, which has found that people with DS generally have the lowest rate of behavioural problems among the overall ID population (Blacher & McIntyre, 2006), although behavioural problems tend to increase in older adults with DS because of cognitive impairment (Prasher & Filer, 1995).

7. FUNCTIONAL-COGNITIVE DECLINE: THE DMR

7.1 Introduction

As described in previous chapters, the DMR is a standardized, caregiver administered instrument designed to evaluate cognitive and functional decline in people with ID. DMR data were obtained, scored and coded using methods described in previous chapters. This chapter analyses specific DMR subscales: short-term memory (STM), long-term memory (LTM), spatial and temporal orientation (SPA), speech (SPE), practical skills (PRA), mood (MOOD), activity and interest (ACT) and behavioural disturbance (BEH). DMR subscale scores are analyzed in two ways:

1. Cross-sectionally at the time of entry to the study
2. Longitudinally as the individual participant progressed through the study.

7.2 Cross-sectional analysis of baseline DMR-subscale scores

Each set of DMR baseline subscale scores was initially explored by the use of scatter diagrams, and mean observed scores were tabulated, including mean scores and standard errors (Table 7-1). Demographics of participants with available baseline DMR data were tabulated in Table 4-3

Initial linear regression was performed with the core independent variables sex, age, and diagnosis of DS, exploring all two-way and three-way interactions. In every case, there was a significant interaction between DS and age, and there was also an almost significant ($p=0.0633$) three-way interaction in the DMR- BEH subscale, as shown in

Table 7-2. These positive interactions meant that in general, younger participants without DS performed more poorly than older participants without DS, whereas, in general, younger participants with DS performed better than older participants with DS.

Table 7-1. Mean (SE) observed baseline DMR-subscale scores

Subscale	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
STM	Non-DS	5.48(0.74)	2.96(0.53)	2.42(0.51)	2.58(0.43)	3.13(0.28)
	DS	1.20(0.37)	1.59(0.35)	2.92(0.66)	7.11(1.21)	2.84(0.37)
LTM	Non-DS	8.65(0.77)	6.05(0.58)	6.43(0.58)	6.60(0.57)	6.73(0.31)
	DS	3.20(0.71)	5.1(0.64)	6.53(0.79)	10.21(0.85)	6.05(0.43)
SPA	Non-DS	7.5(0.78)	4.38(0.57)	4.8(0.56)	5.6(0.55)	5.3(0.31)
	DS	3.4(0.78)	3.6(0.64)	6(0.78)	9.3(0.86)	5.2(0.43)
SPE	Non-DS	2.79(0.35)	1.6(0.26)	1.18(0.20)	1.28(0.20)	1.61(0.13)
	DS	0.75(0.26	1.12(0.23)	1.47(0.32)	2.95(0.57)	1.47(0.18)
PRA	Non-DS	4.38(0.81)	2.05(0.43)	1.67(0.43)	1.57(0.35)	2.2(0.24)
	DS	0.3(0.15)	0.17(0.09)	1.31(0.49)	2.84(0.84)	0.98(0.22)
Mood	Non-DS	4.53(0.34)	4.26(0.23)	3.08(0.23)	3.83(0.31)	3.87(0.14)
	DS	2.75(0.48)	3.29(0.33)	3.78(0.39)	4.53(0.60)	3.55(0.22)
ACT	Non-DS	3.75(0.45)	3.04(0.36)	2.57(0.37)	2.89(0.34)	2.99(0.19)
	DS	1.3(0.36)	1.66(0.32)	3(0.50)	4.21(0.60)	2.43(0.24)
BEH	Non-DS	4.63(0.36)	4.04(0.25)	3.31(0.28)	3.4(0.33)	3.77(0.15)
	DS	2(0.34)	2.24(0.28)	3.56(0.43)	3.58(0.63)	2.83(0.21)

Table 7-2. Interactions in linear regression analyses for baseline DMR subscales.

Subscale	Interaction	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
STM	DS*Age	0.2515(0.0422)	<0.001	0.1686 - 0.3344
LTM	DS*Age	0.2467(0.0483)	<0.0001	0.1516 - 0.3417
SPA	DS*Age	0.2199(0.0486)	<0.0001	0.1243 - 0.3155
SPE	DS*Age	0.1037(0.0198)	<0.0001	0.0649 - 0.1426
PRA	DS*Age	0.1385(0.0355)	<0.0001	0.0687 - 0.2083
Mood	DS*Age	0.0681(0.0232)	<0.005	0.0226 - 0.1137
ACT	DS*Age	0.1049(0.0296)	<0.0001	0.0468 - 0.1631
BEH	DS*Age	0.1233(0.0303)	<0.0001	0.0638 - 0.1828
	DS*Age*Sex	-0.0231(0.0124)	<0.1	-0.0475 - 0.0013

Therefore, all subsequent regression analyses were performed separately for participants with and without DS. Curve estimation techniques from SPSS were then used to estimate the best relationships between the DMR subscales and baseline age. None of these relationships for the DMR subscales with age were linear, and quadratic relationships were found to be more appropriate. All interactions with core independent variables, which included sex, age, and the quadratic variable, age^2, were explored for significance. Tables 7-3 and 7-4 (for participants without and with DS respectively) summarize the final models chosen from these data to best predict DMR subscales at baseline.

Table 7-3. Results of linear regression analyses for baseline DMR-subscales (Non-DS)

Subscale	Parameter	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
STM	Sex	-0.8107 (0.5437)	ns	-1.8817 - 0.2603
	Age	-0.3986 (0.1135)	<0.0001	-0.6222 - -0.1751
	Age^2	0.0037 (0.0012)	<0.005	0.0014 - 0.0061
LTM	Sex	-1.2358 (0.6229)	<0.05	-2.4628 - -0.0087
	Age	-0.2667 (0.1300)	<0.05	-0.5228 - -0.0106
	Age^2	0.0026 (0.0014)	<0.1	-0.0001 - 0.0053
SPA	Sex	-0.6014 (0.6162)	ns	-1.8153 - 0.6125
	Age	-0.3694 (0.1286)	<0.005	-0.6228 -- 0.1160
	Age^2	0.0038 (0.0013)	<0.005	0.0012 - 0.0065
SPE	Sex	-0.6527 (0.2485)	<0.01	-1.1423 - -0.1631
	Age	-0.1723 (0.0519)	<0.001	-0.2745 - -0.0701
	Age^2	0.0015 (0.0005)	<0.01	0.0005 - 0.0026
PRA	Sex	-0.479 (0.4791)	ns	-1.4228 - 0.4648
	Age	-0.4039 (0.1000)	<0.0001	-0.6009 - -0.2069
	Age^2	0.0038 (0.0010)	<0.0005	0.0017 - 0.0059
Mood	Sex	0.7607 (0.2762)	<0.01	0.2167 - 1.3047
	Age	-0.1616 (0.0576)	<0.01	-0.2752 - -0.0481
	Age^2	0.0015 (0.0006)	<0.05	0.0003 - 0.0027
DMR-ACT	Sex	-0.2333 (0.3811)	ns	-0.9841 - 0.5174
	Age	-0.1942 (0.0796)	<0.05	-0.3509 - -0.0375
	Age^2	0.0019 (0.0008)	<0.05	0.0003 - 0.0036
BEH	Sex	0.3567 (0.3006)	ns	-0.2355 - 0.9490
	Age	-0.1611 (0.0628)	<0.05	-0.2848 - -0.0375
	Age^2	0.0014 (0.0007)	<0.05	0.0001 - 0.0027

Table 7-4. Results of linear regression analyses for baseline DMR-subscales (DS)

Subscale	Parameter	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
STM	Sex	-0.8257 (0.6125)	ns	-2.0394 - 0.3879
	Age	-0.4289 (0.2093)	<0.05	-0.8435 - -0.0142
	Age^2	0.0077 (0.0025)	<0.005	0.0027 - 0.0126
LTM	Sex	-1.0607 (0.7581)	ns	-2.5627 - 0.4412
	Age	0.2232 (0.0382	<0.001	0.1475 - 0.2988
SPA	Sex	-0.5793 (0.7651)	ns	-0.9364 - -0.3694
	Age^2	0.0026 (0.0005)	<0.0001	0.0017 - 0.0038
SPE	Sex	-0.6134 (0.3223)	<0.1	-1.2519 - 0.0252
	Age^2	0.0009 (0.0002)	<0.0001	0.0006 - 0.0013
PRA	Sex	-0.0977 (0.4167)	ns	-0.9233 - 0.7278
	Age^2	0.0012 (0.0003)	<0.0001	0.0007 - 0.0017
Mood	Sex	0.0789 (0.4272)	ns	-0.7675 - 0.9254
	Age	0.0492 (0.0215)	<0.05	0.0066 - 0.0919
ACT	Sex	0.2416(0.4555)	ns	-0.6607 - 1.1440
	Age^2	0.0011(0.0003)	<0.0001	0.0006 - 0.0017
BEH	Sex	1.0611(0.9464)	ns	-0.8140 - 2.9362
	Age^2	0.0020(0.0008)	<0.05	0.0005 - 0.0035
	Age^2 * Sex	-0.0009(0.0005)	<0.1	-0.0019 - 0.0001

Mean predicted (adjusted) scores in this cross-sectional analysis showed that participants without DS had the greatest impairments in the youngest age groups, and showed progressively less impairment in older age groups, until a certain age (peak performance age) was reached. (This age was obtained by differentiating the quadratic model equation F[age], setting the derivative F′[age] to zero and solving for age.) After this peak performance age, which varied somewhat with the particular subscale, mean scores started to decline again in older cohorts. The peak performance ages for people without DS are shown below.

DMR-STM	54	DMR-SPE	56	DMR-PRA	53
DMR-LTM	51.5	DMR-BEH	57.8	DMR-Mood	53.5
DMR-SPA	48.4	DMR-ACT	50		

In contrast, mean predicted (adjusted) scores in this cross-sectional analysis showed that participants with DS were generally least impaired in the youngest age groups, and were progressively more impaired in older age groups. Only in the DMR-STM subscale was there a suggestion of a peak performance age (28 years), before which the impairments were slightly greater, and after which the impairments were incrementally greater with increased age of the cohorts.

There was no interaction between the age variables and sex in any analysis except for behavioural problems in participants with DS, where this interaction was almost significant ($p= 0.0783$) and negative. This meant that younger women with DS had more behavioural problems than younger males with DS, whereas older women with DS had fewer behavioural problems than older males with DS. In participants without DS, female sex was associated with significantly better functioning (cross-sectional analysis) in long-term memory and speech, but significantly worse functioning in mood. In participants with DS, female sex was associated with almost significantly ($p=0.0596$) better functioning in the area of speech, but was not significant to any of the other subscales. Predicted model results are shown in Figures 7-1A and 7-1B.

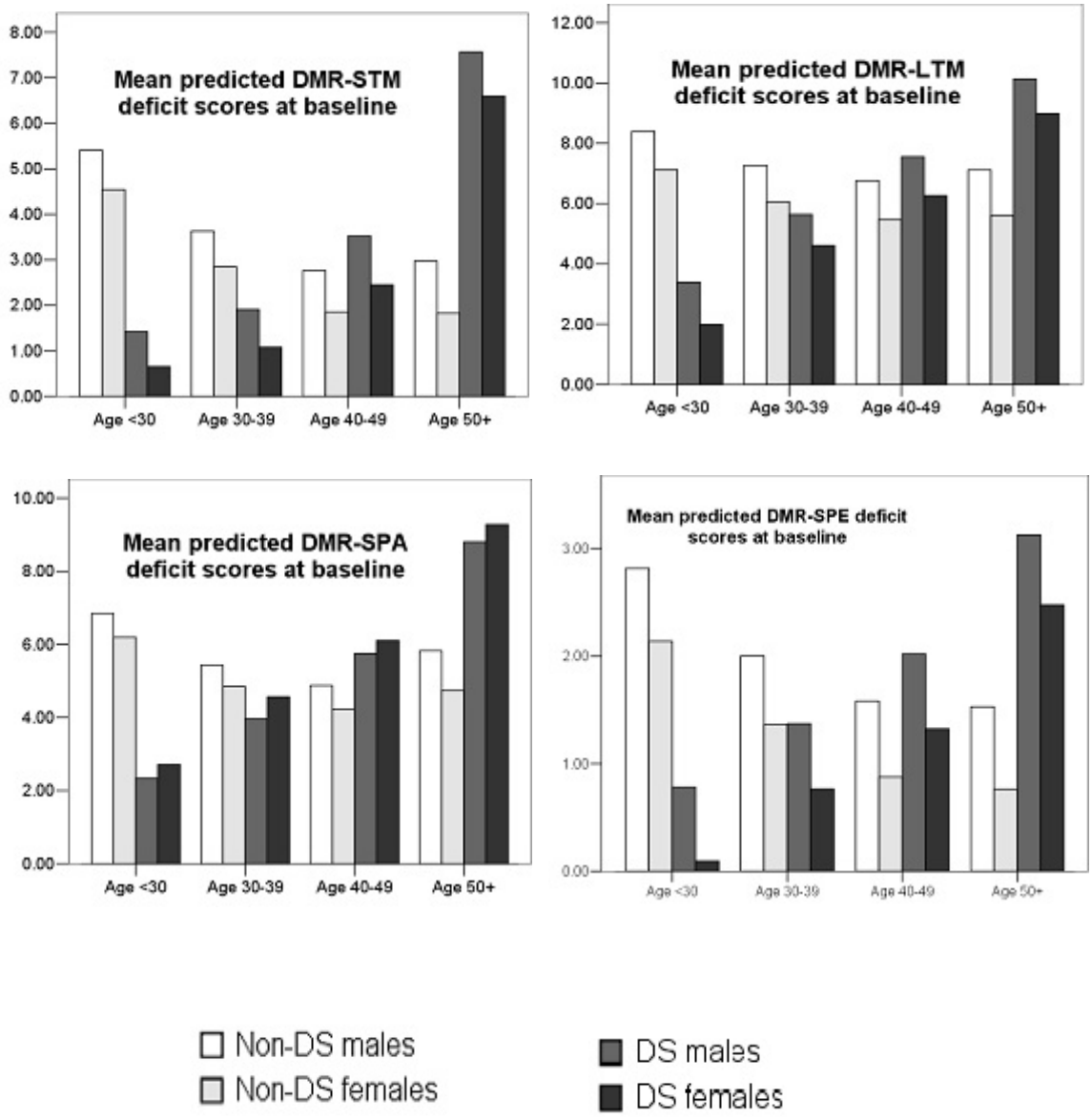


Figure 7-1A. Mean predicted baseline DMR-subscale deficit scores (STM, LTM, SPA, SPE)

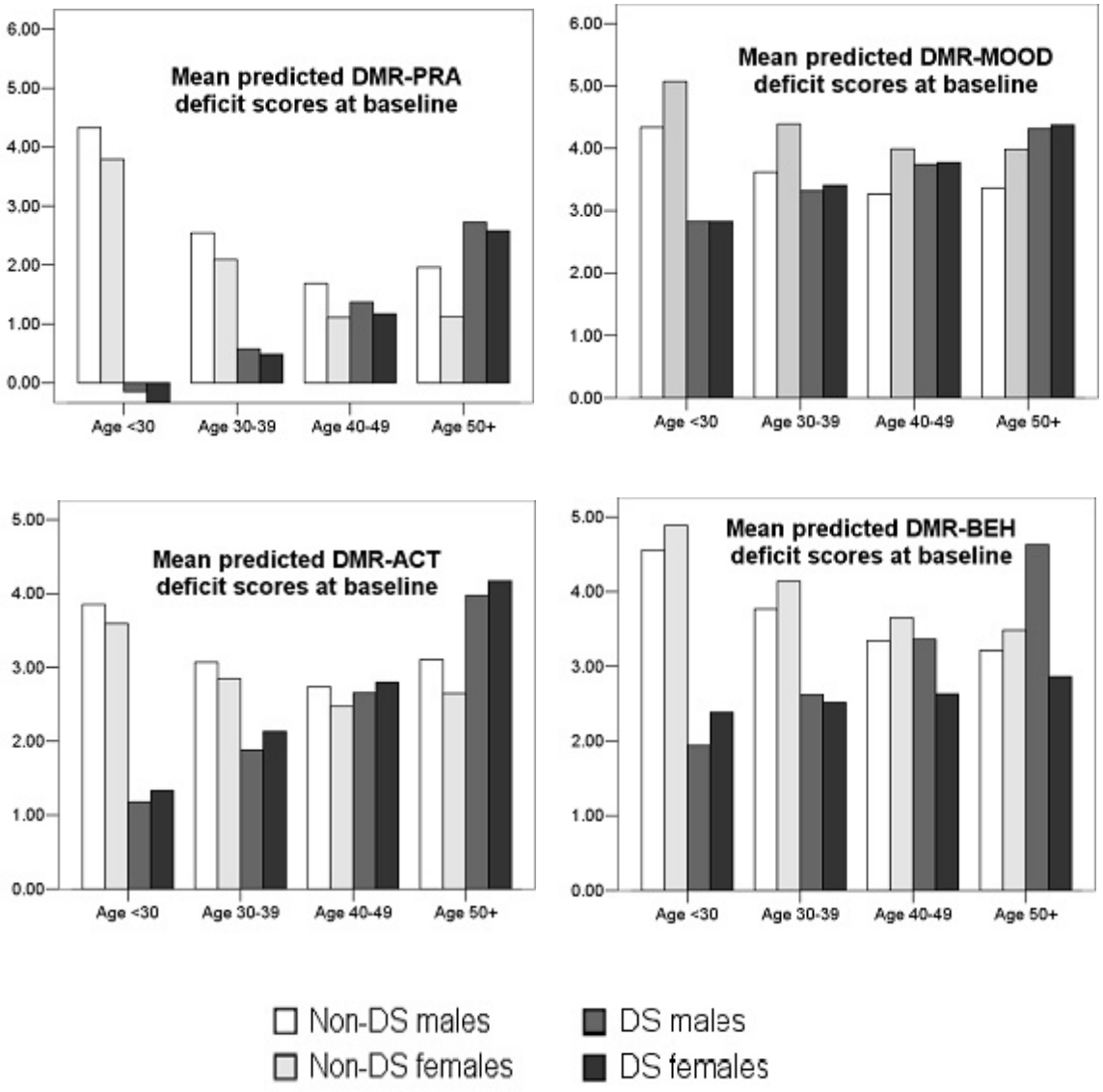


Figure 7-1B. Mean predicted baseline DMR-subscale deficit scores (PRA, MOOD, ACT, BEH)

7.3 Longitudinal analysis of DMR-subscale scores

All available data points were used to calculate individual pooled measures of DMR-subscale score change per year (slope) for participants who had two or more tests available. These individual slopes were calculated using the least squares method as

described in chapter 3. Most individual slopes were very small, suggesting little change over the study period. However, because a small number of participants had large fluctuations, slopes had wide ranges. Overall, participants with DS had greater average yearly decline in DMR-subscales than those without DS.

Each set of DMR subscale slopes was explored similarly to the cross-sectional baseline scores, and mean observed slopes were tabulated, including mean slopes and standard errors (Table 7-5).

Table 7-5. Mean (SE) observed DMR-subscale slopes

Subscale	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
STM	Non-DS	-0.004 (0.098)	0.079 (0.118)	0.028 (0.071)	0.197(0.097)	0.082(0.050)
	DS	0.072 (0.139)	-0.060 (0.066)	0.480 (0.171)	0.524(0.321)	0.225(0.084)
LTM	Non-DS	-0.105 (0.906)	0.136 (0.086)	0.089 (0.080)	0.152(0.086)	0.087(0.044)
	DS	0.359 (0.217)	0.014 (0.087)	0.453 (0.112)	0.594(0.182)	0.303(0.069)
SPA	Non-DS	0.092 (0.080)	0.184 (0.092)	0.127 (0.087)	0.211(0.100)	0.16(0.047)
	DS	-0.036 (0.113)	-0.023 (0.065)	0.269 (0.118)	0.675(0.260)	0.181(0.067)
SPE	Non-DS	-0.020 (0.047)	0.036 (0.043)	0.069 (0.035)	0.088(0.040)	0.049(0.021)
	DS	0.092 (0.060)	0.000 (0.041)	0.201 (0.064)	0.184(0.121)	0.108(0.034)
PRA	Non-DS	0.049 (0.079)	0.085 (0.049)	0.244 (0.083)	0.506(0.125)	0.231(0.045)
	DS	0.027 (0.035)	0.026 (0.020)	0.220 (0.155)	1.252(0.363)	0.29(0.087)
Mood	Non-DS	0.060 (0.072)	0.078 (0.078)	0.186 (0.076)	0.193(0.066)	0.134(0.038)
	DS	0.072 (0.123)	0.010(0.083)	0.008 (0.136)	0.433(0.231)	0.090(0.068)
ACT	Non-DS	-0.046 (0.079)	-0.016 (0.063)	-0.020 (0.081)	0.138(0.089)	0.018(0.039)
	DS	0.132 (0.086)	0.019 (0.057)	0.218 (0.150)	0.877(0.230)	0.242(0.070)
BEH	Non-DS	-0.033 (0.081)	0.027 (0.079)	0.073(0.064)	0.183(0.057)	0.070(0.036)
	DS	0.210 (0.139)	0.148 (0.062)	-0.131(0.114)	0.272(0.271)	0.093(0.066)

As in the cross-sectional analysis, there was either a significant or an almost significant interaction between DS and age interaction in most subscales, and three-way interactions in a few subscales. These are shown in Table 7-6.

Table 7-6. Interactions in linear regression analyses for DMR-slope subscales.

Measure	Interaction	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
STM-slope	DS*Age	0.0818(0.0236)	<0.001	0.0355 - 0.1282
	DS*Sex	1.7406(0.6565)	<0.01	0.4494 - 3.0318
	DS*Age*Sex	-0.0429(0.0156)	<0.01	-0.0736 - -0.0122
LTM-slope	DS*Age	0.0492(0.0203)	<0.05	0.0092 - 0.0891
	DS*Sex	1.0214(0.5653)	<0.1	-0.0905 - 2.1334
	DS*Age*Sex	-0.026(0.0134)	<0.1	-0.0525 - 0.0004
SPA-slope	DS*Age	0.0266(0.0076)	<0.0005	0.0117 - 0.0415
SPE-slope	-	-	-	-
PRA-slope	DS*Age	0.1061(0.0207)	<0.0001	0.0653 - 0.1469
	DS*Sex	1.9077(0.5778)	<0.005	0.7712 - 3.0442
	DS*Age*Sex	-0.0554(0.0137)	<0.0001	-0.0824 - -0.0283
Mood-slope	DS*Age50+	0.3315(0.1824)	<0.1	-0.0273 - 0.6903
ACT-slope	DS*Age	0.0721(0.0186)	<0.0001	0.0356 - 0.1086
	DS*Sex	1.2115(0.517)	<0.05	0.1946 - 2.2284
	DS*Age*Sex	-0.0343(0.0123)	<0.01	-0.0585 - -0.0101
BEH-slope	DS*Age	-0.0925(0.0437)	<0.05	-0.1785 - -0.0066
	$DS*Age^2$	0.001(0.0005)	<0.1	0.0000 - 0.002

Because of the high number of significant interactions found above, regression analyses were performed separately for participants with and without DS, using the same procedure as for the cross-sectional analysis. The best models to predict yearly changes of DMR subscales in participants without DS were all linear, whereas in participants with DS the best models were quadratic, except for those predicting behavioural problems. Tables 7-7 and 7-8 (for participants without DS and participants with DS respectively) summarize the final models chosen from these data to best predict DMR subscales slopes.

Mean predicted (adjusted) scores of participants without DS showed that, although in all subscales there was a trend to increased yearly individual decline with increased baseline age, baseline age was not statistically significant to this decline except in the analysis for practical skills, where age significantly ($p<0.0001$) increased decline and behavioural

problems, where age almost significantly (p=0.0532) increased decline. Sex was not significant to yearly decline in any subscale, and there were no interactions between age variables and sex.

Table 7-7. Results of linear regression analyses for DMR-subscale slopes (Non-DS)

Measure	Parameter	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
STM-slope	Sex	-0.0536 (0.1020)	ns	-0.2547 - 0.1475
	Age	0.0036 (0.0038)	ns	-0.0039 - 0.0111
LTM-slope	Sex	0.1273 (0.0896)	ns	-0.0492 - 0.3039
	Age	0.0049 (0.0034)	ns	-0.0017 - 0.0115
SPA-slope	Sex	-0.0724 (0.0947)	ns	-0.2590 - 0.1143
	Age	0.0005 (0.0035)	ns	-0.0065 - 0.0075
SPE-slope	Sex	0.0041 (0.0420)	ns	-0.0786 - 0.0867
	Age	0.0021 (0.0016)	ns	-0.0010 - 0.0052
PRA-slope	Sex	-0.091 (0.0886)	ns	-0.2657 - 0.0836
	Age	0.0146 (0.0033)	<0.0001	0.0081 - 0.0212
Mood-slope	Sex	-0.001 (0.0763)	ns	-0.1513 - 0.1493
	Age	0.0044 (0.0029)	ns	-0.0012 - 0.0101
ACT-slope	Sex	-0.004 (0.0798)	ns	-0.1609 - 0.1526
	Age	0.0041 (0.0030)	ns	-0.0018 - 0.0100
BEH-slope	Sex	-0.0548 (0.0724)	ns	-0.1975 - 0.0878
	Age	0.0053 (0.0027)	<0.1	-0.0001 - 0.0106

The reference category for sex is male

In contradistinction to this result, the mean predicted (adjusted) slope scores of participants with DS showed that in all subscales except for mood and behavioural problems the baseline age variable (age or age^2) was statistically significant to the yearly decline. There were also significant or almost significant interactions between age^2 and sex in all subscales except for mood and behavioral problems, resulting in younger women with DS having greater yearly decline than men of the same age, but older women with DS having less decline than men of the same age.

Table 7-8. Results of linear regression analyses for DMR-subscale slopes (DS)

Measure	Parameter	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
STM-slope	Sex	0.8621 (0.3733)	<0.05	0.1224 - 1.6019
	Age^2	0.0011 (0.0003)	<0.0005	0.0005 - 0.0016
	Age^2 * Sex	-0.0005 (0.0002)	<0.01	-0.0009 - -0.0001
LTM-slope	Sex	0.6500 (0.3105)	<0.05	-0.0009 - -0.0001
	Age^2	0.0007 (0.0002)	<0.01	0.0002 - 0.0012
	Age^2 * Sex	-0.0003 (0.0002)	<0.1	-0.0006 - 0.0000
SPA-slope	Sex	0.4204 (0.2914)	ns	-0.1570 - 0.9978
	Age^2	0.0008 (0.0002)	<0.005	0.0000 - 0.0012
	Age^2 * Sex	-0.0003 (0.0002)	<0.1	-0.0006 - 0.0000
SPE-slope	Sex	0.2035 (0.1557)	ns	-0.1051 - 0.5121
	Age^2	0.0003 (0.0001)	<0.05	0.0001 - 0.0006
	Age^2 * Sex	-0.0002 (0.0001)	<0.1	-0.0003 - 0.0000
PRA-slope	Sex	0.9576 (0.3102)	<0.005	0.3427 - 1.5724
	Age	-0.1748 (0.0470)	<0.0005	-0.2679 - -0.0818
	Age^2	0.0037 (0.0006)	<0.0001	0.0025 - 0.0050
	Age^2 * Sex	-0.0008 (0.0002)	<0.0001	-0.0011 - -0.0005
Mood-slope	Sex	0.1021 (0.1357)	ns	-0.1669 - 0.3710
	Age^2	0.0000 (0.0001)	<0.1	0.0000 - 0.0003
ACT-slope	Sex	0.6406 (0.2893)	<0.05	0.0671 - 1.2141
	Age	-0.1147 (0.0438)	<0.05	-0.2015 - -0.0279
	Age^2	0.0024 (0.0006)	<0.0001	0.0012 - 0.0035
	Age^2 * Sex	-0.0005 (0.0002)	<0.005	-0.0008 - -0.0002
BEH-slope	Sex	0.1416 (0.1338)	ns	-0.1235 - 0.4067
	Age	-0.0026 (0.0068)	ns	-0.0161 - 0.0109

The reference category for sex is male

Similar to the cross-sectional analysis, peak performance ages for DMR subscales slope in people with DS were calculated and are shown below.

STM slope	26(male) 43(female)	PRA slope	30(males) 40 (females)
LTM slope	29(males) 41(females)	Mood slope	-
SPA slope	-	ACT slope	30(males) 40 (females)
SPE slope	-	BEH slope	-

Predicted model results are shown in Figures 7-2A and 7-2B.

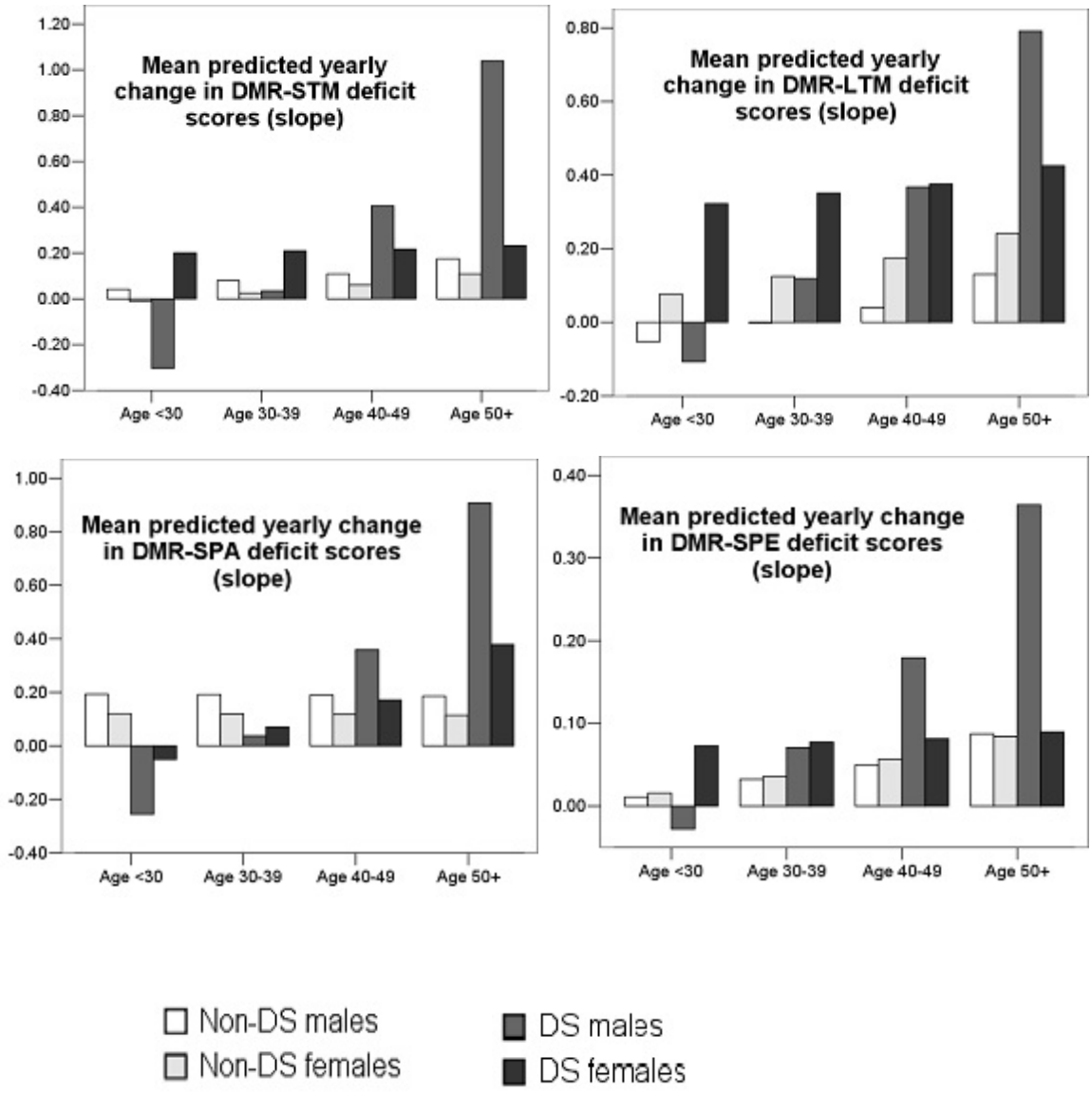


Figure 7-2A. Mean predicted DMR-subscale deficit slopes (STM, LTM, SPA, SPE)

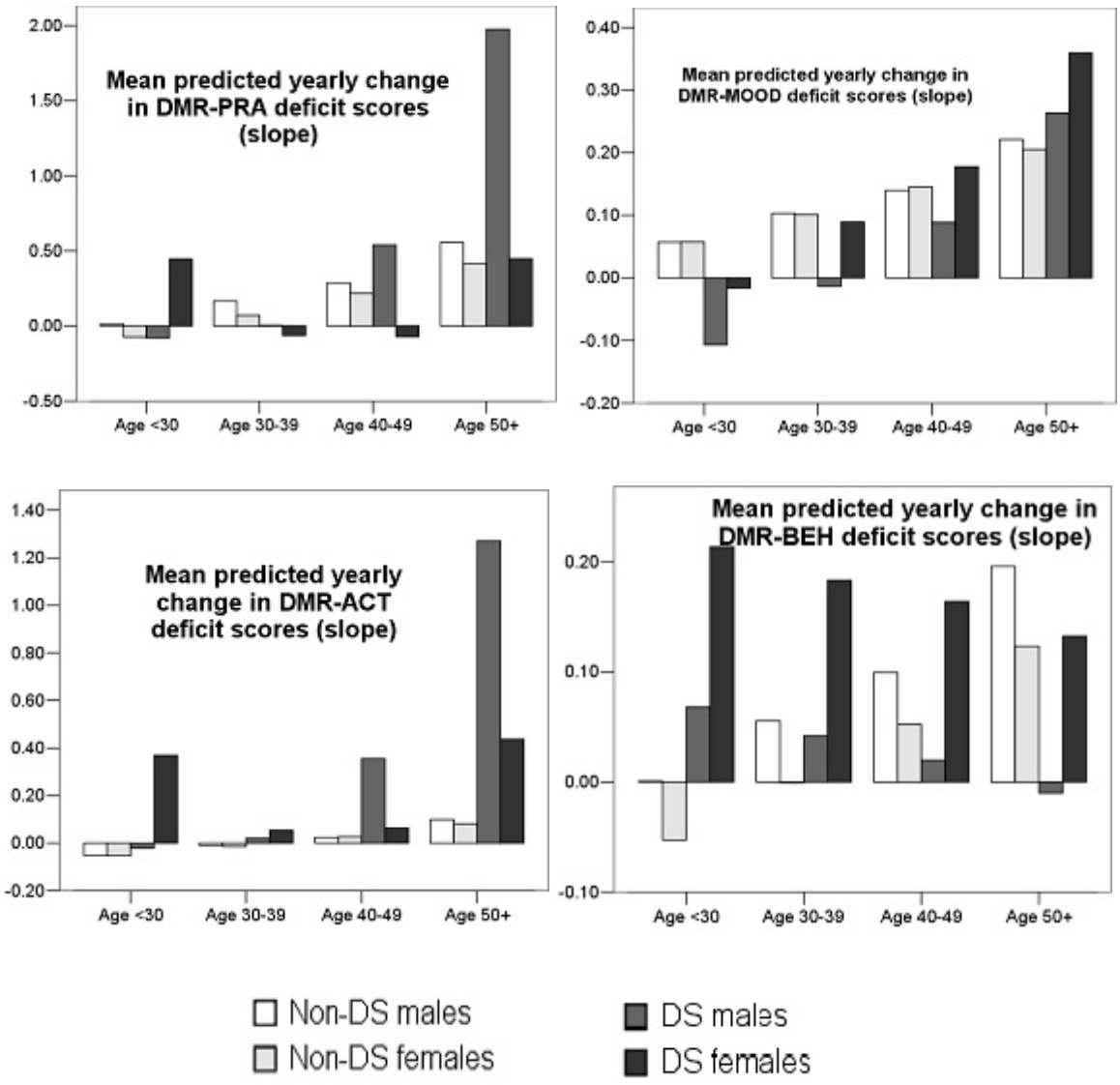


Figure 7-2B. Mean predicted DMR-subscale deficit slopes (PRA, Mood, ACT, BEH)

7.4 Discussion

Cross-sectional analysis using DMR subscale scores showed that in participants without DS, DMR subscales tended to have a quadratic relationship to baseline age, with high impairments in the youngest ages, improved performances in older age cohorts until a certain age was reached, and then gradually worse performance in older age cohorts.

The pattern of greater impairment in young, community dwelling cohorts without DS is likely a result of increased recent survival of infants with severe disabilities, coupled with increased community care of these severely intellectually disabled people. The population with DS is more homogeneous, and thus the range of disabilities is narrower, with fewer people with DS having very severe disabilities, and therefore changes in care patterns can be expected to have less impact on cross-sectional cohort functioning in the youngest cohorts.

Also affecting performance is ongoing learning. Because people with ID now have greater opportunities, it is possible that ongoing learning improves performance during the early adult years, resulting in better performance of older than younger cohorts. As new learning may be decreased in those with DS, even in young adulthood, this factor may not result in the same apparent cohort improvement.

Counteracting the factors described above (which result in better performance in older cohorts) is the normal aging process. This would be anticipated to worsen functioning in most areas with age, although one would not necessarily expect all areas of functioning to decline equally. However, this aging effect might also result in increased institutionalization and mortality, so that the individuals declining the most rapidly would either not have been recruited at all by a community study, or be rapidly lost to followup, resulting in the appearance of reduced yearly declines in direct testing. Because of known early aging and increased mortality in people with DS, we would expect that the measurement of age related decline would most underestimate the decline in this group. This underestimate would be less serious, of course, than the underestimate in direct testing, described later, which would be limited much earlier than the caregiver assessments in the DMR.

The overlay of cohort factors with aging factors likely resulted in the non-linear pattern of cohort functioning seen in participants without DS. In this group, peak performance

ages (the turning point when aging effects have become stronger than the impact of continued learning and cross-sectional changes in the pattern of care) were calculated, which varied from 48.4 years (spatial orientation) to 57.8 years (behavioural changes). Differences in peak times among specific functions are probably due to differences in the ability of learning to improve the function. For example, while spatial and temporal orientation may be largely determined by pre-existing biological deficits, with superimposed, age determined biological deterioration, behaviour is probably more affected by learning and environment, and is therefore more amenable to improvements over time.

Unlike the situation in participants without DS, cross-sectional analysis of DMR subscales in participants with DS disclosed almost universally progressive decreased functioning in older compared to younger cohorts. This suggests that aging effects in people with DS are more pronounced than cohort effects related to changes in care provision, and start earlier in life than in the general population, probably by early adulthood. Furthermore, if one assumes that differential institutionalization of older people with DS caused an underestimation of aging decline in this group, the actual decline might be even greater.

Dementia in the general population is known to have a very long premorbid phase, as early biological changes (with no measurable clinical changes), are followed by very subtle clinical changes which do not meet criteria for dementia, and only much later by a clinical diagnosis of dementia. It is therefore not surprising that adults with DS, who are known to have an earlier onset of dementia, already show declines in various functions by early adulthood.

It was expected that longitudinal measurement of individual decline would be a better gauge of true aging. In general, longitudinal changes over time in individual DMR subscales were greater in those with DS compared to those without DS, although sex-age

interactions in participants with DS made these differences difficult to evaluate. Older males with DS generally had more yearly decline than older females with DS, and this was statistically significant in many of the subscales. This finding was consistent with research by Schupf et al (1998), whose data suggested an earlier onset of dementia in males than females with DS. Schupf (2002) discussed these gender differences further in her review of genetic and host factors for dementia in DS, noting the protective effects of estrogen, and the finding that males with DS have greater gonadal dysfunction than females. She speculated that this might decrease their relative advantage compared to females which is seen in the general population. However, in view of the earlier onset of menopause in women with DS (Schupf et al., 1997) and the fairly strong association between age of menopause and onset of dementia (Schupf et al., 2003; Cosgrave, Tyrrell, McCarron, Gill & Lawlor, 1999), this finding is still puzzling.

The finding of greater and earlier decline in males with DS was not replicated in participants without DS, in whom sex was not significant to yearly decline in any of the subscale analyses. This finding more closely followed the underlying, general population pattern, in which females, rather than males are thought to have a greater rate of dementia, especially after menopause (Baum, 2005), although this may no longer hold once increased female life expectancy is taken into account (Gatz, 2006).

8. NEUROPSYCHOLOGICAL FUNCTIONING: DYSPRAXIA AND MEMORY

8.1 Dyspraxia

Demographic description of participants with available dyspraxia data is shown in Table 8-1.

Table 8-1. Demographics of participants with dyspraxia data

		Non-DS males	Non-DS females	DS males	DS females
Number in each group	Age <30	9	6	9	7
	Age 30-39	23	24	19	17
	Age 40-49	40	18	16	16
	Age 50+	30	31	4	7
Mean age (SE)		46.43(1.31)	46.38(1.40)	38.58(1.32)	40.52(1.44)
Age range		24-86	22-75	23-62	20-63

Scores were coded in the database as percentage correct of the total i.e. a score of 80 correct on Part 1 would be coded as 100. Each subscale was then analysed in two ways:

Cross-sectionally at the time of entry to the study (participants tested over the years 1997-2001)

Longitudinally as the individual participant progressed through the study.

8.1.1 Dyspraxia general data results

Basic cross-sectional descriptive statistics (including the number of participants in each group, mean percentage scores and standard error) for Dyspraxia Part 1, 2, 3 and Overall data at baseline, time 1, time 2 and time 3 are displayed in Tables 8-2, 8-3, 8-4 and 8-5. Participants with DS had a more pronounced pattern of decreased scores with increased cohort age at all test times.

Table 8-2. Mean (SE) observed Dyspraxia Part 1 percentage scores.

Time	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Baseline	Non-DS	82 (6.82)	94.79 (1.53)	86.98 (2.39)	87.42 (2.1)	88.74(1.27)
	DS	92.11 (2.86)	90.9 (2.04)	90.7 (1.71)	74.66 (4.62)	89.16(1.3)
Time 2	Non-DS	96.00(2.71)	94.13 (1.95)	92.70 (2.27)	93.22 (1.49)	93.43(1.03)
	DS	98.86(0.62)	94.58 (1.66)	94.26 (1.06)	79.13 (8.90)	93.20(1.33)
Time 3	Non-DS	95.63 (1.88)	93.8 (2.43)	91.84 (2.22)	90.35 (1.73)	91.63(1.17)
	DS	97.50 (0.88)	94.17 (1.91)	90.90 (1.94)	70.13 (10.26)	89.34(2.06)

Table 8-3. Mean (SE) observed Dyspraxia Part 2 percentage scores.

Time	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Baseline	Non-DS	84.75 (5.46)	94.6 (1.33)	92.59 (1.4)	89.9 (1.64)	91.55 (0.92)
	DS	90.47 (4.27)	93.51 (1.77)	90.47 (2.49)	73.18 (6 .49)	89.62 (1.60)
Time 2	Non-DS	98.63 (0.63)	94.6 9(1.56)	92.55 (2.26)	92.56 (1.24)	93.40 (0.94)
	DS	97.73 (1.10)	95.23 (1.19)	93.65 (1.04)	74.63 (10.33)	92.47 (1.47)
Time 3	Non-DS	98.13 (0.63)	96.73 (1.42)	93.06 (2.00)	90.46 (1.90)	92.71 (1.13)
	DS	97.00 (1.29)	94.05 (2.12)	91.29 (2.24)	71.88 (10.11)	89.71 (2.10)

Table 8-4. Mean (SE) observed Dyspraxia Part 3 percentage scores.

Time	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Baseline	Non-DS	74.24 (7.04)	73.5 (3.45)	65.56 (3.36)	66.63 (3.26)	68.79 (1.88)
	DS	65.34 (7.15)	66.41 (4.14)	61.51 (3.75)	46.28 (8.73)	62.25 (2.59)
Time 2	Non-DS	76.14 (5.92)	72.35 (4.19)	67.65 (3.75)	67.01 (3.00)	68.95 (1.96)
	DS	78.51 (4.87)	64.98 (4.52)	63.17 (3.50)	45.45 (9.22)	63.64 (2.55)
Time 3	Non-DS	47.73 (20.45)	77.1 (3.41)	63.88 (3.67)	65.19 (3.04)	67.02 (2.01)
	DS	72.73 (11.32)	60.17 (5.23)	59.80 (3.24)	37.73 (7.90)	57.62 (2.79)

Table 8-5. Mean (SE) observed Dyspraxia Overall percentage scores.

Time	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Baseline	Non-DS	80.13(5.75)	87.17(1.86)	81.07(2.09)	80.74(2.16)	82.47(1.21)
	DS	82.11(3.90)	83.18(2.43)	80.39(2.34)	64.08(5.77)	79.85(1.62)
Time 2	Non-DS	89.80(2.28)	86.69(2.39)	83.55(2.52)	83.71(1.74)	84.69(1.19)
	DS	91.28(2.04)	84.44(2.31)	83.03(1.75)	65.73(8.81)	82.52(1.62)
Time 3	Non-DS	79.44(8.06)	88.82, 2.02)	82.31(2.34)	81.47(1.98)	83.25(1.27)
	DS	86.94(4.29)	82.07(2.92)	79.99(2.28)	59.19(9.13)	78.08(2.15)

Because of increased comfort with the testing situation, and therefore better cooperation with test protocols on the second testing, it was decided to use data from the second assessments to develop models for cross-sectional scores across diagnostic and age groups. Similarly, test changes from the second to the third test were felt to be a more accurate assessment of aging than test changes from the first to the second test, so these were used to develop a models for a longitudinal changes in the Dyspraxia subscales across diagnostic and age groups (shown later).

8.1.2 Dyspraxia cross-sectional analyses

Linear regression analysis with all Dyspraxia subscale scores at time 2 as the dependent variable and DS diagnosis, age and sex as independent variables showed that there were significant second order interactions between DS diagnosis and age in all subscales, and various other second and third order interactions in specific subscales. These are shown below in Table 8-6.

Table 8-6. Interactions in linear regression analyses of Dyspraxia percentages

Dyspraxia Subscale	Interaction	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
Dyspraxia Part 1	DS * Age	-0.384(0.175)	<0.05	-0.730 - -0 .039
Dyspraxia Part 2	DS * Age	-1.4984(0.4705)	<0.005	-2.4251 -- 0.5717
	DS * Sex	-24.7576(12.549)	<0.05	-49.4763 - - 0.0389
	DS * Age *Sex	0.6838(0.2964)	<0.05	0.0999 - 1.2677
Dyspraxia Part 3	DS * Age	-0.7098(0.3327)	<0.05	-1.3651 - -0.0545
Dyspraxia Overall Score	DS*Age	-0.5313(0.2035)	<0.01	-0.9321 - -0.1305

The reference category for DS is Non-DS, and the reference category for sex is male

Because of these interactions, data from participants with and without DS were analyzed separately. Curve estimation techniques from SPSS were used separately for those with and without DS to estimate the best relationships between scores and age. The relationship between scores and age in participants without DS was found to be linear in

Dyspraxia Part 1 and Part 2, but quadratic in Part 3, whereas in participants with DS the relationship was quadratic in all subscales. Model building was performed separately for the two diagnostic groups, exploring effects of the independent variables, sex, age, and age^2 (age squared) as well as all possible interactions. Table 8-7 summarizes the best final models chosen for participants with and without DS.

Table 8-7. Results of linear regression analysis for Dyspraxia percentages at time 2

Dyspraxia Subscale	Diagnosis	Parameter	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
Dyspraxia Part 1	Non-DS	Sex	0.6354(2.094)	ns	-3.4991 - 4.7700
		Age	-0.0560(0.0842)	ns	-0.2222 - 0.1101
	DS	Sex	67.9197(41.2755)	ns	-14.2056 - 150.0450
		Age	6.5614(3.1523)	<0.05	0.2893 - 12.8334
		Age^2	-0.0918(0.0367)	<0.05	-0.1648 - -0.0187
		Age * Sex	-3.6542(1.9586)	<0.1	-7.5512 - 0.2428
		Age^2 * Sex	0.0491(0.0227)	<0.05	0.0040 - 0.0943
Dyspraxia Part 2	Non-DS	Sex	-0.9948(1.8850	ns	-4.7175 - 2.728
		Age	-0.1171(0.0758)	ns	-0.2667 - 0.0326
	DS	Sex	82.9131(43.3011)	<0.1	-3.2424 - 169.0686
		Age	8.7753(3.3070)	<0.01	2.1955 - 15.3551
		Age^2	-0.1226(0.0385)	<0.005	-0.1993 - - 0.0459
		Age * Sex	-4.6845(2.0547)	<0.05	-8.7727 - -0.5963
		Age^2 * Sex	0.0633(0.0238)	<0.01	0.0160 - 0.1106
Dyspraxia Part 3	Non-DS	Sex	4.7163(3.9279)	ns	-3.0412 - 12.4739
		Age	-1.8756(1.0154)	<0.1	-3.8811 - 0.1299
		Age^2	0.0169(0.0098)	<0.1	-0.003 - 0.0364
	DS	Sex	4.2541(4.8798)	ns	-5.45 - 13.9582
		Age^2	-0.0102(0.0032)	<0.005	-0.0166 - -0.0038
Dyspraxia Overall Score	Non-DS	Sex	1.6025(2.4002)	ns	-3.1376 - 6.3426
		Age	-0.1090(0.0965)	ns	-0.2995 - 0.0816
	DS	Sex	104.6798(49.8366)	<0.05	5.5205 - 203.8391
		Age	9.274(3.8261)	<0.05	1.7011 - 16.8470
		Age^2	-0.1229(0.0443)	<0.01	-0.2112 - -0.0347
		Age*Sex	-5.3300(2.3648)	<0.05	-10.0352 - -0.6247
		Age^2* Sex	0.0668(0.0274)	<0.05	0.0123 - 0.1212

The reference category for sex is male

In participants without DS there were no interactions in any subscale analysis, sex was not significant to the outcome by itself or in interaction in any subscale, and age was only almost significant (p=0.0666 for age, p=0.0869 for age^2) in Dyspraxia Part 3. However,

DS cohort data disclosed significant interactions between age variables and sex in Dyspraxia Parts 1 and 2, resulting in noticeably more impaired functioning in males than females in the oldest cohorts, but less difference between males and females in the youngest cohort. In participants with DS age variables were also independently significant to the outcome in all subscales, tending to decrease performance in older cohorts.

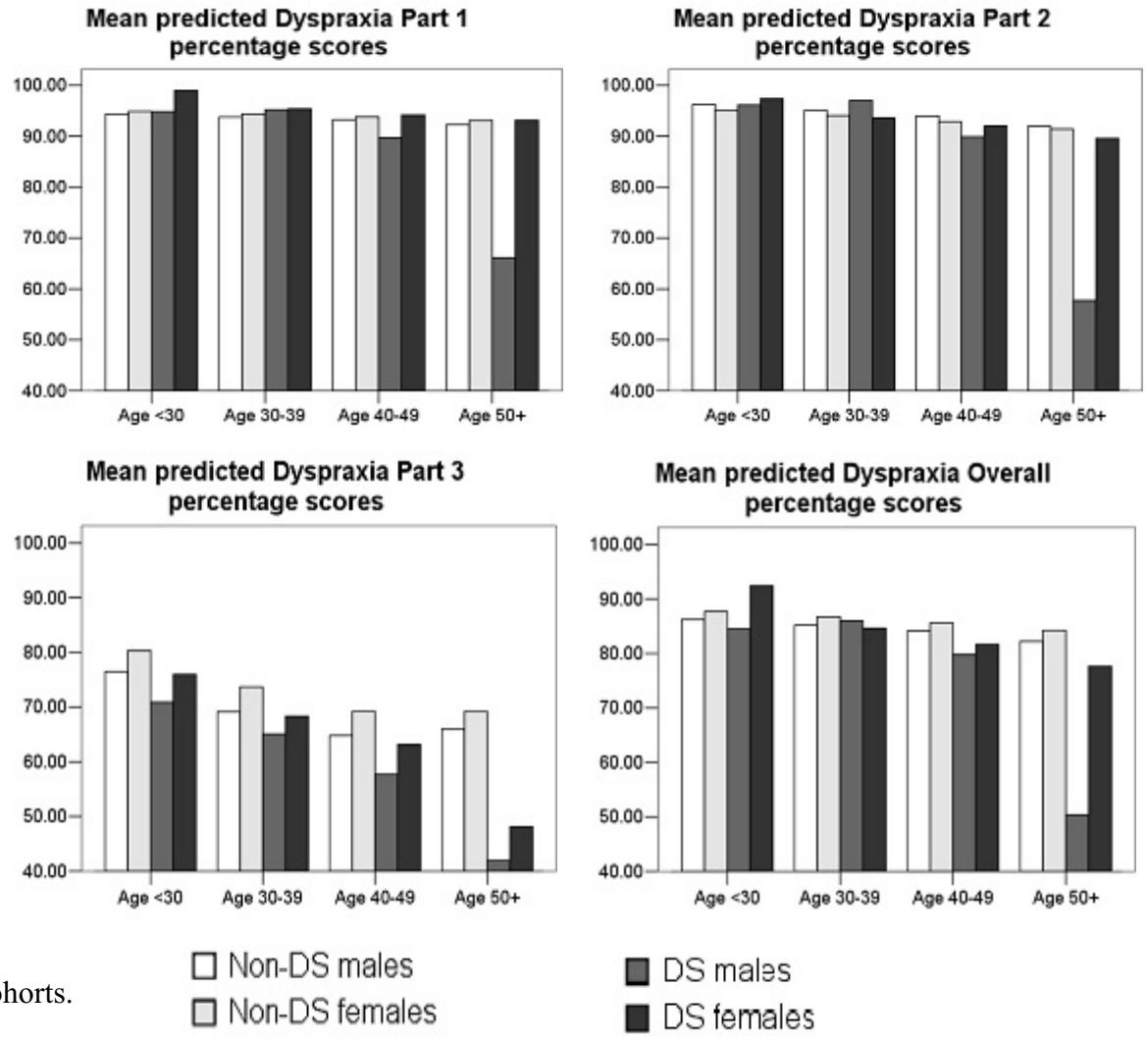


Figure 8-1. Mean predicted Dyspraxia percentages (Time 2)

Figure 8-1 illustrates the predicted (adjusted) percentage scores in the subscales. All groups of participants experienced more difficulty in performing Dyspraxia Part 3

(particularly the left-right discrimination tasks), and total scores are thus lower overall. It can also be seen from these graphs that, while all participants tend to have lower scores in older cohorts, the most pronounced age effect is seen in the males with DS.

8.1.3 Dyspraxia longitudinal analysis

Basic descriptive statistics are shown in Tables 8-8 to 8-11 for the change per year in Dyspraxia percentage scores from time 1 to 2, and from time 2 to 3. Dyspraxia percentage score yearly changes from time 2 to 3 were chosen to develop models for aging effects, again because participant comfort and cooperation was greater for the second and third testing compared to the first testing.

Table 8-8. Mean (SE) observed Dyspraxia Part 1 percentage yearly changes.

Measure	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Change per year 1-2	Non-DS	4.14 (3.67)	0.22 (0.43)	2.27 (0.79)	2.62 (0.72)	1.97(0.46)
	DS	1.67 (0.79)	2.48 (0.72)	0.56 (0.91)	5.63 (2.44)	1.97(0.51)
Change per year 2-3	Non-DS	-0.78 (0.89)	-1.59 (0.53)	-1.02 (0.58)	-1.89 (0.49)	-1.49(0.30)
	DS	-0.25 (0.51)	-1.10 (0.55)	-3.60 (1.64)	-9.49 (4.21)	-2.88(0.87)

Table 8-9. Mean (SE) observed Dyspraxia Part 2 percentage yearly changes.

Measure	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Change per year 1-2	Non-DS	3.00 (1.53)	0.24 (0.36)	-0.61 (0.88)	0.74 (0.67)	0.32 (0.40)
	DS	3.09(2.55)	0.92 (0.52)	0.81 (1.29)	2.55 (4.27)	1.41 (0.75)
Change per year 2-3	Non-DS	-0.25 (0.69)	-0.63 (0.37)	-0.22 (0.60)	-1.42 (0.66)	-0.82 (0.35)
	DS	-0.47 (0.33)	-0.63 (0.56)	-2.54 (1.83)	-5.31 (4.60)	-1.87 (0.91)

Table 8-10. Mean (SE) observed Dyspraxia Part 3 percentage yearly changes.

Measure	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Change per year 1-2	Non-DS	-3.34 (2.06)	-1.07 (1.52)	-0.06 (1.48)	0.05 (1.35)	-0.54 (0.79)
	DS	3.48 (1.76)	-0.79 (1.36)	1.14 (1.18)	-5.63 (3.55)	0.17 (0.83)
Change per year 2-3	Non-DS	-2.19 (2.73)	-0.06 (1.28)	-3.31 (1.06)	-1.56 (0.99)	-1.82 (0.62)
	DS	-1.38 (2.13)	-2.33 (1.96)	-3.48 (1.64)	-5.29 (3.24)	-2.98 (1.05)

Table 8-11. Mean (SE) observed Dyspraxia Overall percentage yearly changes.

Measure	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Change per year time 1-2	Non-DS	1.12(1.69)	-0.18(0.64)	0.41(0.75)	1.18(0.71)	0.55(0.40)
	DS	2.77(1.28)	0.86(0.58)	0.76(0.80)	0.66(2.57)	1.14(0.48)
Change per year 2-3	Non-DS	-1.11(0.93)	-0.81(0.46)	-1.44(0.59)	-1.62(0.49)	-1.36(0.30)
	DS	-1.23(1.02)	-1.38(0.78)	-3.21(1.54)	-6.65(3.56)	-2.66(0.80)

Linear regression analysis was performed with Dyspraxia percentage changes from time 2 to time 3 as the dependent variables and DS, age and sex as independent variables. This analysis showed significant interactions between DS and age in all Dyspraxia subscales, as well as other interactions in specific subscales, as is shown in Table 8-12.

Table 8-12. Interactions in linear regression analyses of Dyspraxia percentage yearly change

Dyspraxia Subscale	Interaction	$\hat{\beta}$	P value	95% CI for $\hat{\beta}$
Dyspraxia Part 1	DS*Age	-0.83 (0.22)	<0.001	-1.27 - -0.40)
	DS*Sex	-11(5.45)	<0.05	-21.7 - -0.25)
	DS*Sex*Age	0.32(0.13)	<0.05	0.055 - 0.580
Dyspraxia Part 2	DS*Age	-0.7452(0.2488)	<0.005	-1.2360 - -0.2544
	DS*Sex	-11.4135(6.1331)	<0.1	-23.5138 - 0.6868
	DS* Age * Sex	0.3528(0.1482)	<0.05	0.0604 - 0.6452
Dyspraxia Part 3	DS * Age	-0.4235(0.1508)	<0.01	-0.7211 - -0.1259
	DS * Sex* Age	0.1638(0.0547)	<0.005	0.0559 - 0.2717
Dyspraxia Overall Score	DS*Age	-0.3885(0.0919)	<0.0001	-0.5698 - -0.2072
	DS*Sex*Age	0.1083(0.0333)	<0.005	0.0426 - 0.1740

The reference category for DS is Non-DS, and the reference category for sex is male

Using similar methods as used in the cross-sectional analysis, model building was therefore again performed separately for the two diagnostic groups, exploring effects of the independent variables, sex, age, and age^2 as well as all possible interactions. Table 8-13 summarizes the two best final models chosen for participants with and without DS.

In participants without DS, neither sex nor age were significant to any yearly Dyspraxia percentage changes from time 2 to time 3, and there were no significant interactions.

However, in participants with DS, except for data from Dyspraxia Part 3, DS cohort data disclosed significant interactions between age variables and sex. In participants with DS male sex conferred an additional and independent disadvantage to scores, which was significant for Dyspraxia Parts 2 and 3, and almost significant to Dyspraxia Part 1 (p=0.0508). Age (in participants with DS) was independently significant to the outcome in all subscales except Dyspraxia Part 3, tending to decrease scores in older age cohorts.

Table 8-13. Results of linear regression analysis for yearly Dyspraxia percentage changes

Dyspraxia Subscale	Diagnosis	Parameter	$\hat{\beta}$	P value	95% CI for $\hat{\beta}$
Dyspraxia Part 1	Non-DS	Sex	0.117(0.6050)	ns	-1.080 - 1.3149
		Age	-0.0250(0.0233)	ns	-0.0712 - 0.0212
	DS	Sex	49.6779(2 4.9357)	<0.1	-0.1678 - 99.5237
		Age	5.6976(2.0571)	<0.01	1.5856 - 9.8796
		Age^2	-0.0804(0.0247)	<0.005	-0.1298 - - 0.0309
		Age * Sex	-2.8006(1.2083)	<0.05	-5.2160 - -0.3852
		Age^2 * Sex	0.0383(0.0143)	<0.01	0.0097 - 0.0669
Dyspraxia Part 2	Non-DS	Sex	0.0265(0.7001)	ns	-1.3595 - 1.4126
		Age	-0.0419(0.0270)	ns	-0.0953 - 0.0115
	DS	Sex	65.5892(2 7.4541)	<0.05	10.7092 - 120.4692
		Age	7.1439(2.2648)	<0.005	2.6166 - 11.6712
		Age^2	-0.0970(0.0272)	<0.001	-0.1514 - - 0.0426
		Age * Sex	-3.5850(1.3304	<0.01	-6.2443 - -0.9256
		Age^2 * Sex	0.0482(0.0157)	<0.005	0.0167 - 0.0797
Dyspraxia Part 3	Non-DS	Sex	-1.3152(1.252)	ns	-3.7965 - 1.1662
		Age	-0.0027(0.0483)	ns	-0.0983 - 0.0929
	DS	Sex	5.893(2.0109)	<0.005	1.877 - 9.9091
		Age^2	-0.0022(0.0013)	0.11	-0.005 - 0.0005
Dyspraxia Overall Score	Non-DS	Sex	-0.5237(0.5988)	ns	-1.7092 - 0.6618
		Age	-0.0223(70231)	ns	-0.0680 - 0.0234
	DS	Sex	54.3210(24.1870)	<0.05	5.9718 - 102.6701
		Age	5.6486(1.9953)	<0.01	1.6601 - 9.6372
		Age^2	-0.0755(0.0240)	<0.005	-0.1234 - -0.0275
		Age*Sex	-2.7856(, 1.1721)	<0.05	-5.1285 - -0.4427
		Age^2 Sex	0.0363(0.0139	<0.05	0.0086 - 0.0641

The reference category for sex is male

These models were used to calculate predicted scores for yearly change in each subscale, with the diagnostic categories calculated separately. Results are shown graphically in Figure 8-2.

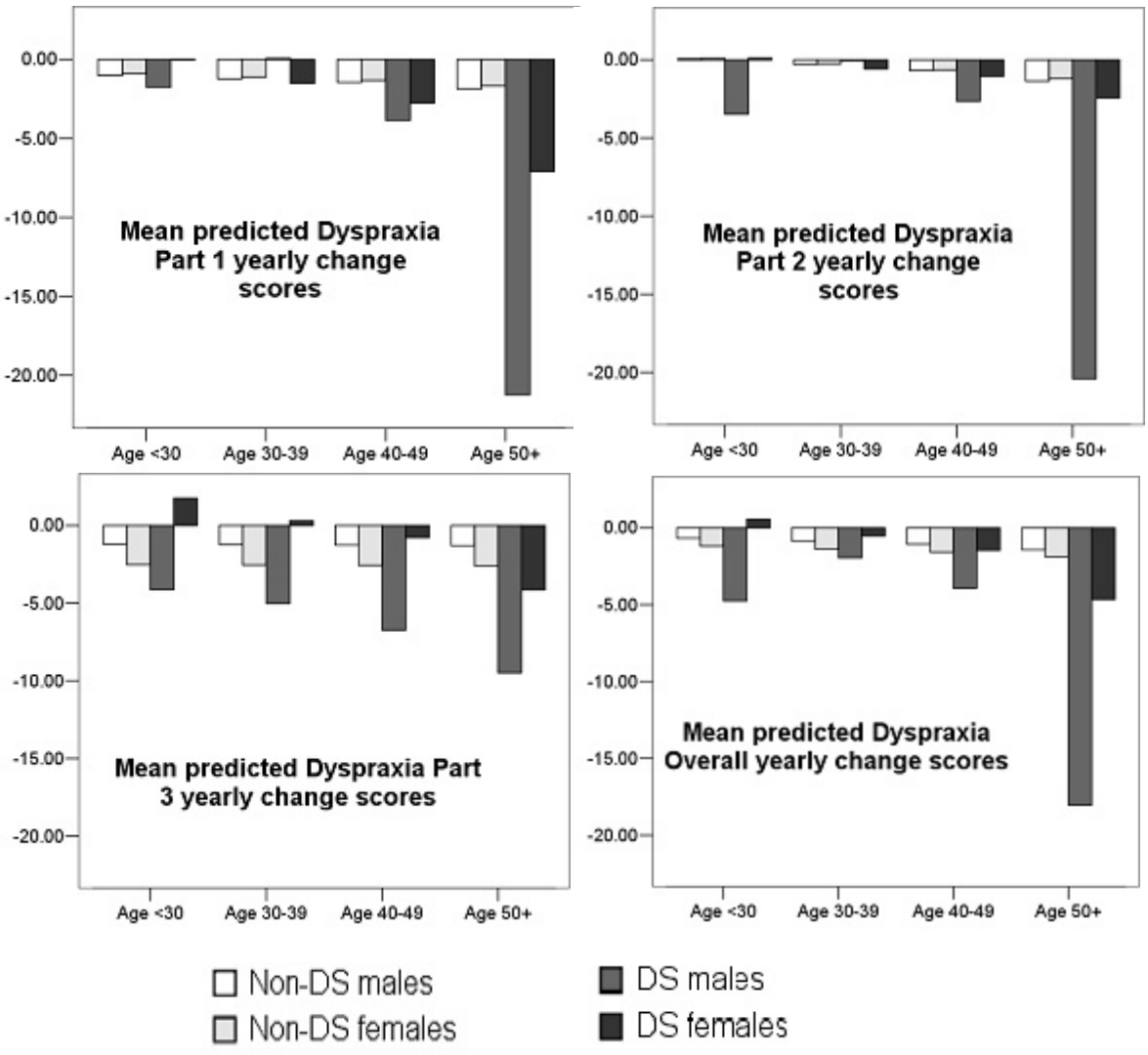


Figure 8-2. Mean predicted Dyspraxia yearly change

8.1.4 Discussion of Dyspraxia results

The three parts of the Dyspraxia Scale measure slightly different skills, and study participants had more difficulty answering questions on Dyspraxia Part Three, body parts/coin task, and also showed more deterioration in this subscale from younger to older cohorts, starting with the youngest cohort. Deficits in Part 3 occurred largely because of difficulties in differentiating between left and right and greater difficulties

identifying different coins. These skills may be more sensitive to deficits in sophisticated executive functioning, which are generally thought to be a hallmark of ID. As reviewed earlier, changes in executive functioning are also now thought to be one of the earliest markers of Alzheimer's Disease, which may explain why declines in Part 3 appeared to start in the youngest cohort already, whereas declines in the other subscales occurred mostly in the oldest cohorts.

In general, adjusted, mean time 2 scores in all three subscales were worse in the older age cohorts, with more pronounced drops in participants with DS, especially males. Yearly decline was also greater in participants with DS, (especially males), which is consistent with the association between early dementia and early apraxic changes, as published by Yesavage, Brooks, Taylor and Tinklenberg (1993). Greater decline of praxis is also consistent with work with adults who have DS published by Oliver, Crayton, Holland, Hall and Bradbury (1998), and Soininen et al. (1993).

Gender differences between age-related yearly decline in praxis depended on the diagnosis of DS. Whereas in participants without DS, males and females generally had similar adjusted yearly decline, in participants with DS, males generally declined significantly more per year than females, especially in the oldest age cohorts. Reasons for this are unclear, and not previously reported in the literature, yet consistent with results from caregiver reports of practical and other functional abilities on the DMR.

8.2. Visual memory: the Dalton/McMurray Visual Memory Test (DMTS)

The Dalton/McMurray Visual Memory Test (Delayed Matching to Sample Cognitive Test, DMTS) was added to the protocol in 1997, and administered in the 1997, 1999 and 2001 waves of data-collection. This chapter describes and analyses data from the two subtests separately: DMTS Shapes (16 items) and DMTS Colours (16 items). Results from each subscale were then analysed cross-sectionally (at both the time of entry to the

study and at the second testing) and longitudinally as the individual participant progressed through the study.

8.2.1 DMTS general data results

The demographic description of participants with available DMTS data is shown in Tables 8-14 and 8-15, and basic cross-sectional descriptive statistics (including mean percentage scores and standard error) for DMTS data at baseline, time 2 and time 3 are displayed in tables 8-16 and 8-17. Participant diagnostic cohorts tended to have a pattern of decreased scores at older ages in the three tests, although observed data patterns varied somewhat between tests.

Table 8-14. Demographics of participants with DMTS data (Shapes)

		Non-DS males	Non-DS females	DS males	DS females
Number in each group	Age <30	7	6	9	7
	Age 30-39	21	23	18	16
	Age 40-49	34	17	17	17
	Age 50+	33	30	3	6
Mean age (SE)		47.04(1.34)	46.12(1.40)	38.1(1.25)	40.29(1.4)
Age range		24-86	22-71	23-60	20-62

Table 8-15. Demographics of participants with DMTS data (Colours)

		Non-DS males	Non-DS females	DS males	DS females
Number in each group	Age <30	8	6	9	7
	Age 30-39	21	24	18	16
	Age 40-49	35	16	17	17
	Age 50+	32	31	3	6
Mean age (SE)		46.79(1.34)	46.14(1.38)	38.1(1.25)	40.29(1.4)
Age range		24-86	22-71	23-60	20-62

Table 8-16. Mean (SE) observed DMTS-Shapes percentages.

Time	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Baseline	Non-DS	79.81(4.96)	78.41(3.12)	74.88(2.73)	68.55(2.43)	73.83(1.52)
	DS	80.86(3.63)	73.9(3.97)	73.53(3.04)	54.17(3.9)	73.05(2.07)
Time 2	Non-DS	81.25(8.14)	80.03(3.19)	68.62(2.92)	68.55(1.96)	71.98(1.53)
	DS	80.11(4.44)	79.33(3.23)	69.26(2.91)	65.18(5.26)	73.61(1.92)
Time 3	Non-DS	71.88(9.38)	78.91(3.48)	71.88(2.85)	66.62(2.25)	71.13(1.61)
	DS	70.31(7.38)	72.5(3.34)	68.13(3.2)	48.21(10.27)	67.42(2.42)

Table 8-17. Mean (SE) observed DMTS-Colours percentages.

Time	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Baseline	Non-DS	88.84(4.82)	91.11(2.20)	89.22(2.18)	88.00(1.73)	89.23(1.13)
	DS	98.05(0.75)	91.18(2.74)	89.34(2.7)	82.64(6.23)	90.86(1.57)
Time 2	Non-DS	97.50(1.91)	94.29(1.65)	89.75(1.68)	88.96(1.94)	90.92(1.03)
	DS	94.89(3.66)	93.52(2.07)	83.49(3.50)	91.96(3.53)	88.91(1.91)
Time 3	Non-DS	81.25(18.75)	92.55(2.02)	85.85(2.64)	80.67(3.29)	84.86(1.83)
	DS	98.44(1.56)	91.37(3.30)	88.33(2.35)	64.06(10.81)	86.90(2.33)

Basic descriptive statistics are also shown in Tables 8-18 and 8-19 for the change per year in DMTS percentage scores from time 1 to 2, and from time 2 to 3.

Table 8-18. Mean (SE) observed DMTS-Shapes percentage yearly changes.

Measure	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Change per year time 1-2	Non-DS	-2.47(2.07)	0.42(1.33)	-4.52(1.98)	0.74(1.57)	-1.26(0.92)
	DS	-1.47(1.95)	1.46(1.34)	-0.5(2.19)	4.27(4.41)	0.42(1.05)
Change per year time 2-3	Non-DS	0.97(3.45)	-3.64(1.2)	1.12(1.67)	-2.21(1.25)	-1.34(0.81)
	DS	-3.19(2.74)	-2.3(1.66)	-2.02(1.89)	-14.67(4.1)	-3.32(1.17)

Table 8-19. Mean (SE) observed DMTS-Colours percentage yearly changes.

Measure	Diagnosis	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Change per year time 1-2	Non-DS	1.06(1.37)	1.52(0.85)	-0.03(1.08)	0.44(1.24)	0.63(0.59)
	DS	-3.17(1.9)	0.03(1.15)	-2.69(1.80)	-1.03(3.93)	-1.62(0.90)
Change per year time 2-3	Non-DS	-3.11(1.36)	-2.31(1.01)	-4.16(1.52)	-3.94(1.24)	-3.61(0.73)
	DS	1.08(2.57)	-0.73(1.16)	0.2(1.97)	-16.65(4.75)	-1.65(1.2)

8.2.2 DMTS- cross-sectional analysis

For the same reasons as in the Dyspraxia analyses, it was decided to use data from the second assessment to develop models for cross-sectional percentage scores across diagnostic and age groups, and test change data from the second to the third test to develop models for longitudinal (or aging) changes in the DMTS Test scores.

Curve estimation techniques from SPSS were used to estimate the best relationships between DMTS percentage scores at time 2 and age, and these were found to be quadratic in both the shapes and the colours test. Linear regression analysis with DMTS Test

scores at time 2 therefore used age, age^2 (age squared) and sex as independent variables for both analyses. There were no significant second or third order interactions. DS diagnosis decreased the performance on both the shapes (not significantly) and the colours analyses (almost significantly, with p=0.074). Sex was not significant in either the shapes or the colours analysis. Age and age^2 were both independently significant (or almost significant) to the outcome. Results are shown in Table 8-20.

Table 8-20. Results of linear regression analysis for DMTS percentages at time 2

Measure	Parameter	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
DMTS Shapes percentage	DS	-0.9118(2.5738)	ns	-5.9828 - 4.1593
	Sex	3.0287(2.3446)	ns	-1.5908 - 7.6482
	Age	-1.9565(0.6133)	<0.005	-3.1649 - -0.748
	Age^2	0.0165(0.0061)	<0.01	0.0044 - 0.0286
DMTS Colours percentage	DS	-3.6933(2.0537)	<0.1	-7.739 - 0.3525
	Sex	1.7262(1.8693)	ns	-1.9562 - 5.4086
	Age	-1.157(0.4922)	<0.05	-2.1267 - -0.1874
	Age^2	0.0095(0.0049)	<0.1	-0.0002 - 0.0192

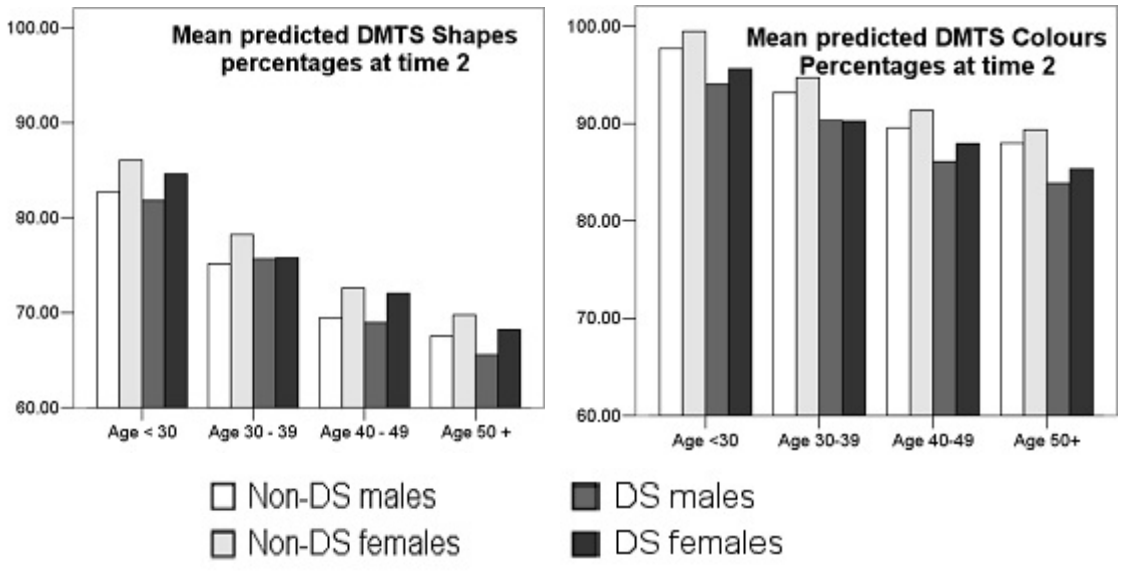


Figure 8-3. Mean predicted DMTS percentage scores at time 2.

Figure 8-3 illustrates the predicted (adjusted) shapes and colours percentage scores in DMTS Test data, based on the models shown in Table 8-17. All groups of participants experienced more difficulty in performing the shapes tests, and total scores are thus lower overall. It can also be seen from these graphs that participants tended to have lower scores in older cohorts, with the lowest scores seen in the shapes data from females with DS.

8.2.3 DMTS- longitudinal analysis, time 2 to time 3

Curve estimation techniques from SPSS were used to estimate the best relationships between DMTS Test yearly change scores and age from time 2 to time 3 and age, and these were found to be quadratic in both the shapes and the colours test. Linear regression analyses with both shapes and colours data showed that there were a variety of second and third order interactions between the three variable (DS, age and sex), resulting in complicated differences between aging changes in participants with and without DS. Table 8-21 summarizes significant and almost significant interaction terms found in the combined analysis. Because of the interactions shown there, model building was performed separately for the participants with and without DS. The best models are shown in Table 8-22.

Table 8-21. Interactions in linear regression analyses of DMTS yearly percentage change

Measure	Interaction	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
DMTS Shapes percentage yearly change	DS * Age	1.7223(0.9436)	0.0699	-0.1415 - 3.5861
	DS * Age^2	-0.0284(0.0110)	0.0108	-0.0502 - -0.0067
	DS*Age^2*Sex	0.0034(0.0014)	0.0190	0.0006 - 0.0063
DMTS Colours percentage yearly change	DS * Age	2.0588(0.8988)	0.0232	0.2847 - 3.833
	DS * Age^2	-0.0293(0.0101)	0.0043	-0.0492 - -0.0093

Table 8-22. Results of linear regression analyses of DMTS yearly percentage change

Measure	Diagnosis	Parameter	$\hat{\beta}$ (SE)	P value	95% CI for $\hat{\beta}$
DMTS Shapes percentage yearly change (2-3)	Non-DS	Sex	-2.3493(1.6076)	ns	-5.5380 - 0.8393
		Age^2	-0.001(0.0006)	<0.1	-0.0021 - 0.0002
	DS	Sex	3.5247(2.2127)	ns	-0.9061 - 7.9555
		Age	2.0019(0.8804)	<0.05	0.2389 - 3.7648
		Age^2	-0.0262(0.0102)	<0.05	-0.0467 - -0.0057
DMTS Colours percentage yearly change (2-3)	Non-DS	Sex	-36.386(21.2178)	<0.1	-78.4347 - 5.6627
		Age	-2.2181(1.1656)	<0.1	-4.528 - 0.0918
		Age^2	0.0235(0.0111)	<0.05	0.0015 - 0.0454
		Sex*Age	1.7752(0.8683)	<0.05	0.0544 - 3.4959
		$Sex*Age^2$	-0.0191(0.0085)	<0.05	-0.036 - -0.0023
	DS	Sex	2.8882(2.0758)	ns	-1.2655 - 7.0419
		Age	1.875(0.8319)	<0.05	0.2104 - 3.5395
		Age^2	-0.028(0.0096)	<0.01	-0.0473 - -0.0087

Analysis of the shapes yearly change data for participants without DS disclosed no significant interactions, and sex was not significant to the outcome. The age variable, age^2, was almost significant ($p=0.094$), and increased the goodness of fit, so was left in the model. Analysis of the shapes yearly change data for participants with DS also disclosed no significant interactions, and sex was again not significant to the outcome. However, both age and age^2 were independently significant to the outcome.

Analysis of the colours yearly change data for participants without DS disclosed significant interactions between sex and age ($p<0.05$) as well as between sex and age^2 ($p<0.05$). Age^2 was also independently significant ($p<0.05$), and age was almost independently significant ($p=0.06$) to the outcome. Sex was almost significant to the outcome ($p=0.09$). Analysis of the colours yearly change data for participants with DS disclosed no significant interactions, and sex was not significant to the outcome. Age ($p<0.05$) and age^2 ($p<0.01$) were both independently significant to the outcome. Predicted, adjusted results based on the separate diagnostic models are illustrated in Figure 8-4. Figure 8-4 illustrates that yearly deterioration scores are greatest in the oldest participants with DS, and fairly low in all of the participants without DS.

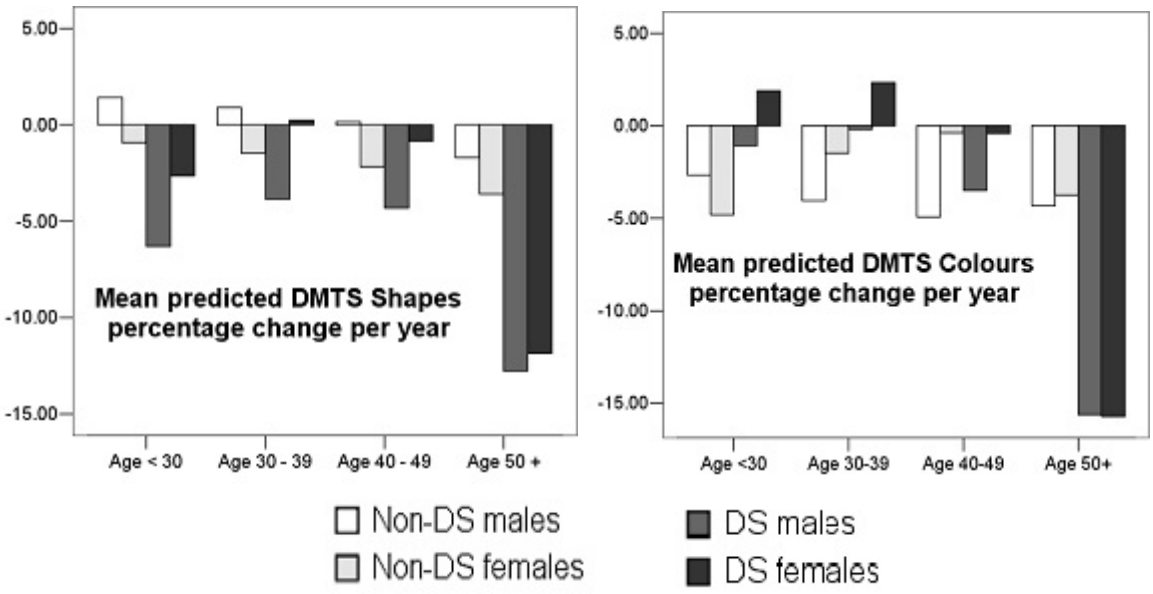


Figure 8-4. Mean predicted DMTS yearly percentage change.

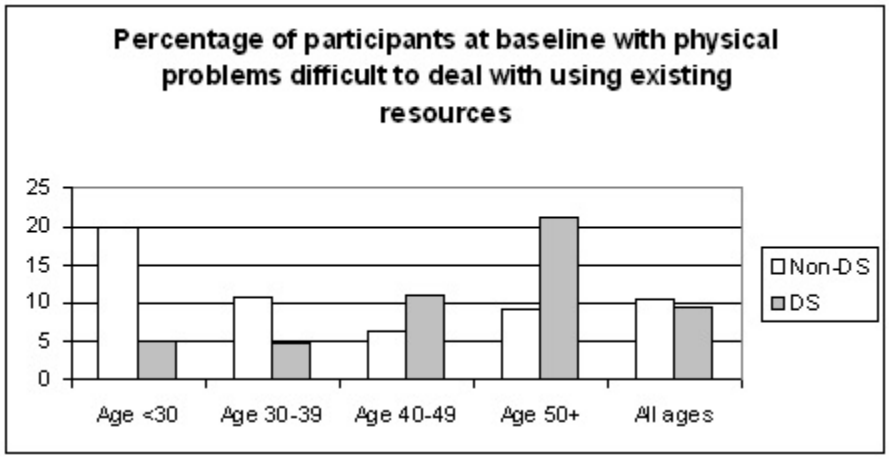
8.2.4 Discussion of DMTS results

Longitudinal data suggested that visual memory tended to decline over the entire lifespan, but that this process of decline became significantly more rapid in participants with DS over the age of 50, unlike in the underlying, non-DS population. It is possible that the non-DS population also had an accelerated decline in older ages, but the study population was too young to pick this up. Unlike the results found in the dyspraxia data, males with DS did not show more yearly deterioration than females, and the reasons for this are unclear.

9. CARE ISSUES: SERVICE PROVISION AND PSYCHOTROPIC MEDICATION

9.1 Service provision

Results of the caregiver survey (demographics of participants were shown in Table 4-3) regarding service issues are tabulated in detail in the Appendix C, and graphically in Figures 9-1 to 9-5. Demographics of participants with available baseline health service data were tabulated in Table 4-3.



9.1.1 Physical health issues

Figure 9-1. Percentage with perceived service deficits for physical problems

The greatest perceived deficits in service provision for physical problems were found to be in the youngest participants without DS and the oldest participants with DS. The percentage of participants whose caregivers perceived deficits in service provision for physical problems tended to decrease over four waves, except in the youngest non-DS

group, where an increase was apparent.

9.1.2 Emotional, behavioural and psychiatric health issues.

Participants with DS had a different pattern of psychiatric care across the age cohorts than did participants without DS. As can be seen in Figure 9-2, participants without DS had the highest rate of psychiatric visits (within five years of study entry) in the youngest cohort, lower rates in the second cohort, and lowest rates in the third cohort. The oldest cohort appears to have had a slight increase compared to the third cohort, but this was still not as high as rates in the first two cohorts. The pattern for participants with DS was quite different, with the lowest rates in the youngest cohort, and higher rates in each subsequent cohort.

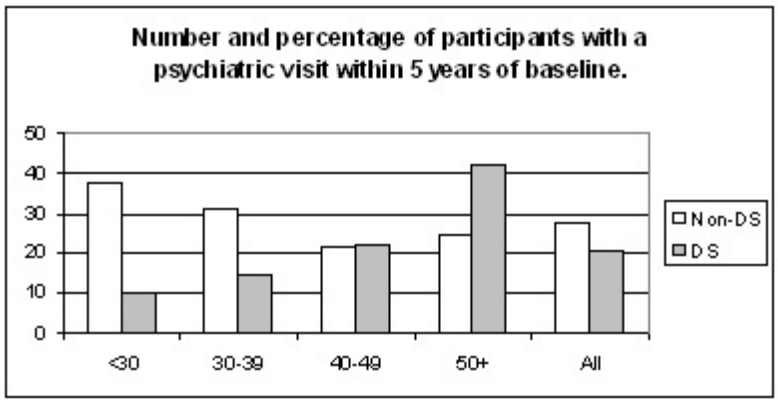


Figure 9-2. Percentage with a psychiatric visit within five years of baseline

Participants without DS were more likely overall to have perceived deficits in service provision for emotional, behavioural and psychiatric problems, and this did not change much over different age cohorts. In participants with DS, older cohorts had greater perceived deficits in service provision for emotional, behavioural and psychiatric problems than younger cohorts. The percentage of participants whose caregivers perceived deficits in service provision for emotional, behavioural and psychiatric problems tended to decrease over four waves.

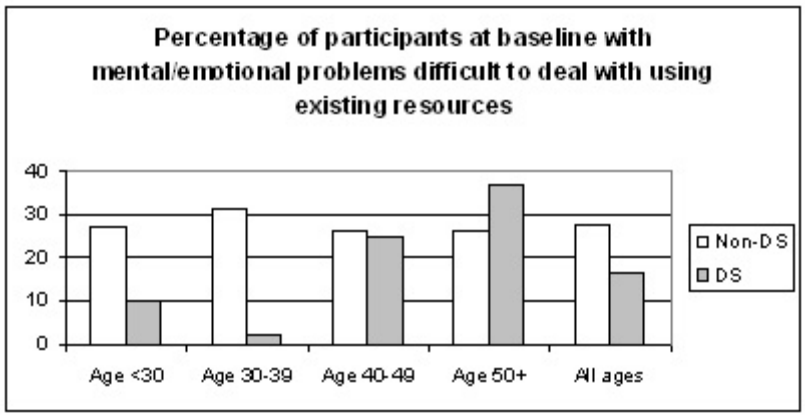


Figure 9-3. Percentage with perceived service deficits for emotional, behavioural or psychiatric problems

9.1.3 Aging issues and services

Caregivers rated those with DS and older participants as posing more baseline age related care difficulties than other groups. Although the percentage of participants felt to have increased aging related care difficulties varied a bit over four waves, there was no clear pattern of change over time obvious from these data.

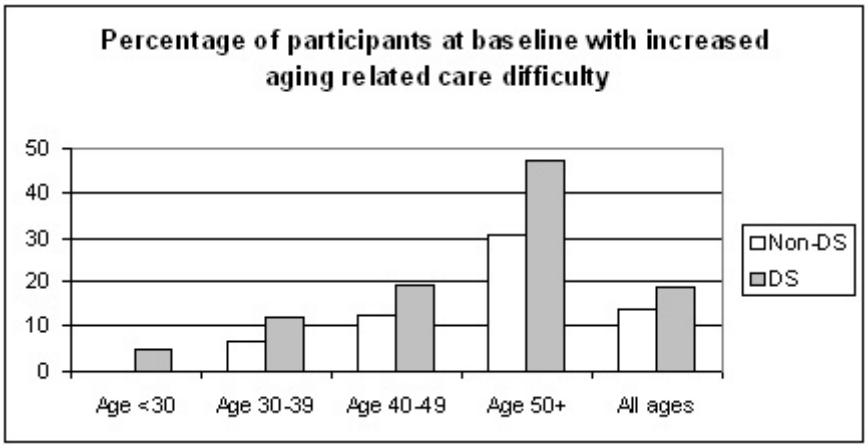


Figure 9-4. Percentage with increased aging related care difficulty

Aging related services were mostly used by the older participants, yet there were six people under the age of fifty (four without and two with DS) who also participated in

these. Overall, a smaller proportion of participants with DS used these aging services, which was probably a reflection of a younger DS population in the study sample. Although the percentage of participants using an age related service varied slightly over four waves, there was no clear pattern of change over time obvious from these data. Older participants tended to have higher use in all waves.

Participants without DS were more likely to use aging services specialized for ID, whereas participants with DS are about equally likely to access specialized as generic aging services. The percentage of participants using a specific age related service varies over four waves, but there was no clear pattern of change over time obvious from these data. Older participants tended to have higher use in all waves.

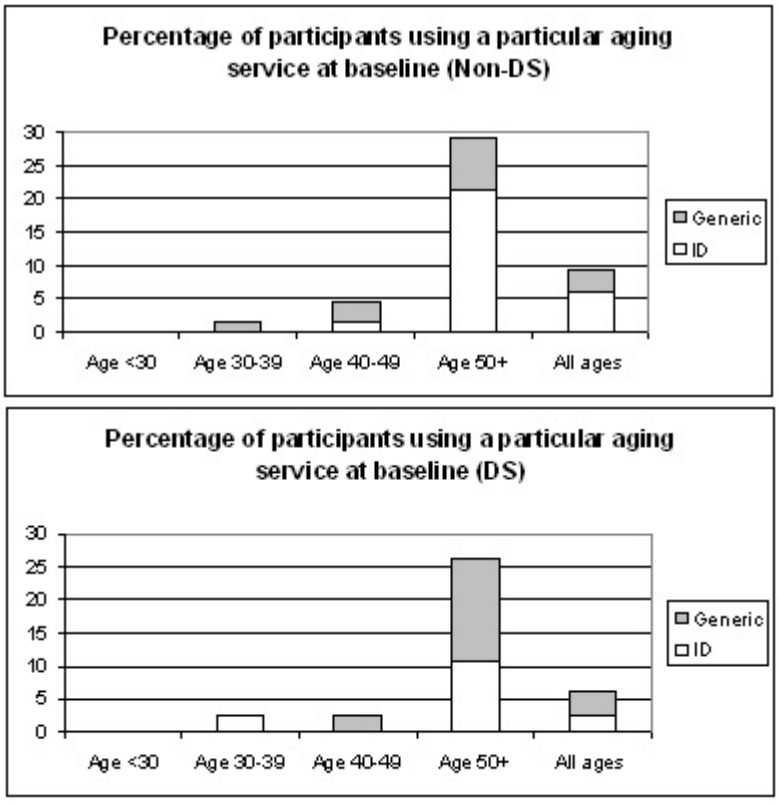


Figure 9-5. Percentage using a particular aging service at baseline

9.1.4 Transinstitutionalization

Eight participants transferred from a residential situation to a nursing home (long-term care facility) during the study. Younger participants who transferred to a nursing home tended to have only perceived service deficits for emotional, behavioural or psychiatric problems, whereas older participants were likely to have physical service deficits as well. No participants with DS under 45 years of age transferred to a nursing home, whereas three participants without DS under 45 were transferred. Numbers were too small to perform any statistical analysis.

Table 9-1. Participants transferring into a nursing home (long-term care)

Diagnosis	Sex	Age (at last assessment	Physical care	Emotional, behavioural or
Non-DS	Male	40.45	0	1
Non-DS	Male	40.81	0	1
Non-DS	Female	33.03	0	1
Non-DS	Female	48.53	0	1
Non-DS	Female	73.82	1	1
DS	Male	46.18	1	1
DS	Male	56.5	1	1
DS	Male	57.84	0	1

9.2 The use of psychotropic medications

9.2.1 Cross-sectional analysis

Baseline data for psychotropic medication use stratified for age and diagnosis are presented in Table 9-2. Observation of this raw data suggests that the use of psychotropic medications was generally more frequent overall in those without DS than in those with DS. There was a particularly high use of antipsychotics in the study population, but a lower use of antidepressant and anxiolytic medications, and a very low use of sedative-hypnotic medications. Participants with DS tended to have a higher use

of psychotropic medications in older cohorts, but participants without DS tended to have higher use in the younger age cohorts, except for antidepressant medication use, which was particularly high in the age group 40 to 49 years.

Table 9-2. Number (percentage) on a medication at baseline.

Medication	Diagnosis	Age≤ 30	Age 30-39	Age 40-49	Age 50+	All Ages
Antipsychotics	Non-DS	13(33)	25(34)	18(28)	23(35)	79(32)
	DS	0(0)	2(5)	6(17)	6(30)	14(12)
	All	13(22)	27(24)	24(24)	29(34)	93(26)
Antidepressants	Non-DS	5(12.5)	7(9.6)	14(21.5)	9(13.6)	35(14.3)
	DS	0(0)	3(7.1)	4(11.4)	5(25)	12(10.3)
	All	5(8.5)	10(8.7)	18(18)	14(16.3)	47(13.1)
Sedative-hypnotics	Non-DS	2(5)	1(1.4)	2(3.1)	2(3)	7(2.9)
	DS	0(0)	0(0)	0(0)	4(20)	4(3.4)
	All	2(3.4)	1(0.9)	2(2)	6(7)	11(3.1)
Anxiolytics	Non-DS	8(20)	9(12.3)	5(7.7)	11(16.7)	33(13.5)
	DS	0(0)	1(2.4)	1(2.9)	1(5)	3(2.6)
	All	8(13.6)	10(8.7)	6(6)	12(14)	36(10)

These data were explored further with the use of logistic regression analysis, using the core independent variables DS diagnosis, sex, and age at baseline. There were no third order interactions, and the only significant second order interactions were between DS and age. Table 9-3 demonstrates these interactions, which were significant for the use of antipsychotics, antidepressants and sedative-hypnotics, but not for anxiolytics. The effect of these positive interactions was a greater increase with age in the probability of medication use among participants with DS, but not in participants without DS.

Table 9-3. Logistic regression analysis for the baseline use of a medication (Interactions)

Medication	Interaction term	$\hat{\beta}$ (SE)	P value	OR(95% CI)
Antipsychotics	DS*Age	0.0783(0.0319)	<0.05	1.0814(1.016-1.1511)
Antidepressants	DS*Age	0.0698(0.035)	<0.05	1.0723(1.0012-1.1485)
Sedative-hypnotics	DS*Age	0.2832(0.1076)	<0.001	1.3273(1.0751-1.6388)
Anxiolytics	DS*Age	0.0326(0.0603)	ns	1.0331(0.9179-1.1627)

Further data exploration disclosed that the pattern of antidepressant use with age in participants without DS was not linear, but showed a peak in the years 40-49, whereas the pattern with age in participants with DS was linear. Age was therefore recoded into three categories: age <40, age 40-49 and age 50+ , and data for antidepressant use in participants without DS was analyzed separately, using these new age categories.

The final models that were chosen to predict medication use in participants at baseline are shown in Table 9-4. Unexpectedly, sex was not found to be a significant predictor of psychotropic medication use, except for the anxiolytics, where women had an almost significantly increased probability for use ($p<0.1$). The predicted probability of antidepressant use in participants without DS was significantly higher in the 40 to 49 year-old age group than in the under 40 year-old age group. Mean predicted probabilities based on these models for the use of psychotropic medications at baseline are illustrated graphically in Figure 9-6.

Table 9-4. Logistic regression analysis for the baseline use of a medication.

Medication	Diagnosis	Parameter	$\hat{\beta}$ (SE)	P value	OR (95% CI)
Antipsychotics	All	DS	-4.5515(1.4769)	<0.005	0.0106(0.0006-0.1907)
		Sex	0.1073(0.2489)	ns	1.1133(0.6835-1.8134)
		Age	0.0037(0.0102)	ns	1.0037(0.9838-1.0239)
		DS*Age	0.0783(0.0319)	<0.05	1.0814(1.0160-1.1511)
Antidepressants	Non-DS	Sex	-0.0743(0.3756)	ns	0.9283(0.4446-1.9383)
		Age (0): <40			
		Age (1): 40-49	0.8459(0.4292)	<0.05	2.3300(1.0046-5.4042)
		Age (2): 50+	0.3127(0.4713)	ns	1.3671(0.5428-3.4435)
	DS	Sex	0.6058(0.6357)	ns	1.8326(0.5271-6.3712)
		Age	0.0744(0.0327)	<0.05	1.0772(1.0104-1.1484)
Sedative-hypnotics	All	DS	-13.7505(5.9796)	<0.05	0.0000(0.0000-0.1313)
		Sex	-0.8106(0.7225)	ns	0.4446(0.1079-1.8319)
		Age	-0.0215(0.0312)	ns	0.9787(0.9207-1.0403)
		DS*Age	0.2832(0.1076)	<0.001	1.3273(1.0751-1.6388)
Anxiolytics	All	DS	-1.7866(0.6171)	<0.005	0.1675(0.0500-0.5615)
		Sex	0.6264(0.3599)	<0.1	1.8709(0.9241-3.7876)
		Age	0.0057(0.0137)	ns	1.0057(0.979-1.0332)

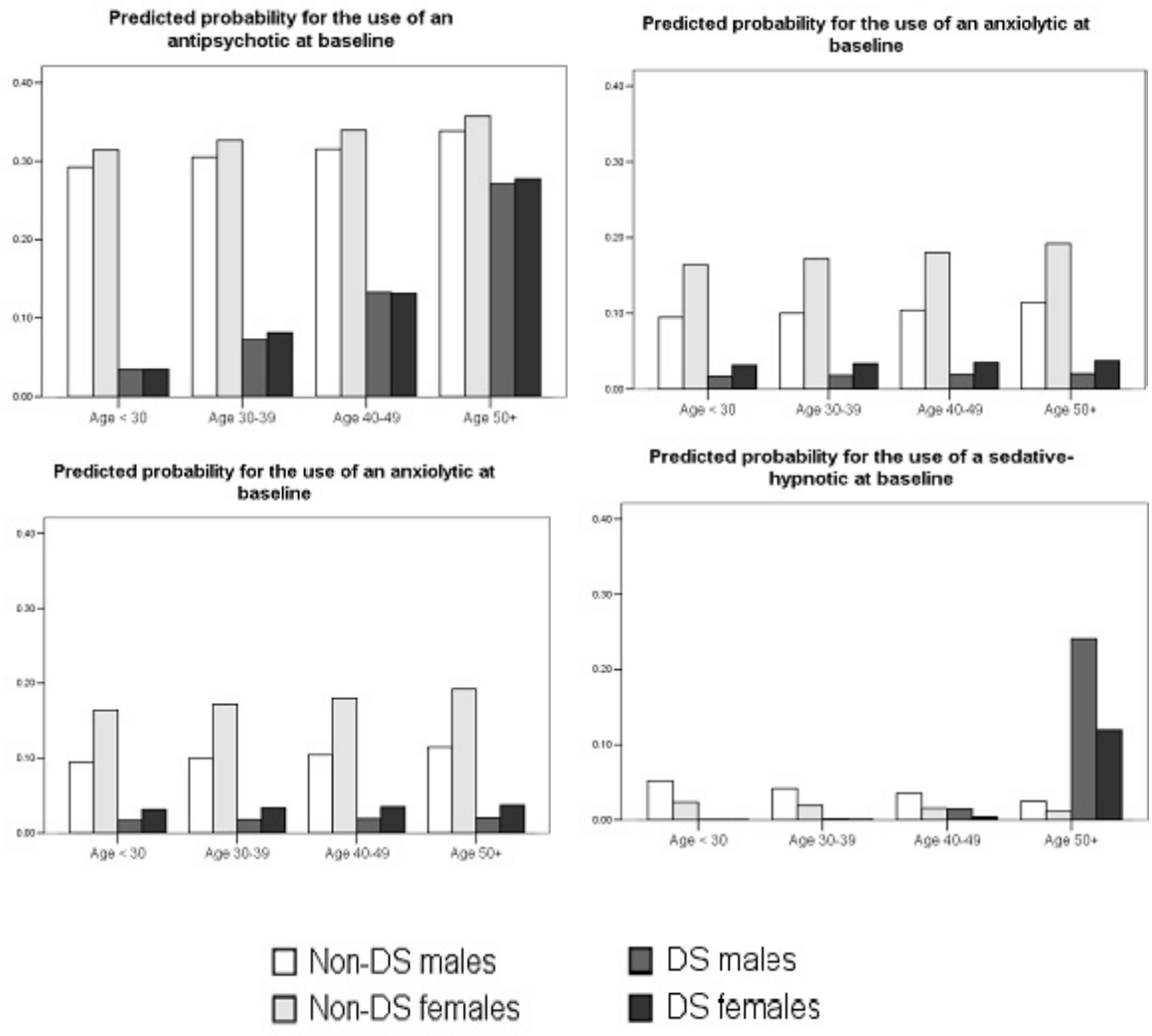


Figure 9-6. Percentage using a medication at baseline

9.2.1.1 Types of antipsychotics used at baseline

Table 9-5 illustrates the types of antipsychotic used at entry to the study by the participants, stratified into age groups. Antipsychotics were coded as typicals (such as haloperidol), atypicals (clozapine, risperidone, olanzapine and quetiapine for this study period) or both atypicals and typicals used concurrently. 93% of participants who were taking an antipsychotic at baseline were taking only a typical antipsychotic, whereas 5% were taking only an atypical antipsychotic and 2% were taking both a typical and an

atypical antipsychotic. Mean cohort age did not seem to be associated with a noticeable pattern of antipsychotic type used.

Table 9-5. Type of antipsychotics used at baseline: Number (%).

Antipsychotic Type	Age < 30	Age 30-39	Age 40-49	Age 50+	All ages
Typical AP	10(77)	25(93)	24(100)	27(93)	86(93)
Atypical AP	2(15)	1(4)	0(0)	2(6.9)	5(5)
Typical and atypical AP	1(8)	1(4)	0(0)	0(0)	2(2)
Total on any AP	13(100)	27(100)	24(100)	29(100)	93(100)

9.2.2 Changes in psychotropic medication use over four waves

Cross-sectional data comparing types of psychotropic medications used in four waves (1995, 1997, 1999 and 2001) of data collection are shown in Table 9-6, and although percentages fluctuated because of the small numbers, there were no obvious time or age associations.

Table 9-6. Psychotropic medication use (%) over four waves

Wave	AP	AD	SED	ANX	Mean age (SD)
1995	65(26)	37(14.9)	8(3.2)	27(10.8)	43(13)
1997	85(26)	42(12.7)	22(6.6)	34(10.3)	43(13)
1999	103(31)	44(13.1)	17(5.1)	38(11.3)	45(12)
2001	98(30)	47(14.5)	14(4.3)	39(12)	46(12)

Data from study participants are presented graphically along with Saskatchewan service data, illustrating percentages of eligible beneficiaries who have filled at least one antipsychotic (Information Management Unit of Saskatchewan Health, personal communication, July 19, 2005) or antidepressant (Information Management Unit of Saskatchewan Health, personal communication, March 29, 2006) prescription in a given year (Figure 9-7).

The comparison of these figures suggests that greater percentages of study participants

used antipsychotics and antidepressants during these time periods than did the overall Saskatchewan population. For example, although about 30% of all study participants used antipsychotics, only about 3% of the overall Saskatchewan population had filled a prescription for antipsychotics during similar time periods. The rate of antipsychotic and antidepressant use in the youngest segment of the study population was particularly different from that in the youngest segment of the Saskatchewan population, which had a very low rate of use. The trend to increased use of antipsychotics and antidepressants in older ages, as is seen in the Saskatchewan population, is much less evident in the study population.

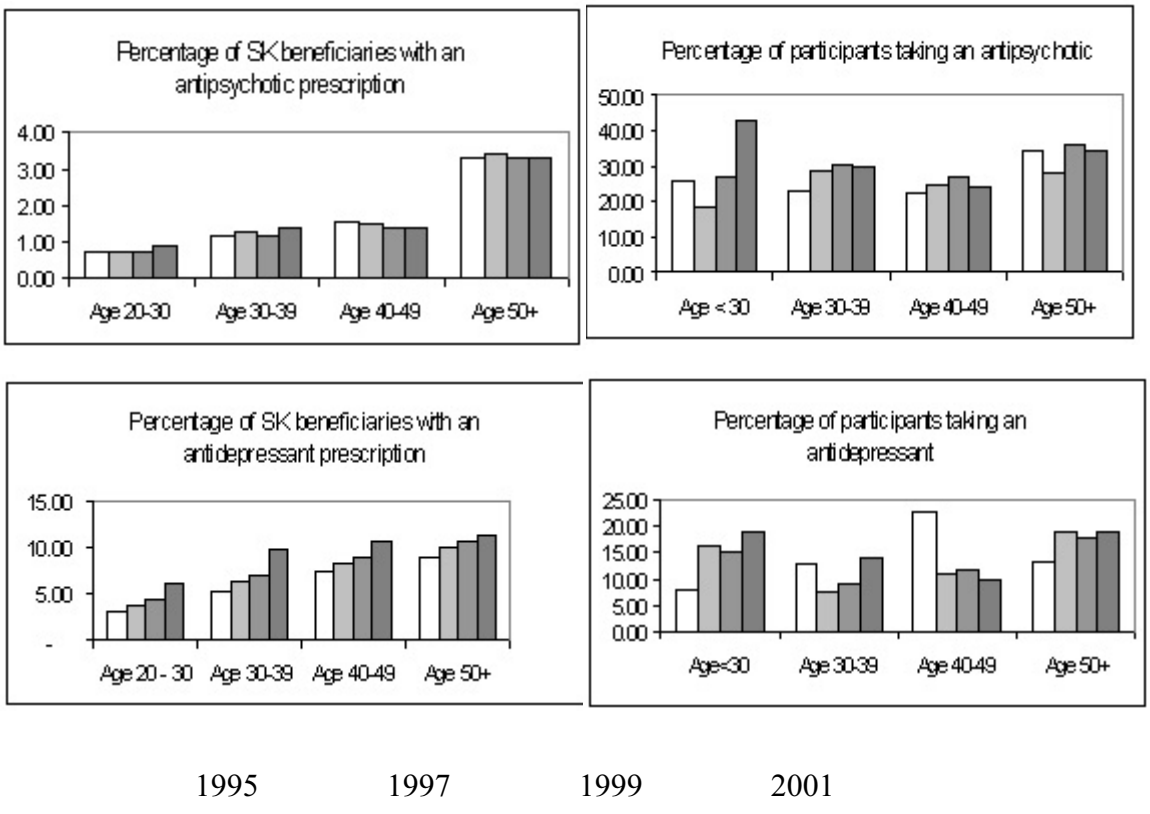


Figure 9-7. Antipsychotic use in participants and Saskatchewan beneficiaries over four years

The use of atypical antipsychotics has increased in the general population over this time period, and Figure 9-8 illustrates the numbers and percentages of the study participants

on an antipsychotic who were on only a typical (TYP), only an atypical (ATYP), or a typical and an atypical concurrently (TYP-ATYP). For comparison, similar data are presented from Saskatchewan Health showing the percentages of eligible beneficiaries aged 20 years and older that filled at least one prescription in each group of medications in a given year. (Note that these data from the Drug Plan do not necessarily mean the use was concurrent). It can be seen that in both the study and the Drug Plan data the percentage of participants who were only on a typical antipsychotic dropped rapidly, from 1995 to 2001. The percentage of participants who took both a typical and an atypical antipsychotic was low and changed little during the waves.

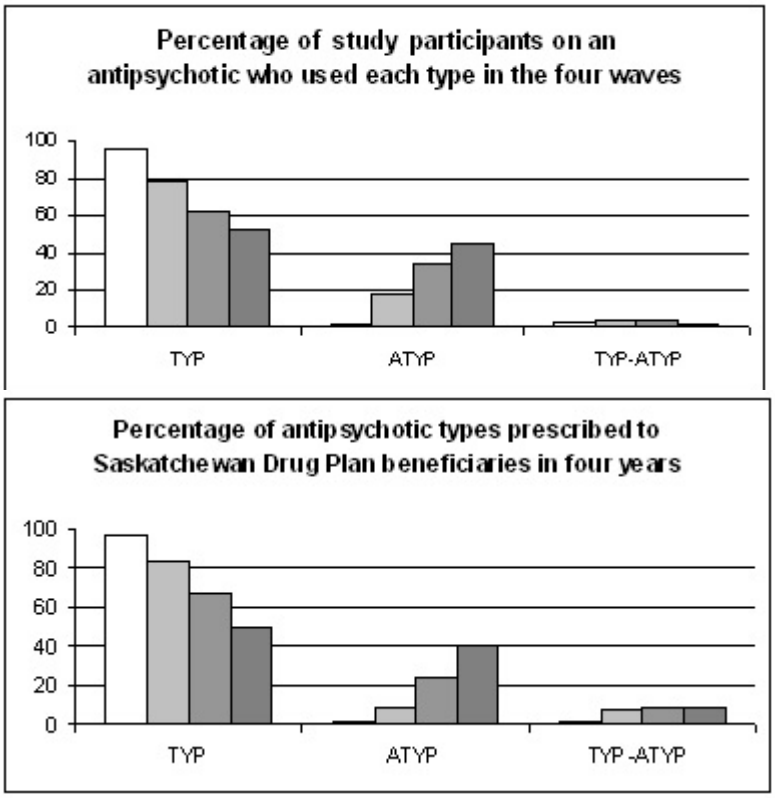


Figure 9-8. Type of antipsychotic use in participants and Saskatchewan beneficiaries over four years

9.2.3 Longitudinal analysis of psychotropic medication use over the course of the study

Observed data suggested that the use of psychotropic medications was fairly stable in individuals during the course of the study. Predicted probabilities for the use of psychotropic medications over the course of the study were obtained by fitting a logistic regression model based on the Generalized Estimating Equations (GEE) approach, as described in the methodology section earlier. The following marginal models using the GEE approach were fitted by using a SAS procedure PROC GENMOD to predict the probability of psychotropic medication use. The variable, time lapse, represents the yearly change in the probability of taking a particular medication. Results of these analyses are shown in Table 9-7.

Table 9-7. Results of logistic regression for the prediction of the probability of use of a particular medication based on GEE approach

Medication	Parameter	Robust estimate(SE)	P value	OR (95% CI)
AP	DS	-2.820(1.05)	<0.01	0.059 (0.008-0.46)
	Sex	0.095(0.22)	ns	1.10 (0.71-1.69)
	Age at baseline	0.004(0.0093)	ns	1.00 (0.99-1.02)
	Time lapse (years)	0.037(0.021	<0.1	1.04 (1.00-1.08)
	DS*Age (baseline)	0.042(0.024)	<0.1	1.04 (0.99-1.09)
AD	DS	-2.010(1.086)	<0.1	0.13 (0.02-1.13)
	Sex	0.067(0.25)	ns	1.07 (0.65-1.77)
	Age at baseline	0.005(0.011)	ns	1.01 (0.98-1.03)
	Time lapse	0.031(0.033)	ns	1.03 (0.97-1.10)
	DS* Age(baseline)	0.040(0.025)	ns	1.04 (0.99-1.09)
SED	DS	-11.360(2.97)	< 0.0005	0.00 (0.00-0.00)
	Sex	-0.330(0.38)	ns	0.72 (0.34-1.51)
	Age at baseline	0.013(0.014)	ns	1.01 (0.99-1.04)
	Time lapse (years)	0.084(0.050)	<0.1	1.09 (0.99-1.20)
	DS*Age (Baseline)	0.210(0.055)	<0.0001	1.24 (1.11-1.38)
ANX	DS	-3.70(1.400)	< 0.01	0.02 (0.00-0.38)
	Sex	0.34(0.250)	ns	1.4 (0.85-2.30)0
	Age (baseline)	0.012(0.011)	ns	1.01(0.99-1.03)
	Time lapse (years)	0.020(0.039)	ns	1.02 (0.95-1.10)
	Age(Baseline)*DS	0.048(0.028)	<0.1	1.05 (0.99-1.11)

The reference category for DS is Non-DS, and the reference category for sex is male

Although the likelihood for individuals to be on a psychotropic medication increased with time from baseline, this was not statistically significant for any medication, although almost significant ($p<0.1$) for antipsychotics and sedative-hypnotics. The interaction between age at baseline with the diagnosis of DS was significant or almost significant in all medications except for antidepressants.

9.3 Discussion

9.3.1 Care issues

Perceived deficits in service delivery for physical problems were more severe for young people without DS and older people with DS. This appears to be a reflection of decreased institutionalization and increased survival of younger people with multiple handicaps, as well as increasing age related problems particularly in those with DS. Perceived deficits in service delivery for emotional, behavioural or psychiatric problems was also rated as more problematic in general for those without DS. There was no age pattern in this group, although participants with DS had increasing perceived difficulties in this area as they aged.

Very few people used specialized aging services, so detailed interpretation was difficult. However, participants with DS appeared more likely to use generic aging services than those without DS. This might have been because of the increased rate of dementia, with characteristic behaviours that are well suited to generic dementia programs.

Very few participants (8/360) transferred from a community placement into a nursing home during the study. Although small numbers made inferences difficult, there was a suggestion that unmet service needs for emotional, behavioural or psychiatric problems were a factor for nursing home placement in all age groups, whereas unmet service needs for physical problems tended to be a precipitant for nursing home placement mostly for older participants.

9.3.2 Use of psychotropic medications

As expected, participants without DS were more likely to use all four types of psychotropic medications (antipsychotics, antidepressants, anxiolytics and sedative-hypnotics) than participants with DS, with the exception of antidepressants and sedative-hypnotics in the oldest (50+) cohort. This is almost certainly a reflection of increased emotional, behavioural and psychiatric morbidity in adults with ID who do not have DS, and the possible reasons for this have been discussed earlier.

As was expected, the use of antipsychotic medication in the study population was much more common than it was in the general population at the time of the study. Close to 30% of participants used an antipsychotic medication at baseline, whereas only about 3% of the Saskatchewan population had filled at least one prescription for an antipsychotic medication in 1995, with similar figures for 1997, 1999 and 2001.

The pattern of use of antipsychotics also changed in tandem with the underlying population trends. While the overwhelming majority of study participants who used an antipsychotic used a typical antipsychotic exclusively in 1995, only half of study participants exclusively used a typical antipsychotic by 2001. Meanwhile, the growing use of atypical antipsychotics was similar to the underlying population, albeit a bit less pronounced.

About 13% of study participants used an antidepressant at baseline, which is a bit less than the 15.5% prevalence found in the general Canadian population by Beck et al., 2005, but greater than the approximately 7% of the Saskatchewan eligible beneficiaries over the age of 20, who had at least one prescription of an antidepressant in 1995. The age distribution of antidepressant use in participants without DS was very similar to the Canadian data presented by Beck and colleagues, which showed a pronounced increased use in mid-life. There was no noticeable cross-sectional change of antidepressant usage

throughout four waves of participant data-collection, and there was no individual trend to greater use of an antidepressant in the years after the participant's entry to the study.

Very unlike general population findings, there was no increased use of antidepressants in female study participants. The reason for this was not clear, although the study was not specifically powered to measure this, so the numbers of antidepressant users were very small in many of the age and diagnostic categories.

Although the diagnosis of DS in general decreased the likelihood of using an antidepressant at baseline, there was a significant and positive DS with age interaction. This meant, that, although younger people with DS rarely used an antidepressant, older cohorts were progressively more likely to have been prescribed one. This was an interesting finding in light of the known increase in the prevalence of dementia in DS, and the potential correlations between mood and cognitive disorders.

Sedative-hypnotics were used only in about 3% of participants at baseline, which is similar to general Canadian rates of 3.1 % described by Beck et al., 2005. They were less commonly used in participants with DS, although there was again a positive interaction between DS diagnosis and age at baseline, with younger participants with DS having lower rates of use than younger participants without DS, but older participants with DS having higher rates of use than older participants without DS. The longitudinal analysis suggested is that there was a trend to the increased use of sedative-hypnotics over time, although this was not quite statistically significant ($p=0.093$).

About 10% of study participants used an anxiolytic at baseline. Participants with DS were less likely to use an anxiolytic at baseline. Female participants had almost twice the likelihood of being on an anxiolytic at baseline, but this was not statistically significant ($p= 0.082$). In the longitudinal analysis, only the diagnosis of DS was significant to the probability of being on an anxiolytic over time. The interaction between

age and DS was almost significant at p= 0.082. Individual participants did not become more likely over time to use an anxiolytic.

Of interest is that the findings from the longitudinal analysis gave similar, but not identical results to the findings from logistic regression analysis using only the baseline data. The longitudinal analysis included all data points throughout the study, which may have led to some healthy survivor bias. On the other hand, because more data points were available for analysis, more subtle trends may have become apparent using this methodology. For example, as there were a few very old participants, changes related to old age may have occurred in individual participants, but may not have been statistically significant in the baseline analysis.

To explore the potential non-randomness of dropouts, and new variable called "dropout" was created. This variable was scored zero if the last available tests were completed, and one if the last available tests were not completed for any reason. This new variable was entered into the logistic regression analysis for the use of all the medications of interest individually, which included antipsychotics, antidepressants, sedative-hypnotics and anxiolytics. None of the logistic regression analyses showed that the new variable "dropout" was significant to the outcome. In other words, completers and non-completers of the study were equally likely to be taking any of these medications at entry to the study. The healthy survivor effect was therefore not likely to have adversely impacted the longitudinal analysis of the probability of taking psychotropic medications at any time after entry to the study.

10. GENERAL SUMMARY OF FINDINGS AND CONCLUSIONS

The initial goals of the study were to explore biological, psychological, and functional aspects of the health of adults with ID, exploring cross-sectional predictive factors relating to birth cohort (age and diagnostic category), as well as predictive factors for individual longitudinal changes. The study also sought to study issues related to care provision and the use of psychotropic medications.

Hypotheses were made in the introduction, which were based on clinical experience and literature review. These hypotheses will now be reviewed, synthesizing results of data presented in the body of this thesis. Fuller discussion of specific results will not be reproduced, as this has been presented in earlier chapters.

10.1 Review of hypotheses

10.1.1 Epidemiology/Mortality

Male gender, older age, more severe baseline impairments in physical and mental functioning, and a diagnosis of DS will be associated with increased mortality.

As expected, data presented in chapter 5 showed that participants with DS, males, older participants, and those with more severe baseline impairments in their physical and mental functioning were found to have increased mortality. Also found (rather unexpectedly) was that higher baseline depressive symptoms predicted increased mortality. Discussion of this finding appears in the discussion at the end of chapter on mortality.

10.1.2 Physical morbidity

Cross-sectional data on the general health of adults with ID will reveal more typical, aging related medical problems in older compared to younger cohorts with ID, but fewer severe health conditions related to genetic, chromosomal or birth conditions.

Caregiver data on general health and care issues presented in chapter six confirmed the expected pattern of increased medical problems with increased cohort age, except in body systems that are known to be affected by congenital problems, such as cardiac problems in people with DS. Unfortunately, the data were not precise enough to make detailed comments about specific health problems within the general body system categories.

10.1.3 Emotional, behavioural or psychiatric morbidity

Emotional, behavioural and psychiatric problems will be more common in those without DS, particularly in the youngest cohorts.

Overall, current emotional, behavioural, and psychiatric problems (no information on specific diagnoses were available) were more common in participants without DS compared to those with DS. However, baseline caregiver data from participants without DS did not show the expected association of lower age with increased nervous and psychiatric problems, although visits to a psychiatrist were more common in the younger cohorts. In contradistinction to this finding, participants with DS had higher baseline nervous or psychiatric problems in older cohorts, and also had a pattern of increased psychiatric visits in the older cohorts.

Behavioral problems (from the BEH subscale of the standardized caregiver instrument, the DMR) were more common overall in participants without DS, particularly in the

youngest cohorts.

10.1.4 Functional-cognitive decline

Cross-sectional data from adults with ID without DS on behavioural and functional measures will reveal better functioning in mid-age compared to younger cohorts (related to continued learning and differential community placement), but poorer scores in the functions typically affected by aging in the oldest cohorts.

Cross-sectional DMR data from participants without DS presented in chapter 7 confirmed the expected pattern of initially improved functioning in all subscales with increasing age of the cohort, followed by worsening functioning across the oldest cohorts. Peak performances in specific functions were generally reached after the age of fifty, with peak performances in spatial abilities being reached the earliest (age 48.4) and peak performances in behaviours being reached the latest (57.8 years). Possible reasons for this were discussed in chapter 7.

Cross-sectional data from adults with ID and DS on behavioural and functional measures will reveal a pattern of poorer scores with older age starting with the youngest age cohorts.

Cross-sectional DMR data from participants with DS confirmed expected poorer performances with increased age of the cohorts in participants with DS, starting at the youngest cohorts. This is likely a result of increasing cognitive impairment with age, starting in early adulthood, although a formal diagnosis of dementia is unlikely to be made until middle age or later.

Longitudinal data from adults with ID on behavioural and functional measures (using a standardized caregiver instrument) will reveal yearly decline in most functions, most

noticeably in the oldest cohorts, and more in those with DS compared to those without DS. Specific functions will exhibit different rates of decline.

Results presented in chapter 7 were more complex than was originally hypothesized. Participants with DS exhibited unexpected gender differences, with older males declining more per year than older female in all areas of functioning except for mood and behavior. These gender differences were not seen in participants without DS. Probably because of the relatively young age of the participants, there was no significant yearly worsening of functioning in those without DS, but yearly worsening was apparent in those with DS, and increased with increased age of the cohort.

Cross-sectional data from adults with ID on specific neuropsychological measures (using standardized instruments to measure dyspraxia and visual memory) will not reflect continued learning (as in the case of functional data), but will reveal slightly lower functioning in older age cohorts, except in the oldest cohorts with DS, where scores will be more noticeably decreased.

Although cross-sectional data from both diagnostic groups showed a very small trend to decreased performance on the three dyspraxia tests in older age groups, this was only statistically significant in participants with DS (where the only the oldest males had a particularly poor performance), although it was almost ($p<0.1$) significant in participants without DS in Part 3 (which is thought to more sensitive to executive dysfunction). However, visual memory scores in participants with DS showed a more uniform pattern of decline across the age cohorts, starting with the youngest age cohort. These findings are consistent with research previously cited, which suggests that memory starts declining earlier in the course of dementia than does praxis, and deficits in executive functioning may be one of the earliest precursors of later dementia.

Longitudinal data from adults with ID on specific neuropsychological measures (using

standardized instruments to measure dyspraxia and visual memory) will reveal a small yearly decline in most functions, most noticeably in the oldest cohorts, and more in those with DS compared to those without DS. Specific functions will exhibit different rates of decline.

Research data supported most of this hypothesis. Although there was a trend to yearly decline in dyspraxia scores in all age and diagnostic categories, this decline was only statistically significant in participants with DS. The oldest male participants with DS had a particularly large yearly decline in this test (males significantly more than females). Yearly decline in visual memory was also only statistically significant in participants with DS, and the pattern of decline started at younger ages in memory for shapes compared to the dyspraxia decline. Males with DS again declined more than females with DS, although this was not statistically significant. However, females without DS had more decline than males, and this almost reached significance ($p<0.1$).

10.1.5 Service provision

Perceived deficits in service provision for emotional, behavioural or psychiatric problems will be greater than perceived deficits in service provision for physical problems. Younger participants without DS will have greater perceived deficits in service provision for physical, emotional, behavioural and psychiatric problems than older participants without DS, but older participants with DS will have perceived deficits in service provision for physical, emotional, behavioural and psychiatric problems than younger participants with DS.

Fewer participants (11% of those without DS and 9% of those with DS) were considered to have service deficits for physical problems compared to those considered to have service deficits for emotional, behavioral or psychiatric problems (28% of those without DS and 16% of those with DS), so this hypothesis was correct. However, although

younger participants without DS did have greater deficits in service provision for physical problems than older ones without DS, service deficits for emotional, behavioral or psychiatric problems did not show a clear age cohort difference, as had been hypothesized. Participants with DS did tend to have greater perceived service deficits for physical, emotional, behavioral or psychiatric problems in older compared to younger age cohorts, and this is likely related to the increase in cognitive impairment.

Perceived deficits in service provision for physical, emotional, behavioural or psychiatric needs will increase the likelihood of institutionalization (for example, to a nursing home), and this will be more pronounced for younger people with emotional, behavioural or psychiatric unmet service needs and older people with unmet physical service needs.

Because of the small numbers of people who transferred into a nursing home, it was not possible to draw firm conclusions about the association between service deficits and institutionalization. However, all participants who transferred into a nursing home had perceived deficits in service provision for emotional, behavioral or psychiatric problems, whereas only older participants who transferred into a nursing home had additional perceived deficits in service provision for their physical problems. This suggests that emotional, behavioral or psychiatric problems (especially aggression) pose a bigger challenge to care provision in small, community settings, and are more likely to result in institutionalization.

Participants will be less likely than the underlying population to have seen a psychiatrist recently, but psychiatric contact will be more likely for younger people without DS and older people with DS compared to the total study group.

It was not possible to make firm conclusions about differences in psychiatric access between the general Saskatchewan population and the study participants, as the equivalent Saskatchewan service data was not available. However, as previously noted,

in Saskatchewan only about 2.5% of the general population receives some formal mental health care each year (defined as a visit with a psychiatrist or psychologist), whereas 28% of study participants without DS and 21% of participants with DS had received a psychiatric visit within five years of baseline. This suggests that people with ID are probably more likely than the general population to receive formal mental health services overall, although it is possible that they may receive less frequent services.

Older participants will be more likely than younger participants to use aging programs. Older participants with DS will be more likely than older participants without DS to participate in a generic (rather than a specialized ID) aging program (because their behaviours will be more typical of a generic Alzheimer service population).

The data were consistent with the hypothesis that older participants were more likely than younger ones to use aging services. Whereas participants without DS were more likely to use aging services specialized for ID (probably because of challenging behaviors), participants with DS were about equally likely to access specialized as generic aging services.

The overall use of aging programs will increase over the time of the study.

Although participants with DS showed a trend to increased use of aging programs over the course of the study, this was not the case for the overall population.

10.1.6 Psychotropic medications

Overall, people without DS will be more likely to use psychotropic medications than those with DS.

Research data supported the hypothesis that psychotropic medications were more

commonly used in people without DS than with DS. This is consistent with the increased rate of emotional, behavioural and psychiatric problems in those without DS compared to those with DS, discussed earlier.

Older people without DS will be more likely than young ones without DS to use sedative-hypnotic medication, but less likely than young participants without DS to use medications such as antipsychotics to treat behavior disorders.

The expected relationship between age and psychotropic medications in people without DS was not found, in spite of the known increase of sleep disorders with age in the general population, and the decrease in behavioural problems with age. There was very little change across the age cohorts in the use of any of the medications that were explored, except for antidepressant medications, which were most commonly used in middle-aged people without DS.

The main reason for the loss of the ususal association between age and sedative-hypnotics was probably the high use of these medications in earlier years related to ongoing behavioural problems.

Older people with DS will be more likely than younger ones with DS to use antipsychotic, sedative hypnotic, and anxiolytic medications because of the increased prevalence of dementia.

Older people with DS were more likely than younger people with DS to use antipsychotic medications, antidepressant medications and sedative hypnotic medications, but the use of anxiolytic medications was not different in any of the age cohorts.

Antidepressant use will be most common in middle-aged females.

Unlike patterns of use in the underlying population, females were not significantly more likely to use antidepressants than males, although there appeared to be a trend for DS females to have a greater use of antidepressants than DS males. It is possible that the use of antidepressants for reasons other than depression (for example trazadone for aggression or sleep) is more common in people with ID, obscuring the usual pattern of midlife increase because of higher depression rates at that time of life.

There will not be much change in the individual, longitudinal use of particular psychotropic medications.

As expected, there was not much individual level change in the use of any of the psychotropic medications. This is probably not surprising, as, in spite of some fluctuations, most mental-health disorders tend to be lifelong problems, and the study follow-up time was relatively short.

There will be a systemic increase in the use of all psychotropic medications throughout the time of the study, consistent with underlying population trends. There will be an increase in the use of the newer, atypical antipsychotics throughout the time of this study, but this will be less noticeable than that seen in the underlying population. People with ID will be more likely to use antipsychotic medications, but less likely to use antidepressant medications than adults in the underlying population.

There was no systemic increase in the use of psychotropic medications among study participants throughout the time of the study, unlike that apparent from the information provided by the Saskatchewan Drug plan. This discrepancy is probably related to ongoing efforts by service providers to decrease the excessive use of psychotropic medication in people with ID. Patterns of antipsychotic use across the four waves of data collection in the study population were consistent with underlying population trends towards the use of atypical rather than typical agents. People with ID were more likely to

use antipsychotic medications than those in the underlying population, but the data did not support the reduced use of antidepressants in adults with ID.

10.2 Discussion of research findings

Research findings are largely consistent with data presented in the literature survey, as discussed in each individual chapter, although differences in methodology make direct comparisons difficult. In addition, this research explored a broader range of functions than available in most published data, including individually linked information on service provision, which is less commonly published.

Results reflected a variety of biological, psychological and social etiological factors, consistent with the biopsychosocial model. For example, the biological factor, trisomy 21, was found to be a strong factor predicting increased decline with age, which was evident in direct as well as indirect measures, as well as in cross-sectional and longitudinal analyses. The importance of psychological factors was suggested by apparent improvements of many functions in middle aged compared to the youngest cohorts (attributed to ongoing learning), and the association between depressive symptoms at baseline and increased mortality, although causality could not be established for either of these. Social factors resulting in deinstitutionalization and increased community placement of very disabled people, were thought to be important factors contributing to greater morbidity in younger than older cohorts in those without DS .

10.3. Clinical impact of findings

Although this study set out to explore aging changes in people with ID, it became apparent from research results that difficulties related to an increasingly more disabled young population may have even greater clinical impact on services required in the community. Difficulties with service provision for physical as well as emotional,

behavioral or psychiatric problems in this young population can be anticipated to increase with time, as infants with severe disabilities increasingly reach adulthood, and institutions for people with ID continue to shrink.

Challenging behaviors (particularly severe aggression) in these multihandicapped individuals will continue to pose a greater service provision challenge than physical problems. Acute, inpatient psychiatric facilities are not well designed to teach new, more adaptive behaviors, because of their short length of stay, rapid turnover, and focus on major mental disorders that respond to medications. They also do not generally have staff trained in intellectual disabilities. Therefore, it may be necessary to develop intermediate level care facilities in the community which can manage severe behaviors, and can also institute consistent, well designed behavioral management programs designed to increase more productive behaviors. These facilities will need to plan for longer admissions than acute inpatient facilities, as the learning of new behaviors is not as fast as the response to medications.

Reliance on nursing homes to provide care will probably increase over time, even for young people with ID, and this development is probably not in the spirit of normalization and increased quality of life for people with ID. However, unless alternative community services are available for severely challenging behaviors, it is not likely that this trend will change.

Continued deinstitutionalization over time of people with ID will require improved training of community care providers, such as physicians and nurses, in issues related to ID. More mandatory content on ID must be integrated into formal training programs, such as programs to train residents in psychiatry and family medicine. Increased informal learning will also be necessary. For example, staff of nursing homes will see more aging adults with ID, and may benefit from gaining increased knowledge from staff experienced in ID, who might come to give practical workshops. Conversely, staff

experienced in the behaviors related to dementia may be able to provide some teaching about this to staff in core ID services who will increasingly provide services to enable their clients to age in place.

In spite of the increased rate of aging related cognitive disabilities in adults with DS, most clinically significant deterioration in this group will not take place until after middle age, and not all individuals will necessarily receive a diagnosis of dementia. However, accommodations must be made for subtle declines in functioning, even in younger adulthood, of these individuals, as the failure to do so can cause increased frustration and declines in the quality of life.

In view of the association of depressive symptoms with increased mortality, these symptoms should be energetically evaluated, including a search for underlying pathology as well as aggressive treatment of depressive disorder, if appropriate.

10.4 Limitations

A major limitation of this study was the small number of participants (360), which resulted in insufficient power to enable conclusions to be drawn in many areas, even ones in which clinical experience suggested that research findings would be likely. Another limitation was the selection of participants from an established, community dwelling service population, rather than by random sampling, using a stratified process that sampled from community as well as institutional settings. Fortunately, most adults with ID do now live in the community, so the lack of data from institutions is less problematic. Still problematic, however, is the fact that many people with ID do not receive any services, so were automatically excluded from this research study, and there was no way of knowing how this unserviced population compares to the service population.

10.5 Future research

10.5.1 Epidemiology/mortality

Already under way is a phone follow-up component to the current study, which will establish mortality, cause of death and changes in residential placement on a yearly basis, exploring baseline determinants for these outcomes. The current study was not able to ascertain causes of death and had a relatively short follow-up, which decreased the potential for designing interventions that might improve the health of people with ID.

10.5.2 Physical morbidity

This study was not able to perform individual physical examinations with all participants, and therefore did not have access to accurate data about physical morbidity, and was thus unable to establish accurate diagnoses. Future research will need to build this component into the research design, including standard physical assessments, and making diagnoses using standard protocols.

10.5.3 Emotional, behavioral and psychiatric morbidity

This study was also not able to perform mental health interviews with all participants, and therefore did not have access to accurate data about emotional, behavioral and psychiatric morbidity, and thus was also unable to establish accurate psychiatric diagnoses. Future research will need to build a skilled psychiatric interview into the research design, using a standardized process, and making diagnoses using standard protocols.

10.5.4 Functional-cognitive decline

This study was not able to directly assess the neuropsychological functioning of

participants who had extremely low baseline IQ because of limitations in the instruments. Follow-up research might need to include an instrument such as the Severe Impairment Battery, which would increase the proportion of direct assessments available for analysis.

10.5.5 Service provision

Although this research project obtained some information on the adequacy of resources to manage physical and mental health challenges, the questions to establish this were not standardized, and did not include enough detail to allow for clinical planning. Future research might include a standardized instrument addressing satisfaction with services.

10.5.6 Psychotropic medications

The use of psychotropic medications to manage behaviors is still common among people with ID, in spite of the known, and high prevalence of medication adverse effects. Little information is known about potential methods to reduce this, and future research should ideally address this challenging topic.

LIST OF REFERENCES

Albert, M., & Cohen, C. (1992). The Test for Severe Impairment: An instrument for the assessment of patients with severe cognitive dysfunction. *Journal of the American Geriatrics Society, 40,* 449-453.

Alexander, G. E., Saunders, A. M., Szczepanik, J., Strassburger, T. L., Pietrini, P., Dani, A., et al. (1997). Relation of age and apolipoprotein E to cognitive function in Down syndrome adults. *Neuroreport, 8,* 1835-1840.

American Association on Mental Retardation (2004). *Community for all toolkit: Resources for supporting community-living.* (1.1 ed.) Washington, DC: American Association on Mental Retardation.

American Psychiatric Association (1987). *Diagnostic and statistical manual of mental disorders (3rd ed., revised).* Washington, DC: American Psychiatric Association.

American Psychiatric Association (1994). *Diagnostic and statistical manual of mental disorders (4th ed.).* Washington, DC: American Psychiatric Association.

Andel, R., Vigen, C., Mack, W. J., Clark, L. J., & Gatz, M. (2006). The effect of education and occupational complexity on rate of cognitive decline in Alzheimer patients. *Journal of the International Neuropsychological Society, 12,* 147-152.

Anderson, L. L., Lakin, K. C., Mangan, T. W., & Prouty, R. W. (1998). State institutions: Thirty years of depopulation and closure. *Mental Retardation, 36,* 431-443.

Aylward, E.H., Burt, D.B., Thorpe, L.U., Lai, F., & Dalton, A. (1997). Diagnosis of dementia in individuals with intellectual disability. *Journal of Intellectual Disability Research, 41(2),* 152-164.

Aylward, E. H., Li, Q., Honeycutt, N. A., Warren, A. C., Pulsifer, M. B., Barta, P. E., et al. (1999). MRI volumes of the hippocampus and amygdala in adults with Down syndrome with and without dementia. *American Journal of Psychiatry, 156,* 564-568.

Barron, P., Hassiotis, A., & Banes, J. (2002). Offenders with intellectual disability: The size of the problem and therapeutic outcomes. *Journal of Intellectual Disability Research, 46,* 454-463.

Batty, G. D., & Deary, I. J. (2004). Early life intelligence and adult health. *British Medical Association, 29,* 585-586.

Baum, L. W. (2005). Sex, hormones, and Alzheimer's disease. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 60,* 736-743.

Beck, C. A., Williams, J. V., Wang, J. L., Kassam, A., El Guebaly, N., Currie, S. R., et al. (2005). Psychotropic medication use in Canada. *Canadian Journal of Psychiatry, 50,* 605-613.

Bishop, G. M., & Robinson, S. R. (2002). The amyloid hypothesis: let sleeping dogmas lie? *Neurobiology of Aging, 23,* 1101-1105.

Bittles, A. H., Petterson, B. A., Sullivan, S. G., Hussain, R., Glasson, E. J., & Montgomery, P. D. (2002). The influence of intellectual disability on life expectancy. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 57,* M470-M472.

Blacher, J., & McIntyre, L. L. (2006). Syndrome specificity and behavioural disorders in young adults with intellectual disability: Cultural differences in family impact. *Journal of Intellectual Disability Research, 50,* 184-198.

Blazer, D. G., & Hybels, C. F. (2004). What symptoms of depression predict mortality in community-dwelling elders? *Journal of the American Geriatrics Society, 52,* 2052-2056.

Bohmer, C. J., Taminiau, J. A., Klinkenberg-Knol, E. C., & Meuwissen, S. G. (2001). The prevalence of constipation in institutionalized people with intellectual disability. *Journal of Intellectual Disability Research, 45,* 212-218.

Bowley, C., & Kerr, M. (2000). Epilepsy and intellectual disability. *Journal of Intellectual Disability Research, 44 (Pt. 5),* 529-543.

Bradley, E. A., Thompson, A., & Bryson, S. E. (2002). Mental retardation in teenagers: Prevalence data from the Niagara region, Ontario. *Canadian Journal of Psychiatry, 47,* 652-659.

Brodtkorb, E. (1994). The diversity of epilepsy in adults with severe developmental disabilities: Age at seizure onset and other prognostic factors. *Seizure, 3,* 277-285.

Brugge, K. L., Nichols, S. L., Salmon, D. P., Hill, L. R., Delis, D. C., Aaron, L., et al. (1994). Cognitive impairment in adults with Down's syndrome: Similarities to early cognitive changes in Alzheimer's disease. *Neurology, 44,* 232-238.

Bruininks, R. H., Hill, B. K., & Weatherman, R. F. (1986). *Inventory for clients and agency planning (ICAP)*. Allen, Texas: DLM Teaching Resources.

Burd, L., Selfridge, R., Klug, M., & Bakko, S. (2004). Fetal alcohol syndrome in the United States corrections system. *Addiction Biology, 9,* 169-176.

Burt, D. B., Loveland, K. A., Chen, Y. W., Chuang, A., Lewis, K. R., & Cherry, L. (1995). Aging in adults with Down syndrome: Report from a longitudinal study. *American Journal of Mental Retardation, 100,* 262-270.

Burt, D. B., Primeaux-Hart, S., Loveland, K. A., Cleveland, L. A., Lewis, K. R., Lesser, J., et al. (2005). Aging in adults with intellectual disabilities. *American Journal of Mental Retardation, 110,* 268-284.

Buschke, H. (1973). Selective reminding for analysis of memory and learning. *Journal of Verbal Learning and Verbal Behavior, 12,* 543-550.

Bush, A., & Beail, N. (2004). Risk factors for dementia in people with Down syndrome: Issues in assessment and diagnosis. *American Journal of Mental Retardation, 109,* 83-97.

Canadian study of health and aging. Canadian study of health and aging: Study methods and prevalence of dementia (1994). *Canadian Medical Association Journal, 150,* 899-913.

Carlesimo, G. A., Marotta, L., & Vicari, S. (1997). Long-term memory in mental retardation: Evidence for a specific impairment in subjects with Down's syndrome. *Neuropsychologia, 35,* 71-79.

Carney, C. P., Jones, L., Woolson, R. F., Noyes, R., Jr., & Doebbeling, B. N. (2003). Relationship between depression and pancreatic cancer in the general population. *Psychosomatic Medicine, 65,* 884-888.

Centers for Disease Control and Prevention (1996). State-Specific Rates of Mental Retardation -- United States, 1993. *Morbidity and Mortality Weekly Report, 45,* 61-65.

Chapman, R. S., & Hesketh, L. J. (2000). Behavioral phenotype of individuals with Down syndrome. *Mental Retardation and Developmental Disability Research Reviews, 6,* 84-95.

Charlot, L., Fox, S., & Friedlander, R. (2002). Obsessional slowness in Down syndrome. *Journal of Intellectual Disability Research, 46,* 517-524.

Clark, C. M., Ewbank, D., Lerner, A., Doody, R., Henderson, V. W., Panisset, M., et al. (1997). The relationship between extrapyramidal signs and cognitive performance in patients with Alzheimer disease enrolled in the CERAD Study. Consortium to Establish a Registry for Alzheimer Disease. *Neurology, 49,* 70-75.

Collacott, R. A. (1993). Epilepsy, dementia and adaptive behaviour in Down's syndrome. *Journal of Intellectual Disability Research, 37 (Pt. 2),* 153-160.

Colton, T. (1974). Regression and correlation. In *Statistics in medicine* (pp. 189-217). Boston: Little, Brown & Co.

Cooper, S. A. (1997). Deficient health and social services for elderly people with learning disabilities. *Journal of Intellectual Disability Research, 41,* 331-338.

Cooper, S. A. (1997). High prevalence of dementia among people with learning disabilities not attributable to Down syndrome. *Psychological Medicine, 27,* 609-616.

Cosgrave, M. P., Tyrrell, J., McCarron, M., Gill, M., & Lawlor, B. A. (1999). Age at onset of dementia and age of menopause in women with Down's syndrome. *Journal of Intellectual Disability Research, 43 (Pt. 6),* 461-465.

Coucouvanis, K., Polister, B., Prouty, R., & Lakin, K. C. (2003). Continuing reduction in populations of large state residential facilities for persons with intellectual and developmental disabilities. *Mental Retardation, 41,* 67-70.

da Cunha, R. P., & Moreira, J. B. (1996). Ocular findings in Down syndrome. *American Journal of Ophthalmology, 122,* 236-244.

Dalton, A. J. (1992). Dementia in Down syndrome: methods of evaluation. *Progress in Clinical and Biological Research, 379,* 51-76.

Dalton, A. J., & Fedor, B. L. (1998). Onset of dyspraxia in aging persons with Down Syndrome. *Journal of Intellectual and Developmental Disabilities, 23,* 13-24.

Dalton, A. J., Mehta, P. D., Fedor, B. L., & Patti, P. J. (1999). Cognitive changes in memory precede those in praxis in aging persons with Down Syndrome. *Journal of Intellectual and Developmental Disabilities, 24,* 169-187.

Das, J. P., Divis, B., Alexander, J., Parrila, R. K., & Naglieri, J. A. (1995). Cognitive decline due to aging among persons with Down syndrome. *Research in Developmental Disabilities, 16,* 461-478.

Davis, J. P., Judd, F. K., & Herrman, H. (1997). Depression in adults with intellectual disability. Part 1: A review. *Australian and New Zealand Journal of Psychiatry, 31,* 232-242.

de la Monte, S. M., & Hedley-Whyte, E. T. (1990). Small cerebral hemispheres in adults with Down syndrome: Contributions of developmental arrest and lesions of Alzheimer disease. *Journal of Neuropathology and Experimental Neurology, 49,* 509-520.

Deary, I. J., & Der, G. (2005). Reaction time explains IQ association with death. *Psychological Science, 16,* 64-69.

Deb, S., Thomas, M., & Bright, C. (2001). Mental disorder in adults with intellectual disability. 2: The rate of behaviour disorders among a community-based population aged between 16 and 64 years. *Journal of Intellectual Disability Research, 45,* 506-514.

Del Giudice, E., Staiano, A., Capano, G., Romano, A., Florimonte, L., Miele, E., et al.

(1999). Gastrointestinal manifestations in children with cerebral palsy. *Brain and Development, 21,* 307-311.

Devenny, D. A., Hill, A. L., Patxot, O., Silverman, W. P., & Wisniewski, K. E. (1992). Ageing in higher functioning adults with Down syndrome: An interim report in a longitudinal study. *Journal of Intellectual Disability Research, 36 (Pt. 3),* 241-250.

Devenny, D. A., Krinsky-McHale, S. J., Sersen, G., & Silverman, W. P. (2000). Sequence of cognitive decline in dementia in adults with Down's syndrome. *Journal of Intellectual Disability Research, 44 (Pt. 6),* 654-665.

Devenny, D. A., Silverman, W. P., Hill, A. L., Jenkins, E., Sersen, E. A., & Wisniewski, K. E. (1996). Normal ageing in adults with Down's syndrome: A longitudinal study. *Journal of Intellectual Disability Research, 40 (Pt. 3),* 208-221.

Devenny, D. A., Zimmerli, E. J., Kittler, P., & Krinsky-McHale, S. J. (2002). Cued recall in early-stage dementia in adults with Down's syndrome. *Journal of Intellectual Disability Research, 46,* 472-483.

Edgerton, R. B., Gaston, M. A., Kelly, H., & Ward, T. W. (1994). Health care for aging people with mental retardation. *Mental Retardation, 32,* 146-150.

Elkin, L. (1976). *A question of rights: Saskatchewan mentally retarded people move from institutions to the community. The sociology and politics of change in programs for the mentally retarded.* Regina, Saskatchewan: Lorne Elkin.

Evenhuis, H. M. (1990). The natural history of dementia in Down syndrome. *Archives of Neurology, 47,* 263-267.

Evenhuis, H. M., Kengen, M. M. F., & Eurlings, H. A. L. (1991*). Dementia Questionnaire*

for Mentally Retarded Persons. Zwannerdam, the Netherlands: Hooge Burch Institute for Mentally Retarded People.

Evenhuis, H. M. (1992). Evaluation of a screening instrument for dementia in ageing mentally retarded persons. *Journal of Intellectual Disability Research, 36 (Pt. 4),* 337-347.

Evenhuis, H. M., Theunissen, M., Denkers, I., Verschuure, H., & Kemme, H. (2001). Prevalence of visual and hearing impairment in a Dutch institutionalized population with intellectual disability. *Journal of Intellectual Disability Research, 45,* 457-464.

Fidler, D. J., Hepburn, S. L., Mankin, G., & Rogers, S. J. (2005). Praxis skills in young children with Down syndrome, other developmental disabilities, and typically developing children. *American Journal of Occupational Therapy, 59,* 129-138.

Forsgren, L., Edvinsson, S. O., Nystrom, L., & Blomquist, H. K. (1996). Influence of epilepsy on mortality in mental retardation: An epidemiologic study. *Epilepsia, 37,* 956-963.

Fotheringham, J. B., Abdo, K., Ouellette-Kuntz, H., & Wolfgarth, A. (1993). Survey of community adjustment of previously institutionalized developmentally disabled persons. *Canadian Journal of Psychiatry, 38,* 641-648.

Franceschi, M., Comola, M., Piattoni, F., Gualandri, W., & Canal, N. (1990). Prevalence of dementia in adult patients with trisomy 21. *American Journal of Medical Genetics. Supplement, 7,* 306-308.

Fraser, J., & Mitchell, A. (1876). Kalmuc idiocy; report of the case with autopsy; with notes on sixty-two cases. *Journal of Mental Science, 22,* 161.

Freedman, R. I., & Chassler, D. (2004). Physical and behavioral health of adults with mental retardation across residential settings. *Public Health Reports, 119,* 401-408.

Gabre, P. (2000). Studies on oral health in mentally retarded adults. *SwedishDental Journal. Supplement,* 1-48.

Gedye, A. (1995). *Dementia Scale for Down Syndrome. Manual*. Vancouver, Canada: Gedye Research and Consulting.

Hancock, R. D., Weber, S. L., Kaza, R., & Her, K. S. (1991). Changes in psychotropic drug use in long-term residents of an ICF/MR facility. *American Journal of Mental Retardation, 96,* 137-141.

Hand, J. E. (1994). Report of a national survey of older people with lifelong intellectual handicap in New Zealand. *Journal of Intellectual Disability Research, 38 (Pt. 3),* 275-287.

Hand, J. E., & Reid, P. M. (1996). Older adults with lifelong intellectual handicap in New Zealand: Prevalence, disabilities and implications for regional health authorities. *New Zealand Medical Journal, 109,* 118-121.

Haveman, M., Maaskant, M. A., & Sturmans, F. (1989). Older Dutch residents of institutions, with and without Down syndrome: Comparison of mortality and morbidity trends and motor/social functioning. *Australian and New Zealand Journal of Developmental Disabilities, 15*, 241-255.

Haw, C.M., Barnes, T.R., Clark, K., Crichton, P., & Kohen, D. (1996). Movement disorder in Down's syndrome: A possible marker of the severity of mental handicap. *Movement Disorders, 11*, 395-403.

Hawkins, B. A., Eklund, S. J., James, D. R., & Foose, A. K. (2003). Adaptive behavior and cognitive function of adults with down syndrome: Modeling change with age. *Mental Retardation, 41,* 7-28.

Haxby, J. V. (1989). Neuropsychological evaluation of adults with Down syndrome: Patterns of selective impairment in non-demented old adults. *Journal of Mental Deficiency Research, 33 (Pt. 3),* 193-210.

Health Canada. (2002). *Congenital anomalies in Canada, a perinatal health report, 2002.* Ottawa, Canada: Health Canada.

Hesdorffer, D. C., Hauser, W. A., Annegers, J. F., Kokmen, E., & Rocca, W. A. (1996). Dementia and adult-onset unprovoked seizures. *Neurology, 46,* 727-730.

Holden, T. J. (1992). Mental retardation. *Annals of the Royal College of Physicians and Surgeons of Canada, 25,* 315.

Holden, B., & Gitlesen, J. P. (2004). Psychotropic medication in adults with mental retardation: Prevalence, and prescription practices. *Research in Developmental Disabilities, 25,* 509-521.

Holland, A. J., Hon, J., Huppert, F. A., Stevens, F., & Watson, P. (1998). Population-based study of the prevalence and presentation of dementia in adults with Down syndrome. *British Journal of Psychiatry, 172,* 493-498.

Holland, A. J., Hon, J., Huppert, F. A., & Stevens, F. (2000). Incidence and course of dementia in people with Down syndrome: Findings from a population-based study. *Journal of Intellectual Disability Research, 44 (Pt. 2),* 138-146.

Jacobs, D., Sano, M., Marder, K., Bell, K., Bylsma, F., Lafleche, G., et al. (1994). Age at onset of Alzheimer disease: Relation to pattern of cognitive dysfunction and rate of decline. *Neurology, 44,* 1215-1220.

Jahnsen, R., Villien, L., Egeland, T., Stanghelle, J. K., & Holm, I. (2004). Locomotion skills in adults with cerebral palsy. *Clinical Rehabilitation, 18,* 309-316.

Janicki, M. P., Dalton, A. J., Henderson, C. M., & Davidson, P. W. (1999). Mortality and morbidity among older adults with intellectual disability: Health services considerations. *Disability and Rehabilitation, 21,* 284-294.

Janicki, M. P., & Dalton, A. J. (1997). Pending impact of dementia related care on intellectual disabilities providers. *Proceedings of the International Congress III on the Dually Diagnosed-Mental Health Aspects of Mental Retardation* (pp. 188-190). Montreal, P.Q., Canada.

Janicki, M. P., & Dalton, A. J. (2000). Prevalence of dementia and impact on intellectual disability services. *Mental Retardation, 38,* 276-288.

Janicki, M. P., Davidson, P. W., Henderson, C. M., McCallion, P., Taets, J. D., Force, L. T., et al. (2002). Health characteristics and health services utilization in older adults with intellectual disability living in community residences. *Journal of Intellectual Disability Research, 46,* 287-298.

Jarrold, C., Baddeley, A. D., & Phillips, C. (1999). Down syndrome and the phonological loop: The evidence for, and importance of, a specific verbal short-term memory deficit. *Down Syndrome Research and Practice, 6,* 61-75.

Jenkins, E. C., Schupf, N., Genovese, M., Ye, L. L., Kapell, D., Canto, B., et al. (1997). Increased low-level chromosome 21 mosaicism in older individuals with Down syndrome. *American Journal of Medical Genetics, 68,* 147-151.

Jervis, G. A. (1948). Early senile dementia in mongoloid idiocy. *American Journal of Psychiatry, 105,* 102-106.

Jorm, A. F. (2001). History of depression as a risk factor for dementia: An updated review. *Australian and New Zealand Journal of Psychiatry, 35,* 776-781.

Kapell, D., Nightingale, B., Rodriguez, A., Lee, J. H., Zigman, W. B., & Schupf, N. (1998). Prevalence of chronic medical conditions in adults with mental retardation: Comparison with the general population. *Mental Retardation, 36,* 269-279.

Kerker, B. D., Owens, P. L., Zigler, E., & Horwitz, S. M. (2004). Mental health disorders among individuals with mental retardation: Challenges to accurate prevalence estimates. *Public Health Reports, 119,* 409-417.

Kessing, L. V., & Nilsson, F. M. (2003). Increased risk of developing dementia in patients with major affective disorders compared to patients with other medical illnesses. *Journal of Affective Disorders, 73,* 261-269.

Kesslak, J. P., Nagata, S. F., Lott, I., & Nalcioglu, O. (1994). Magnetic resonance imaging analysis of age-related changes in the brains of individuals with Down syndrome. *Neurology, 44,* 1039-1045.

Kiernan, C., Reeves, D., & Alborz, A. (1995). The use of anti-psychotic drugs with adults with learning disabilities and challenging behaviour. *Journal of Intellectual Disability Research, 39 (Pt. 4),* 263-274.

Kim, S., Larson, S. A., & Lakin, K. C. (2001). Behavioural outcomes of deinstitutionalization for people with intellectual disability: A review of US studies conducted between 1980 and 1999. *Journal of Intellectual and Developmental Disabilities, 26,* 35-50.

Kleinbaum, D. G. (1996). *Survival analysis - A self-learning text*. New York: Springer Verlag.

Krigger, K. W. (2006). Cerebral palsy: An overview. *American Family Physician, 73,* 91-100.

Lai, F., & Williams, R. S. (1989). A prospective study of Alzheimer disease in Down syndrome. *Archives of Neurology, 46,* 849-853.

Lai, F., Kammann, E., Rebeck, G. W., Anderson, A., Chen, Y., & Nixon, R. A. (1999). APOE genotype and gender effects on Alzheimer disease in 100 adults with Down syndrome. *Neurology, 53,* 331-336.

Lakin, K. C., Hill, B. K., & Anderson, D. J. (1991). Persons with mental retardation in nursing homes in 1977 and 1985. *Mental Retardation, 29,* 25-33.

Lanfranchi, S., Cornoldi, C., & Vianello, R. (2004). Verbal and visuospatial working memory deficits in children with Down syndrome. *American Journal of Mental Retardation, 109,* 456-466.

Laurin, D., Verreault, R., Lindsay, J., MacPherson, K., & Rockwood, K. (2001). Physical activity and risk of cognitive impairment and dementia in elderly persons. *Archives of Neurology, 58,* 498-504.

Lawlor, B. A., McCarron, M., Wilson, G., & McLoughlin, M. (2001). Temporal lobe-oriented CT scanning and dementia in Down syndrome. *International Journal of Geriatric Psychiatry, 16,* 427-429.

Leichner, P. (1987). Postgraduate education in psychiatry: 10 years later. *Annals of the Royal College of Physicians and Surgeons of Canada, 20,* 517.

Leichner, P. P. (1977). Present psychiatric postgraduate education and future professional trends in Canada: A survey of the opinions of fourth-year residents. Part I--Evaluation of

psychiatric training for Canadian residents. *Canadian Psychiatric Association Journal, 22,* 123-130.

Leonard, H., Petterson, B., Bower, C., & Sanders, R. (2003). Prevalence of intellectual disability in Western Australia. *Paediatric and Perinatal Epidemiology, 17,* 58-67.

Leverenz, J. B., & Raskind, M. A. (1998). Early amyloid deposition in the medial temporal lobe of young Down syndrome patients: A regional quantitative analysis. *Experimental Neurology, 150,* 296-304.

Lhatoo, S. D., Langan, Y., & Sander, J. W. (1999). Sudden unexpected death in epilepsy. *Postgraduate Medical Journal, 75,* 706-709.

Lifshitz, H., & Merrick, J. (2004). Aging among persons with intellectual disability in Israel in relation to type of residence, age, and etiology. *Research in Developmental Disabilities, 25,* 193-205.

Lindsay, J., Laurin, D., Verreault, R., Hebert, R., Helliwell, B., Hill, G. B., et al. (2002). Risk factors for Alzheimer disease: A prospective analysis from the Canadian Study of Health and Aging. *American Journal of Epidemiology, 156,* 445-453.

Lopez, O. L., Wisniewski, S. R., Becker, J. T., Boller, F., & DeKosky, S. T. (1999). Psychiatric medication and abnormal behavior as predictors of progression in probable Alzheimer disease. *Archives of Neurology, 56,* 1266-1272.

Lott, I. T., & Lai, F. (1982). Dementia in Down's syndrome: Observations from a neurology clinic. *Applied Research in Mental Retardation, 3,* 233-239.

Lunsky, Y., & Bradley, E. (2001). Developmental disability training in Canadian psychiatry residency programs. *Canadian Journal of Psychiatry, 46,* 138-143.

Matson, J. L., Bamburg, J. W., Mayville, E. A., Pinkston, J., Bielecki, J., Kuhn, D., et al. (2000). Psychopharmacology and mental retardation: A 10 year review (1990-1999). *Research in Developmental Disabilities, 21,* 263-296.

McDermott, S., Moran, R., Platt, T., Wood, H., Isaac, T., & Dasari, S. (2005). Prevalence of epilepsy in adults with mental retardation and related disabilities in primary care. *American Journal of Mental Retardation, 110,* 48-56.

McKeown, D. A., Doty, R. L., Perl, D. P., Frye, R. E., Simms, I., & Mester, A. (1996). Olfactory function in young adolescents with Down's syndrome. *Journal of Neurology, Neurosurgery and Psychiatry, 61,* 412-414.

McKhann, G., Drachman, D., Folstein, M., Katzman, R., Price, D., & Stadlan, E. M. (1984). Clinical diagnosis of Alzheimer disease: Report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer Disease. *Neurology, 34,* 939-944.

Medline Plus National Library of Medicine (US) (2006). Mental Retardation: Causes, incidence and risk factors. In Medline Plus [On-line]. Retrieved August 1, 2006 from http://www.nlm.nih.gov/medlineplus/ency/article/001523.htm.

Melville, C. A., Cooper, S. A., McGrother, C. W., Thorp, C. F., & Collacott, R. (2005). Obesity in adults with Down syndrome: A case-control study. *Journal of Intellectual Disability Research, 49,* 125-133.

Menendez, M. (2005). Down syndrome, Alzheimer's disease and seizures. *Brain and Development, 27,* 246-252.

Moran, R., Drane, W., McDermott, S., Dasari, S., Scurry, J. B., & Platt, T. (2005). Obesity among people with and without mental retardation across adulthood. *Obesity Research, 13,* 342-349.

Morris, S. (2003). Dual diagnosis. In Psychiatric Patient Advocate Office (Ed.) *Mental health and patients' rights in Ontario: Yesterday, today and tommorrow* (pp. 85-87). Toronto: Queen's Printer for Ontario.

Morrissey, J. P., & Goldman, H. H. (1986). Care and treatment of the mentally ill in the United States: Historical developments and reforms. *Annals of the American Academy of Political and Social Science,* 12-27.

National Institute of Aging, Laboratory of Neuroscience. (1989). *The Daily Living Skills Questionnaire*. Bethesda, Maryland: National Institute of Aging.

Nelson, L. D., Orme, D., Osann, K., & Lott, I. T. (2001). Neurological changes and emotional functioning in adults with Down Syndrome. *Journal of Intellectual Disability Research, 45,* 450-456.

Nihira, K., Foster, R., Shellhaas, M., & Leland, H. (1974). *AAMD Adaptive Behavior Scale*. Washington, D.C.: American Association on Mental Deficiency.

Nijjar, R. K., & Murphy, C. (2002). Olfactory impairment increases as a function of age in persons with Down syndrome. *Neurobiology of Aging, 23,* 65-73.

Nora, J. J., & Fraser, F. C. (1993). *Medical Genetics. Principles and Practice*. (4th ed.). Philadelphia: Lea and Febiger.

Nottestad, J. A., & Linaker, O. M. (2003). Psychotropic drug use among people with intellectual disability before and after deinstitutionalization. *Journal of Intellectual Disability Research, 47,* 464-471.

Obrenovich, M. E., Joseph, J. A., Atwood, C. S., Perry, G., & Smith, M. A. (2002). Amyloid-beta: A (life) preserver for the brain. *Neurobiology of Aging, 23,* 1097-1099.

Oliver, C., Crayton, L., Holland, A., Hall, S., & Bradbury, J. (1998). A four year prospective study of age-related cognitive change in adults with Down's syndrome. *Psychological Medicine, 28,* 1365-1377.

Pary, R. (1993). Psychoactive drugs used with adults and elderly adults who have mental retardation. *American Journal of Mental Retardation, 98,* 121-127.

Patja, K., Iivanainen, M., Vesala, H., Oksanen, H., & Ruoppila, I. (2000). Life expectancy of people with intellectual disability: A 35-year follow-up study. *Journal of Intellectual Disability Research, 44 (Pt. 5),* 591-599.

Peila, R., White, L. R., Masaki, K., Petrovitch, H., & Launer, L. J. (2006). Reducing the risk of dementia: Efficacy of long-term treatment of hypertension. *Stroke, 37,* 1165-1170.

Penninx, B. W., Geerlings, S. W., Deeg, D. J., van Eijk, J. T., van Tilburg, W., & Beekman, A. T. (1999). Minor and major depression and the risk of death in older persons. *Archives of General Psychiatry, 56,* 889-895.

Prasher, V. P. (1995). Prevalence of psychiatric disorders in adults with Down syndrome. *European Journal of Psychiatry, 9,* 77-82.

Prasher, V. P., & Filer, A. (1995). Behavioural disturbance in people with Down's syndrome and dementia. *Journal of Intellectual Disability Research, 39 (Pt. 5),* 432-436.

Prasher, V. P., Chung, M. C., & Haque, M. S. (1998). Longitudinal changes in adaptive behavior in adults with Down syndrome: Interim findings from a longitudinal study. *American Journal of Mental Retardation, 103,* 40-46.

Prouty, R.W., Smith, G., & Lakin, K.C. (Eds.). (2005). *Residential services for persons with developmental disabilities: Status and trends through 2004*. Minneapolis, MN: University of Minnesota, Institute on Community Integration, Research and Training Center on Community Living.

Pueschel, S. M. (1990). Clinical aspects of Down syndrome from infancy to adulthood. *American Journal of Medical Genetics Supplement, 7,* 52-56.

Pueschel, S. M., Louis, S., & McKnight, P. (1991). Seizure disorders in Down syndrome. *Archives of Neurology, 48,* 318-320.

Pueschel, S. M., Jackson, I. M., Giesswein, P., Dean, M. K., & Pezzullo, J. C. (1991). Thyroid function in Down syndrome. *Research in Developmental Disabilities, 12,* 287-296.

Puri, B. K., Ho, K. W., & Singh, I. (2001). Age of seizure onset in adults with Down's syndrome. *International Journal of Clinical Practice, 55,* 442-444.

Radouco-Thomas, M., Bolduc, M., Brisson, A., Brassard, P., Fortier, L., & Thivierge, J. (2004). Pilot study on the use of psychotropic medication in persons with mental retardation. *Progress in Neuro-Psychopharmacology and Biological Psychiatry, 28,* 879-883.

Reid, W., Broe, G., Creasey, H., Grayson, D., McCusker, E., Bennett, H., et al. (1996). Age at onset and pattern of neuropsychological impairment in mild early-stage Alzheimer disease. A study of a community-based population. *Archives of Neurology, 53,* 1056-1061.

Reisberg, B., Ferris, S. H., de Leon, M. J., & Crook, T. (1982). The Global Deterioration Scale for assessment of primary degenerative dementia. *American Journal of Psychiatry, 139,* 1136-1139.

Ritchie, K., & Lovestone, S. (2002). The dementias. *Lancet, 360,* 1759-1766.

Roeden, J. M., & Zitman, F. G. (1995). Ageing in adults with Down's syndrome in institutionally based and community-based residences. *Journal of Intellectual Disability Research, 39 (Pt. 5),* 399-407.

Rosow, I., & Breslau, N. (1966). A Guttman health scale for the aged. *Journal of Gerontology, 21,* 556-559.

Roth, M., Huppert, F. A., Tym, E., & Mountjoy, C. Q. (1988). *The Cambridge Examination for Mental Disorders of the Elderly (CAMDEX)*. Cambridge, UK: Cambridge University Press.

Sachdev, P. S. (1991). Psychoactive drug use in an institution for intellectually handicapped persons. *Medical Journal of Australia, 155,* 75-79.

Sand, T., Mellgren, S. I., & Hestnes, A. (1983). Primitive reflexes in Down's syndrome. *Journal of Mental Deficiency Research, 27 (Pt 1),* 39-44.

SAS Institute Inc. (2000). SAS Version 8.2. [computer software]. Cary, North Carolina: SAS Institute.

Saskatchewan Department of Community Resources and Employment (2005). Valleyview Center strategic plan, 2000 to 2005. In *Saskatchewan Department of Community Resources and Employment [On-line]*. Retrieved September 1, 2006 from http://www.dcre.gov.sk.ca/services/peoplewdis/StrategicPlan.pdf

Schapiro, M. B., Haxby, J. V., & Grady, C. L. (1992). Nature of mental retardation and dementia in Down syndrome: Study with PET, CT, and neuropsychology. *Neurobiology of Aging, 13,* 723-734.

Schott, J. M., Fox, N. C., & Rossor, M. N. (2002). Genetics of the dementias. *Journal of Neurology, Neurosurgery and Psychiatry, 73 Supplement 2,* II27-II31.

Schulz, R., Drayer, R. A., & Rollman, B. L. (2002). Depression as a risk factor for non-suicide mortality in the elderly. *Biological Psychiatry, 52,* 205-225.

Schupf, N. (2002). Genetic and host factors for dementia in Down's syndrome. *British Journal of Psychiatry, 180,* 405-410.

Schupf, N., Kapell, D., Lee, J. H., Zigman, W., Canto, B., Tycko, B., et al. (1996). Onset of dementia is associated with apolipoprotein E epsilon4 in Down's syndrome. *Annals of Neurology, 40,* 799-801.

Schupf, N., Kapell, D., Nightingale, B., Rodriguez, A., Tycko, B., & Mayeux, R. (1998). Earlier onset of Alzheimer disease in men with Down syndrome. *Neurology, 50,* 991-995.

Schupf, N., Pang, D., Patel, B. N., Silverman, W., Schubert, R., Lai, F., et al. (2003). Onset of dementia is associated with age at menopause in women with Down's syndrome. *Annals of Neurology, 54,* 433-438.

Schupf, N., Zigman, W., Kapell, D., Lee, J. H., Kline, J., & Levin, B. (1997). Early menopause in women with Down's syndrome. *Journal of Intellectual Disability Research, 41 (Pt 3),* 264-267.

Scott, A., March, L., & Stokes, M. L. (1998). A survey of oral health in a population of adults with developmental disabilities: comparison with a national oral health survey of the general population. *Australian Dental Journal, 43,* 257-261.

Seltzer, M. M. (1988). Structure and patterns of service utilization by elderly persons with mental retardation. *Mental Retardation, 26,* 181-185.

Seltzer, M. M., Krauss, M. W., Litchfield, L. C., & Modlish, N. J. (1989). Utilization of aging network services by elderly persons with mental retardation. *Gerontologist, 29,* 234-238.

Seshadri, S., Beiser, A., Selhub, J., Jacques, P. F., Rosenberg, I. H., D gostino, R. B., et al. (2002). Plasma homocysteine as a risk factor for dementia and Alzheimer disease. *New England Journal of Medicine, 346,* 476-483.

Shavelle, R., Strauss, D., & Day, S. (2005). Deinstitutionalization in California: mortality of persons with intellectual disabilities after transferring to community care: 1997 to 1999. *Journal of Data Science, 3,* 371-380.

Sigafoos, J., Elkins, J., Kerr, M., & Attwood, T. (1994). A survey of aggressive behaviour among a population of persons with intellectual disability in Queensland. *Journal of Intellectual Disability Research, 38 (Pt. 4),* 369-381.

Singh, N. N., Ellis, C. R., & Wechsler, H. (1997). Psychopharmacoepidemiology of mental retardation: 1966 to 1995. *Journal of Child and Adolescent Psychopharmacology, 7,* 255-266.

Sliger, M., Lander, T., & Murphy, C. (2004). Effects of the ApoE epsilon4 allele on olfactory function in Down syndrome. *Journal of Alzheimer Disease, 6,* 397-402.

Snowdon, D. A., Greiner, L. H., & Markesbery, W. R. (2000). Linguistic ability in early life and the neuropathology of Alzheimer's disease and cerebrovascular disease. Findings from the Nun Study. *Annals of the New York Academy of Sciences, 903,* 34-38.

Soininen, H., Partanen, J., Jousmaki, V., Helkala, E. L., Vanhanen, M., Majuri, S., et al. (1993). Age-related cognitive decline and electroencephalogram slowing in Down's syndrome as a model of Alzheimer's disease. *Neuroscience, 53,* 57-63.

Sperling, M. R. (2001). Sudden Unexplained Death in Epilepsy. *Epilepsy Currents., 1,* 21-23.

Spreat, S., Conroy, J. W., & Jones, J. C. (1997). Use of psychotropic medication in Oklahoma: a statewide survey. *American Journal of Mental Retardation, 102,* 80-85.

Spreat, S., & Conroy, J. (1998). Use of psychotropic medications for persons with mental retardation who live in Oklahoma nursing homes. *Psychiatric Services, 49,* 510-512.

Spreat, S., Conroy, J. W., & Fullerton, A. (2004). Statewide longitudinal survey of psychotropic medication use for persons with mental retardation: 1994 to 2000. *American Journal of Mental Retardation, 109,* 322-331.

Spreat, S., Conroy, J., & Fullerton, A. (2005). A cost-benefit analysis of community and institutional placements for persons with mental retardation in Oklahoma. *Research in Developmental Disabilities, 26,* 17-31.

SPSS. (2002). Statistical package for the social sciences-release 11.5. [computer software]. Chicago, Illinois: SPSS Corp.

Statistics Canada (2002A). Percentage of Population Who Reported Unmet Health Care Needs, by Health Region, 2000/01. In *Statistics Canada [On-line]*. Retrieved August 1, 2006

from http://www.statcan.ca/Daily/English/020508/d020508h.htm.

Statistics Canada (2002B). *Unmet health care needs associated with mental health problems, by sex, household population aged 15 and over, Canada and provinces, 2002* (Rep. No. Catalog number 82-617). Ottawa: Statistics Canada.

Steele, L. S., Glazier, R. H., & Lin, E. (2006). Inequity in mental health care under Canadian universal health coverage. *Psychiatric Services, 57,* 317-324.

Stokholm, J., Vogel, A., Gade, A., & Waldemar, G. (2005). The executive interview as a screening test for executive dysfunction in patients with mild dementia. *Journal of the American Geriatrics Society, 53,* 1577-1581.

Stone, R. K., Alvarez, W. F., Ellman, G., Hom, A. C., & White, J. F. (1989). Prevalence and prediction of psychotropic drug use in California developmental centers. *American Journal of Mental Retardation, 93,* 627-632.

Strauss, D., Ojdana, K., Shavelle, R., & Rosenbloom, L. (2004). Decline in function and life expectancy of older persons with cerebral palsy. *NeuroRehabilitation., 19,* 69-78.

Streissguth, A. P., Bookstein, F. L., Barr, H. M., Sampson, P. D., O'Malley, K., & Young, J. K. (2004). Risk factors for adverse life outcomes in fetal alcohol syndrome and fetal alcohol effects. *Journal of Developmental and Behavioral Pediatrics, 25,* 228-238.

Sutherland, G., Couch, M. A., & Iacono, T. (2002). Health issues for adults with developmental disability. *Research in Developmental Disabilities, 23,* 422-445.

Teipel, S. J., Alexander, G. E., Schapiro, M. B., Moller, H. J., Rapoport, S. I., & Hampel, H. (2004). Age-related cortical grey matter reductions in non-demented Down syndrome adults determined by MRI with voxel-based morphometry. *Brain, 127,* 811-824.

Tellez-Zenteno, J. F., Pondal-Sordo, M., Matijevic, S., & Wiebe, S. (2004). National and regional prevalence of self-reported epilepsy in Canada. *Epilepsia, 45,* 1623-1629.

Thase, M. E., Liss, L., Smeltzer, D., & Maloon, J. (1982). Clinical evaluation of dementia in Down syndrome: A preliminary report. *Journal of Mental Deficiency Research, 26 (Pt 4),* 239-244.

Thase, M. E., Tigner, R., Smeltzer, D. J., & Liss, L. (1984). Age-related neuropsychological deficits in Down's syndrome. *Biological Psychiatry, 19,* 571-585.

Thinn, K., Clarke, D. J., & Corbett, J. A. (1990). Psychotropic drugs and mental retardation: 2. A comparison of psychoactive drug use before and after discharge from hospital to community. *Journal of Mental Deficiency Research, 34 (Pt. 5),* 397-407.

Thompson, S. B. N. (2003). Rate of decline in social and cognitive abilities in dementing individuals with Down syndrome and other learning disabilities. *Clinical Gerontologist, 26,* 145-153.

Tjepkema, M. (2005). *Adult obesity in Canada: Measured height and weight* (Rep. No. 82-620-MWE2005001). Ottawa, Canada: Statistics Canada.

Tsiouris, J. A., & Brown, W. T. (2004). Neuropsychiatric symptoms of fragile X syndrome: Pathophysiology and pharmacotherapy. *CNS Drugs, 18,* 687-703.

Tunbridge, W. M., Evered, D. C., Hall, R., Appleton, D., Brewis, M., Clark, F., et al. (1977). The spectrum of thyroid disease in a community: The Whickham survey. *Clinical Endocrinology (Oxford), 7,* 481-493.

Tyrrell, J., Cosgrave, M., McCarron, M., McPherson, J., Calvert, J., Kelly, A. et al. (2001). Dementia in people with Down syndrome. *International Journal of Geriatric Psychiatry,*

16, 1168-1174.

van Allen, M. I., Fung, J., & Jurenka, S. B. (1999). Health care concerns and guidelines for adults with Down syndrome. *American Journal of Medical Genetics, 89,* 100-110.

Van Buggenhout, G. J., Trommelen, J. C., Schoenmaker, A., De Bal, C., Verbeek, J. J., Smeets, D. F., et al. (1999). Down syndrome in a population of elderly mentally retarded patients: Genetic-diagnostic survey and implications for medical care. *American Journal of Medical Genetics, 85,* 376-384.

van Splunder, J., Stilma, J. S., Bernsen, R. M., & Evenhuis, H. M. (2005). Prevalence of visual impairment in adults with intellectual disabilities in the Netherlands: Cross-sectional study. *Eye, 20* (9), 1004-1010.

Vanderpump, M. P., & Tunbridge, W. M. (2002). Epidemiology and prevention of clinical and subclinical hypothyroidism. *Thyroid, 12,* 839-847.

Vasiliadis, H. M., Lesage, A., Adair, C., & Boyer, R. (2005). Service use for mental health reasons: Cross-provincial differences in rates, determinants, and equity of access. *Canadian Journal of Psychiatry, 50,* 614-619.

Velez, L., & Selwa, L. M. (2003). Seizure disorders in the elderly. *American Family Physician, 67,* 325-332.

Verghese, J., Lipton, R. B., Katz, M. J., Hall, C. B., Derby, C. A., Kuslansky, G., et al. (2003). Leisure activities and the risk of dementia in the elderly. *New England Journal of Medicine, 348,* 2508-2516.

Vieregge, P., Ziemens, G., Freudenberg, M., Piosinski, A., Muysers, A., & Schulze, B. (1991). Extrapyramidal features in advanced Down's syndrome: Clinical evaluation and

family history. *Journal of Neurology, Neurosurgery and Psychiatry, 54,* 34-38.

Wallace, R. A., Schluter, P. J., Duff, M., Ouellette-Kuntz, H., Webb, P. M., & Scheepers, M. (2004). Review of the risk factors for, consequences, diagnosis, and management of helicobacter pylori in adults with intellectual disabilities. *Journal of Policy and Practice in Intellectual Disabilities, 1,* 147-163.

Wechsler, D. A. (1974). *Wechsler Intelligence Scale for Children-Revised*. New York: Psychological Corporation.

White, P., Chant, D., Edwards, N., Townsend, C., & Waghorn, G. (2005). Prevalence of intellectual disability and comorbid mental illness in an Australian community sample. *Australian and New Zealand Journal of Psychiatry, 39,* 395-400.

Wilson, R. S., Bennett, D. A., Bienias, J. L., Aggarwal, N. T., Mendes de Leon, C. F., Morris, M. C., et al. (2002). Cognitive activity and incident AD in a population-based sample of older persons. *Neurology, 59,* 1910-1914.

Wishart, J. (1938). Growth rate determinations and nutrition studies with the bacon pig and their analysis. *Biometrika, 30,* 16-28.

Wisniewski, K. E., Dalton, A. J., McLachlan, C., Wen, G. Y., & Wisniewski, H. M. (1985). Alzheimer's disease in Down's syndrome: Clinicopathologic studies. *Neurology, 35,* 957-961.

Wisniewski, K. E., & Hill, A. L. (1985). Clinical aspects of dementia in mental retardation and developmental disabilities. In M.P.Janicki & H. M. Wisniewski (Eds.), *Aging and developmental disabilities* (pp. 195-207). Baltimore: Paul H. Brooks.

Wisniewski, K., Howe, J., Williams, D. G., & Wisniewski, H. M. (1978). Precocious aging and dementia in patients with Down's syndrome. *Biological Psychiatry, 13,* 619-627.

Wisniewski, K. E., Wisniewski, H. M., & Wen, G. Y. (1985). Occurrence of neuropathological changes and dementia of Alzheimer s disease in Down syndrome. *Annals of Neurology, 17,* 278-282.

World Health Organization. (1992). *ICD-10 international statistical classification of diseases and related health problems. 10th revision*. Geneva: World Health Organization.

World Health Organization. (1993). *The ICD-10 classification of mental and behavioral disorders. Diagnostic criteria for research*. Geneva: World Health Organization.

World Medical Association (2000). World Medical Association declaration of Helsinki: Ethical principles for medical research involving human subjects. *Journal of the American Medical Association, 284,* 3043-3045.

Wulsin, L. R., Vaillant, G. E., & Wells, V. E. (1999). A systematic review of the mortality of depression. *Psychosomatic Medicine, 61,* 6-17.

Yesavage, J. A., Brooks, J. O., III, Taylor, J., & Tinklenberg, J. (1993). Development of aphasia, apraxia, and agnosia and decline in Alzheimer disease. *American Journal of Psychiatry, 150,* 742-747.

Zeger, S. L., & Liang, K. Y. (1986). Longitudinal data analysis for discrete and continuous outcomes. *Biometrics, 42,* 121-130.

Zigman, W., Schupf, N., Haveman, M., & Silverman, W. (1997). The epidemiology of Alzheimer disease in intellectual disability: Results and recommendations from an international conference. *Journal of Intellectual Disability Research, 41 (Pt 1),* 76-80.

Zigman, W. B., Schupf, N., Lubin, R. A., & Silverman, W. P. (1987). Premature regression of adults with Down syndrome. *American Journal of Mental Deficiency, 92,* 161-168.

Zigman, W. B., Schupf, N., Devenny, D. A., Miezejeski, C., Ryan, R., Urv, T. K., et al. (2004). Incidence and prevalence of dementia in elderly adults with mental retardation without Down Syndrome. *American Journal of Mental Retardation, 109,* 126-141.

Zucco, G. M., & Negrin, N. S. (1994). Olfactory deficits in Down subjects: A link with Alzheimer disease. *Perceptual and Motor Skills, 78,* 627-631.

APPENDIX A. ETHICS APPROVALS

A-1. Ethics approval May 8, 1992

UNIVERSITY ADVISORY COMMITTEE ON ETHICS IN HUMAN EXPERIMENTATION
(Medical Sciences)

NAME AND E.C.#: Lillian Thorpe 92-63
Department of Psychiatry

DATE: May 8, 1992

Your study entitled "Cognitive and Functional Deterioration in Down's Syndrome" has been approved by the University Advisory Committee on Ethics in Human Experimentation (Medical Sciences).

1. Therefore you are free to proceed with the project subject to the following conditions:

APPROVED

2. Any significant changes to your protocol should be reported to the Director of Research Services, Room 210, Kirk Hall, for Committee consideration in advance of its implementation.

DR. MICHAEL OWEN
Director of Research Services
University of Saskatchewan

for E.A. McKenna
Chair
University Advisory Committee on Ethics in Human Experimentation

cc: Royal University Hospital

A-2. Ethics approval November 27, 1997

University of Saskatchewan
Advisory Committee on Ethics in Human Experimentation

November 27, 1997

Certificate of Approval

PRINCIPAL INVESTIGATOR	DEPARTMENT	EC #
L. Thorpe	Psychiatry	97-201

INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT

CO-INVESTIGATORS

SPONSORING AGENCIES

Saskatchewan Health Care Association Externship Program

TITLE:

Intellectual Disabilities and Aging Longitudinal Study

APPROVAL DATE	TERM (YEARS)	AMENDED:	MODIFICATION OF:
November 27, 1997	3	November 26, 1997	Title Change

CERTIFICATION:

The protocol and consent form for the above-named project have been reviewed by the Committee and the experimental procedures were found to be acceptable on ethical grounds for research involving human subjects.

APPROVED.

H.E. Emson MA MD FRCPC
Acting Chair
University Advisory Committee on
Ethics in Human Experimentation

This Certificate of Approval is valid for the above term provided there is no change in the experimental procedures, subject to annual reapproval.

Please send all correspondence to:

Office of Research Services
University of Saskatchewan
Room 210 Kirk Hall, 117 Science Place
Saskatoon, SK S7N 5C8

A-3. Ethics approval September 30, 2005

September 30, 2005

Dr. L. Thorpe,
Geriatric Assessment Program,
Saskatoon City Hospital,
701 Queen Street, Saskatoon, S7K 0M7

Dear Dr. Thorpe,

The Biomedical Research Ethics Board met September 7 and reviewed your submission for use of the data collected in 2001 under protocol (EC#97-201) whose Certificate of Ethics Approval lapsed November 26, 2000.

You received approval in November 27, 1997 for 3 years for a longitudinal study on intellectual disabilities and aging. The study was minimal risk to participants being primarily data collection on medical condition, physical and emotional functioning abilities and general quality of life. There was a one-time blood sample collection for an immunological sub-study. The consent form included a statement that participants could be contacted again in the future. The statement read "There are no risks or side effects from participating in the study, but, participants may be contacted again in the future to look at further changes in their functioning". The statement was open-ended without a time limit. You collected four waves of data, three prior to November 27, 2000 and one in 2001 (after the ethics approval expired) but on the same participants that previously consented to the follow-ups. No new participants were added after November 26, 2000.

The protocol, inclusive of your letter to the Chair (dated July 12, 2005) explaining the situation, was discussed by the REB at a full board meeting September 7, 2005. The REB agreed to grant permission to the use of the data collected in 2001 for the research purposes to which they were collected.

The REB's decision was based on the following rationale: (1) The REB accepts your explanations for the lapse in your ethics approval; (2) the lapse is of an administrative nature rather than an ethical one; (3) the REB viewed the data collected in 2001 as an extension of the original study, for which consent was obtained; (4) the original consent included a statement about the possibility of follow-ups; and (5), the administrative monitoring for current Ethics approval was not in place in 2001. The REB currently provides a service reminding investigators of the status of the Certificate of Approval but this service was not in place in 2001.

Associate Vice-President Research, Office of the Vice-President Research, University of Saskatchewan
Box 5000 RPO University, 110 Gymnasium Place, Saskatoon SK S7N 4J8 Canada
Telephone: (306) 966-1615 Facsimile: (306) 966-4737
http://www.usask.ca/vpresearch

Please be advised that it is the Principal Investigator's responsibility to ensure that their research project(s) maintain current ethics approval.

If you have any questions or concerns, please do not hesitate to contact me.

Best regards,

M. Desautels, Ph.D.
Chair,
Biomedical Research Ethics Board,
University of Saskatchewan.

MD/bjk

A-4. Ethics approval Mar 22, 2006

University of Saskatchewan
Biomedical Research Ethics Board (Bio-REB)

22-Mar-2006

Certificate of Approval

PRINCIPAL INVESTIGATOR
Lillian Thorpe

DEPARTMENT
Psychiatry

BMC#
97-201

INSTITUTION(S) WHERE RESEARCH WILL BE CONDUCTED (STUDY SITE)
Royal University Hospital
103 Hospital Drive
Saskatoon SK S7N 0W8

SPONSORING AGENCIES
SASKATCHEWAN HEALTH

TITLE
Intellectual Disabilities and Aging Longitudinal Study

ORIGINAL APPROVAL DATE	ORIGINAL EXPIRY DATE	CURRENT APPROVAL	CURRENT EXPIRY DATE
27-Nov-1997	27-Nov-2000	22-Mar-2006	01-Mar-2007

APPROVAL OF
Researcher's Summary, version 15-Feb-2006
Participant Information and Consent Form, version 15-Feb-2006
Substitute Decision Maker Information and Consent Form, version 15-Feb-2006

CERTIFICATION

The University of Saskatchewan Biomedical Research Ethics Board (Bio-REB) has reviewed the above-named research project at a full-board meeting (any research classified as minimal risk is reviewed through the expedited review process). The proposal was found to be acceptable on ethical grounds. The principal investigator has the responsibility for any other administrative or regulatory approvals that may pertain to this research project, and for ensuring that the authorized research is carried out according to governing law. This Certificate of Approval is valid for the above time period provided there is no change in experimental protocol or consent process or documents.

ONGOING REVIEW REQUIREMENTS / REB ATTESTATION

In order to receive annual renewal, a status report must be submitted to the Chair for Committee consideration within one month of the current expiry date each year the study remains open, and upon study completion. Please refer to the following website for further instructions: http://www.usask.ca/research/ethics.shtml. In respect to clinical trials, the University of Saskatchewan Research Ethics Board complies with the membership requirements for Research Ethics Boards defined in Division 5 of the Food and Drug Regulations and carries out its functions in a manner consistent with Good Clinical Practices. This approval and the views of this REB have been documented in writing.

APPROVED.

Michel Desautels, Ph.D., Chair
University of Saskatchewan
Biomedical Research Ethics Board

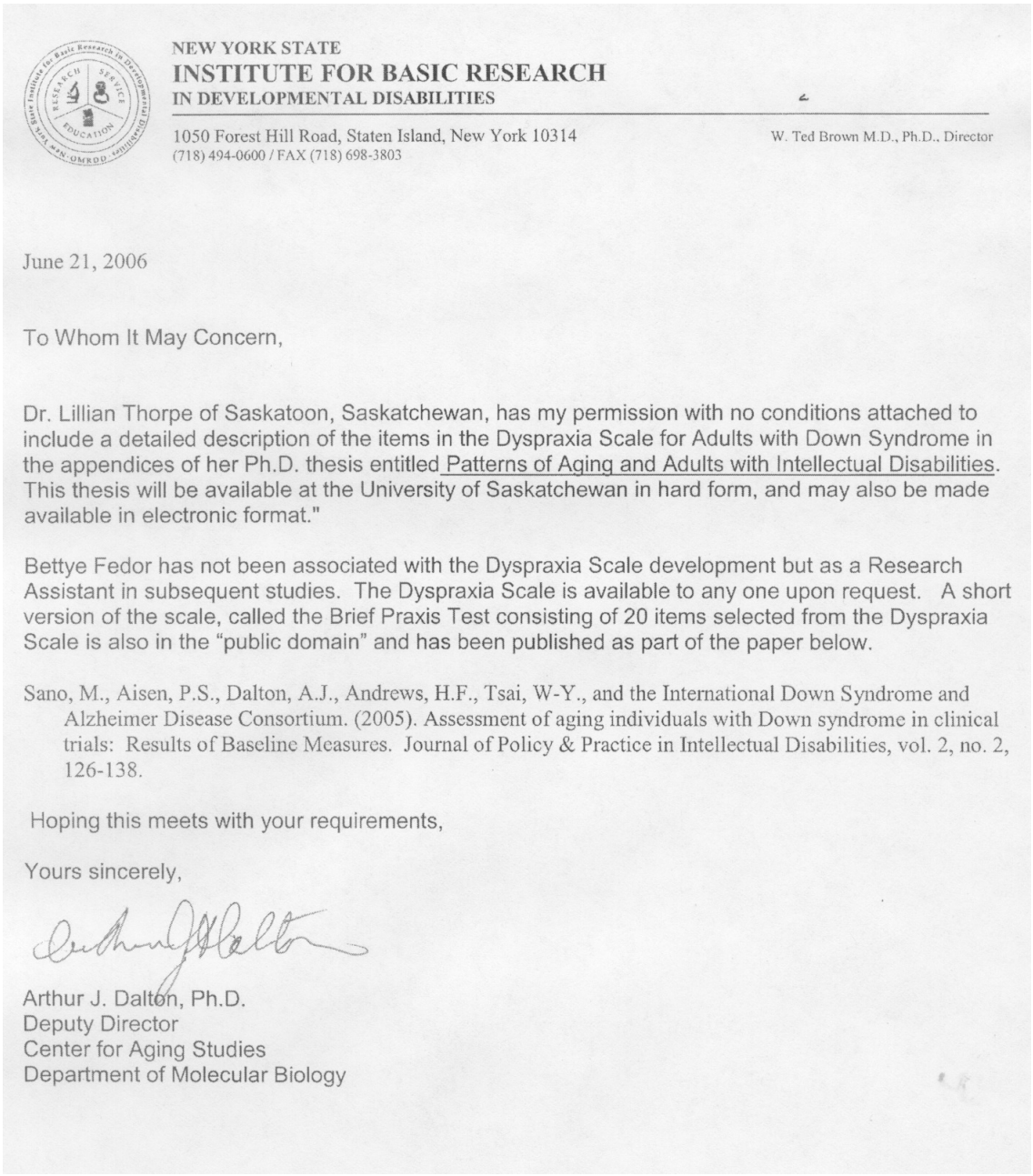
APPENDIX B. ADDITIONAL INFORMATION ABOUT INSTRUMENTS

B.1 Items from the three parts of the Dyspraxia Scale for Adults with Down Syndrome

Part 1: Psychomotor skills	Part 2: Apraxia	Part 3: Body Parts/Coin Task
walking	make a fist	point to your ear
standing	salute	point to your nose
look up	wave goodbye	point to your eye
bend your head	scratch your head	point to your chest
bow from the waist	snap your fingers	point to your neck
clap hands	close your eyes	point to your chain
lift one arm	sniff a flower	point to your thumb
lift other arm	use a comb	point your ring finger
turn head to one side	use a toothbrush	point to your index finger
turn head to the other side	use a spoon	point to your little finger
lift one leg	use a hammer	point to your middle finger
lift the other leg	use the key	point to your right ear
sitting	open a jar	point to your right shoulder
draw a circle	close a jar	point to your left knee
draw a straight line	put on right glove	point to your left ankle
clip two sheets	put on left glove	point to your right wrist
cut paper sheet	unlock padlock	point to your left elbow
three coins (one hand)	lock padlock	point to your right knee
coins (other hand)	fold a sheet of paper	give me a penny
put on cap/take off	fold sheet again	give me a nickel
		give me a quarter
		give me a dime

Adapted from: Dalton AJ, Fedor BL. DYSPRAXIA Scale for Adults with Down Syndrome. Available from NYS Institute for Basic Research in Developmental Disabilities, 1050 Forest Hill Road, Staten Island, NY 10314, USA 1997.; http:/ / daltonaj@aol.com

B.2 Permission to reproduce items from the three parts of the Dyspraxia Scale for Adults with Down Syndrome



NEW YORK STATE
INSTITUTE FOR BASIC RESEARCH
IN DEVELOPMENTAL DISABILITIES

1050 Forest Hill Road, Staten Island, New York 10314
(718) 494-0600 / FAX (718) 698-3803

W. Ted Brown M.D., Ph.D., Director

June 21, 2006

To Whom It May Concern,

Dr. Lillian Thorpe of Saskatoon, Saskatchewan, has my permission with no conditions attached to include a detailed description of the items in the Dyspraxia Scale for Adults with Down Syndrome in the appendices of her Ph.D. thesis entitled Patterns of Aging and Adults with Intellectual Disabilities. This thesis will be available at the University of Saskatchewan in hard form, and may also be made available in electronic format."

Bettye Fedor has not been associated with the Dyspraxia Scale development but as a Research Assistant in subsequent studies. The Dyspraxia Scale is available to any one upon request. A short version of the scale, called the Brief Praxis Test consisting of 20 items selected from the Dyspraxia Scale is also in the "public domain" and has been published as part of the paper below.

Sano, M., Aisen, P.S., Dalton, A.J., Andrews, H.F., Tsai, W-Y., and the International Down Syndrome and Alzheimer Disease Consortium. (2005). Assessment of aging individuals with Down syndrome in clinical trials: Results of Baseline Measures. Journal of Policy & Practice in Intellectual Disabilities, vol. 2, no. 2, 126-138.

Hoping this meets with your requirements,

Yours sincerely,

Arthur J. Dalton, Ph.D.
Deputy Director
Center for Aging Studies
Department of Molecular Biology

APPENDIX C. SUPPLEMENTARY DATA

Table C-1 Profile definition of Community Living Division Clients

Profile	Description	Profile	Description
0	-Individuals who would not likely be assigned a level of care. -May have borderline intellectual disability or developmental delay with no other characteristics identified.	3	Individual has one or more of the following characteristics: -Severe intellectual disability -Chronic mental illness -Maladaptive behavior -Major personal assistance required -Uncontrolled seizures -Moderate intellectual disability with one or more of the following: profound hearing loss, total vision loss, chronic health problems, limited communication.
1	Individual has one or more of the following characteristics: -Mild intellectual disability -Limited personal assistance required -Independent with adapted environment -Interpretation required -Borderline intellectual disability with one or more of mild hearing loss, slight vision loss, speech and language delay or impairments, restricted mobility.	4	Individual has one or more of the following characteristics: -Profound intellectual disability -Severe maladaptive behavior -Autistic characteristics -Complete or intensive dependence -Assistance with physiological functions -Deaf-blind -No communication
2	Individual has one or more of the following characteristics: -Moderate intellectual disability -Moderate personal assistance required -Mild intellectual disability with one or more of the following: profound hearing loss, total vision loss, chronic health problems, limited communication.		-Severe intellectual disability with one or more of the following: profound hearing loss, total vision loss, chronic health problems, limited communication.

Table C-2. Caregiver ratings (%) of seizure frequency at baseline.

Diagnosis	Baseline seizure frequency	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	No history of seizures	24(60)	52(70.27)	42(64.62)	43(66.15)	161(65.98)
	Seizures, but none in past year	6(15)	14(18.92)	10(15.38)	15(23.08)	45(18.44)
	Seizures, less than one per month	5(12.5)	2(2.7)	4(6.15)	5(7.69)	16(6.56)
	Seizures, 1-4 per month	3(7.5)	4(5.41)	6(9.23)	2(3.08)	15(6.15)
	Seizures, 2-6 per week	2(5)	2(2.7)	3(4.62)	0(0)	7(2.87)
	Total	40(100)	74(100)	65(100)	65(100)	244(100)
DS	No history of seizures	19(95)	38(92.68)	29(80.56)	16(84.21)	102(87.93)
	Seizures, but none in past year	1(5)	2(4.88)	4(11.11)	1(5.26)	8(6.9)
	Seizures, less than one per month	0(0)	1(2.44)	3(8.33)	1(5.26)	5(4.31)
	Seizures, 1-4 per month	0(0)	0(0)	0(0)	1(5.26)	1(0.86)
	Seizures, 2-6 per week	0(0)	0(0)	0(0)	0(0)	0(0)
	Total	20(100)	41(100)	36(100)	19(100)	116(100)

Table C-3. Caregiver ratings (%) of epilepsy at baseline.

Diagnosis	Sex	Age <30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Males	11(45.83)	11(26.19)	11(28.21)	9(24.32)	42(29.58)
	Females	4(25.00)	8(25.00)	10(38.46)	9(32.14)	31(30.39)
DS	Males	1(7.69)	1(4.55)	1(5.26)	1(10.00)	4(6.25)
	Females	0(0.00)	1(5.26)	3(17.65)	0(0.00)	4(7.69)

Table C-4. Caregiver ratings (%) of heart or blood pressure problems at baseline.

Diagnosis	Blood/-blood pressure problems	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Never	39 (97.5)	70 (94.6)	59 (90.8)	51 (78.5)	219 (89.8)
	Previously	0 (0)	0 (0)	0 (0)	4 (6.2)	4 (1.6)
	Well controlled	1 (2.5)	2 (2.7)	3 (4.6)	6 (9.2)	12 (4.9)
	Intermittently significant	0 (0)	1 (1.4)	3 (4.6)	3 (4.6)	7 (2.9)
	Currently significant	0 (0)	1 (1.4)	0 (0)	1 (1)	2 (0.8)
	Total	40(100)	74(100)	65(100)	65(100)	244(100)
DS	Never	13 (65)	29 (70.8)	24 (66.8)	12 (63.2)	78 (67.2)
	Previously	1 (5)	4 (9.8)	3 (8.3)	0 (0)	8 (6.9)
	Well controlled	4 (20)	7 (17.1)	7 (19.4)	4 (21.1)	22 (19)
	Intermittently significant	0 (0)	0 (0)	1 (2.8)	3 (15.8)	4 (3.5)
	Currently significant	2 (10)	1 (2.4)	1 (2.8)	0 (0)	4 (3.5)
	Total	20(100)	41(100)	36(100)	19(100)	116(100)

Table C-5. Caregiver ratings (%) of breathing problems at baseline.

Diagnosis	Breathing problems	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Never	38 (95.0)	69 (93.2)	63 (96.9)	58 (89.2)	228 (93.4)
	Previously	0 (0.0)	2 (2.7)	0 (.00)	0 (0.0)	2 (0.8)
	Well controlled	2 (5.0)	0 (0.0)	1 (1.5)	3 (4.6)	6 (2.5)
	Intermittently significant	0 (0.0)	2 (2.7)	1 (1.5)	1 (1.5)	4 (1.6)
	Currently significant	0 (0.0)	1 (1.4)	0 (0.0)	3 (4.6)	4 (1.6)
	Total	40(100)	74(100)	65(100)	65(100)	244(100)
DS	Never	16 (80.0)	35 (85.4)	26 (72.2)	14 (73.7)	91 (78.4)
	Previously	0 (0.0)	1 (2.4)	1 (2.8)	3 (15.8)	5 (4.3)
	Well controlled	1 (5.0)	5 (12.2)	6 (16.7)	2 (10.5)	14 (12.1)
	Intermittently significant	2 (10.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.7)
	Currently significant	1 (5.0)	0 (0.0)	3 (8.3)	0 (0.0)	4 (3.4)
	Total	20(100)	41(100)	36(100)	19(100)	116(100)

Table C-6. Caregiver ratings (%) of stomach, bowel or liver problems at baseline.

Diagnosis	Gastrointestinal problems	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Never	30 (75.0)	54 (73.0)	50 (76.9)	44 (67.7)	178 (73.0)
	Previously	1 (2.5)	4 (5.4)	0 (0.0)	6 (9.2)	11 (4.5)
	Well controlled	4 (10.0)	11 (14.9)	10 (15.4)	11 (16.9)	36 (14.8)
	Intermittently significant	3 (7.5)	2 (2.7)	3 (4.6)	1 (1.5)	9 (3.7)
	Currently significant	2 (5.0)	3 (4.1)	2 (3.1)	3 (4.6)	10 (4.1)
	Total	40(100)	74(100)	65(100)	65(100)	244(100)
DS	Never	14 (70.0)	29 (70.7)	24 (66.7)	11 (57.9)	78 (67.2)
	Previously	2 (10.0)	5 (12.2)	3 (8.3)	1 (5.3)	11 (9.5)
	Well controlled	2 (10.0)	5 (12.2)	4 (11.1)	3 (15.8)	14 (12.1)
	Intermittently significant	2 (10.0)	2 (4.9)	3 (8.3)	4 (21.1)	11 (9.5)
	Currently significant	0 (0.0)	0 (0.0)	2 (5.6)	0 (0.0)	2 (1.7)
	Total	20(100)	41(100)	36(100)	19(100)	116(100)

Table C-7. Caregiver ratings (%) of dental problems at baseline

Diagnosis	Dental problems	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Never	33 (82.5)	61 (82.4)	53 (81.5)	41 (63.1)	188 (77)
	Previously	0 (0.0)	2 (2.7)	4 (6.2)	13 (20.0)	19 (7.8)
	Well controlled	4 (10.0)	8 (10.8)	5 (7.7)	6 (9.2)	23 (9.4)
	Intermittently significant	1 (2.5)	2 (2.7)	2 (3.1)	4 (6.2)	9 (3.7)
	Currently significant	2 (5.0)	1 (1.4)	1 (1.5)	1 (1.5)	5 (2)
	Total	40(100)	74(100)	65(100)	65(100)	244(100)
DS	Never	18 (90.0)	35 (85.4)	19 (52.8)	13 (68)	85 (73.3)
	Previously	1 (5.0)	1 (2.4)	4 (11.1)	1 (5.3)	7 (6)
	Well controlled	0 (0.0)	4 (9.8)	4 (11.1)	2 (10.5)	10 (8.6)
	Intermittently significant	1 (5.0)	0 (0.0)	1 (2.8)	1 (5.3)	3 (2.6)
	Currently significant	0 (0.0)	1 (2.4)	8 (22.2)	2 (10.5)	11 (9.5)
	Total	20(100)	41(100)	36(100)	19(100)	116(100)

Table C-8. Caregiver ratings (%) of diabetes at baseline.

Diagnosis	Diabetes	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Never	39 (97.5)	71 (95.9)	63 (96.9)	60 (92.3)	233 (95.5)
	Previously	0 (0.0)	1 (1.4)	0 (0.0)	0 (0.0)	1 (0.4)
	Well controlled	0 (0.0)	1 (1.4)	0 (0.0)	2 (3.1)	3 (1.2)
	Intermittently significant	0 (0.0)	1 (1.4)	1 (1.5)	1 (1.5)	3 (1.2)
	Currently significant	1 (2.5)	0 (0.0)	1 (1.5)	2 (3.1)	4 (1.6)
	Total	40(100)	74(100)	65(100)	65(100)	244(100)
DS	Never	20 (100)	41 (100)	35 (97.2)	19 (100.0)	115 (99.1)
	Previously	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Well controlled	0 (0.0)	0 (0.0)	1 (2.8)	0 (0.0)	1 (0.9)
	Intermittently significant	0 (0.0)	0 (0.0)	0 (0)	0 (0.0)	0 (0.0)
	Currently significant	0 (0.0)	0 (0.0)	0 (0.0)	0 (0)	0 (0)
	Total	20(100)	41(100)	36(100)	19(100)	116(100)

Table C-9. Caregiver ratings (%) of thyroid problems at baseline

Diagnosis	Thyroid problems	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Never	39 (97.5)	74 (100.0)	57 (87.7)	63 (96.9)	233 (95.5)
	Previously	1 (2.5)	0 (0.0)	2 (3.1)	0 (0.0)	3 (1.2)
	Well controlled	0 (0.0)	0 (0.0)	4 (6.2)	1 (1.5)	5 (2.0)
	Intermittently significant	0 (0.0)	0 (0.0)	1 (1.5)	1 (1.5)	2 (0.8)
	Currently significant	0 (0.0)	0 (0.0)	1 (1.5)	0 (0.0)	1 (0.4)
	Total	40(100)	74(100)	65(100)	65(100)	244(100)
DS	Never	17 (85.0)	32 (78.0)	25 (69.4)	11 (57.9)	85 (73.3)
	Previously	0 (0.0)	1 (2.4)	1 (2.8)	0 (0.0)	2 (1.7)
	Well controlled	1 (5.0)	6 (14.6)	9 (25.0)	7 (36.8)	23 (19.8)
	Intermittently significant	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.3)	1 (0.9)
	Currently significant	2 (10.0)	2 (4.9)	1 (2.8)	0 (0.0)	5 (4.3)
	Total	20(100)	41(100)	36(100)	19(100)	116(100)

Table C-10. Caregiver ratings (%) of visual problems at baseline.

Diagnosis	Visual problems	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Never	29 (72.5)	45 (60.8)	41 (63.1)	32 (49.2)	147 (60.2)
	Previously	1 (2.5)	2 (2.7)	2 (3.1)	6 (9.2)	11 (4.5)
	Well controlled	6 (15)	21 (28.4)	17 (26.2)	21 (32.3)	65 (26.6)
	Intermittently significant	0 (0)	1 (1.4)	2 (3.1)	1 (1.5)	4 (1.6)
	Currently significant	4 (10)	5 (6.8)	3 (4.6)	5 (7.7)	17 (7)
	Total	40(100)	74(100)	65(100)	65(100)	244(100)
DS	Never	10 (50)	18 (43.9)	16 (44.4)	5 (26.3)	49 (42.2)
	Previously	1 (5)	7 (17.1)	4 (11.1)	2 (10.5)	14 (12.1)
	Well controlled	8 (40)	12 (29.3)	11 (30.6)	5 (26.3)	36 (31)
	Intermittently significant	0 (0)	2 (4.9)	0 (0.0)	4 (21.1)	6 (5.2)
	Currently significant	1 (5)	2 (4.9)	5 (13.9)	3 (15.8)	11 (9.5)
	Total	20(100)	41(100)	36(100)	19(100)	116(100)

Table C-11. Caregiver ratings (%) of hearing problems at baseline.

Diagnosis	Hearing problems	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Never	40 (100.0)	68 (91.9)	60 (92.3)	53 (81.5)	221 (90.6)
	Previously	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
	Well controlled	0 (0.0)	2 (2.7)	2 (3.1)	8 (12.3)	12 (4.9)
	Intermittently significant	0 (0)	0 (0.0)	2 (3.1)	0 (0.0)	2 (0.8)
	Currently significant	0 (0.0)	4 (5.4)	1 (1.5)	4 (6.2)	9 (3.7)
	Total	40(100)	74(100)	65(100)	65(100)	244(100)
DS	Never	15(75.0)	36 (87.8)	27 (75)	10 (52.6)	88 (75.9)
	Previously	1 (5.0)	0 (0.0)	1 (2.8)	0 (0.0)	2 (1.7)
	Well controlled	4 (20.0)	3 (7.3)	4 (11.1)	3 (16)	14 (12.1)
	Intermittently significant	0 (0.0)	1 (2.4)	2 (5.6)	1 (5.3)	4 (3.4)
	Currently significant	0 (0.0)	1 (2.4)	2 (5.6)	5 (26.3)	8 (6.9)
	Total	20(100)	41(100)	36(100)	19(100)	116(100)

Table C-12. Caregiver ratings (%) of "other" problems at baseline

Diagnosis	Other problems	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Never	28 (70)	51 (68.9)	44 (67.7)	39 (60.0)	162 (66.4)
	Previously	0 (0.0)	3 (4.1)	0 (0.0)	0 (0.0)	3 (1.2)
	Well controlled	6 (15.4)	5 (6.8)	5 (7.8)	7 (10.8)	23 (9.5)
	Intermittently significant	0 (0.0)	3 (4.1)	6 (9.4)	5 (7.7)	14 (5.8)
	Currently significant	6 (15.4)	12 (16.2)	10 (15.6)	14 (21.5)	42 (17.4)
	Total	40(100)	74(100)	65(100)	65(100)	244(100)
DS	Never	12 (60.0)	27 (65.9)	18 (50.0)	9 (47.4)	66 (56.9)
	Previously	1 (5.0)	2 (4.9)	1 (2.8)	0 (0.0)	4 (3.4)
	Well controlled	4 (20.0)	8 (19.5)	8 (22.2)	2 (10.5)	22 (19.0)
	Intermittently significant	1 (5.0)	1 (2.4)	1 (2.8)	3 (15.8)	6 (5.2)
	Currently significant	2 (10.0)	3 (7.3)	8 (22.2)	5 (26)	18 (15.5)
	Total	20(100)	41(100)	36(100)	19(100)	116(100)

Table C-13. Caregiver ratings (%) of nervous or psychiatric problems at baseline.

Diagnosis	Nervous/psychiatric problems	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Never	26 (65.0)	39 (52.7)	38 (58.5)	32 (49.2)	135 (55.3)
	Previously	1 (2.5)	4 (5.4)	4 (6.2)	4 (6.2)	13 (5.3)
	Well controlled	4 (10.0)	12 (16.2)	6 (9.2)	7 (10.8)	29 (11.9)
	Intermittently significant	1 (2.5)	4 (5.4)	8 (12.3)	11 (16.9)	24 (9.8)
	Currently significant	8 (20.0)	15 (20.3)	9 (13.8)	11 (16.9)	43 (17.6)
	Total	40(100)	74(100)	65(100)	65(100)	244(100)
DS	Never	18 (90.0)	32 (78.0)	21 (58.3)	12 (63.2)	83 (71.6)
	Previously	1 (5.0)	3 (7.3)	2 (5.6)	1 (5.3)	7 (6.0)
	Well controlled	0 (0)	3 (7.3)	2 (5.6)	0 (0.0)	5 (4.3)
	Intermittently significant	0 (0.0)	2 (4.9)	6 (16.7)	0 (0.0)	8 (6.9)
	Currently significant	1 (5.0)	1 (2.4)	5 (13.9)	6 (32)	13 (11.2)
	Total	20(100)	41(100)	36(100)	19(100)	116(100)

Table C-14. Participants (%) who saw a psychiatrist within five years of the baseline visit

Diagnosis	Psychiatric visit	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	Yes	15 (37.5)	23 (31.1)	14 (21.5)	16 (24.6)	68 (27.9)
DS	Yes	2 (10.0)	6 (14.6)	8 (22.2)	8 (42.1)	24 (20.7)

Table C-15. Participants (%) with physical problems at baseline that were difficult to deal with.

Diagnosis	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	8 (20)	8 (10.8)	4 (6.2)	6 (9.2)	26 (10.7)
DS	1 (5)	2 (4.9)	4 (11.1)	4 (21.1)	11 (9.5)
All	9 (15)	10 (8.7)	8 (7.9)	10 (11.9)	37 (10.3)

Table C-16. Participants (%) with physical problems that were difficult to deal with (Waves 1-4)

Diagnosis	Wave	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	1995	4 (14.8)	6 (11.5)	4 (7.5)	6 (11.8)	20 (10.9)
	1997	6 (19.4)	9 (14.8)	4 (6.1)	6 (9.4)	25 (11.3)
	1999	4 (18.2)	4 (6.8)	5 (7.5)	8 (10.3)	21 (9.3)
	2001	4 (26.7)	2 (3.7)	3 (4.4)	8 (9.5)	17 (7.7)
DS	1995	1 (8.3)	2 (7.7)	3 (15.8)	3 (33.3)	9 (13.6)
	1997	0 (0)	0 (0)	2 (5.6)	2 (11.1)	4 (3.7)
	1999	1 (7.7)	0 (0)	3 (6.7)	2 (8.7)	6 (5.5)
	2001	0 (0)	0 (0)	1 (2.1)	1 (4)	2 (1.9)

Table C-17. Participants (%) with mental/emotional problems at baseline that were difficult to deal with.

Diagnosis	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	11 (27.5)	23 (31.1)	17 (26.2)	17 (26.2)	68 (27.9)
DS	2 (10)	1 (2.4)	9 (25)	7 (36.8)	19 (16.4)
All	13 (21.8)	24 (20.9)	26 (25.7)	24 (28.6)	87 (24.2)

Table C-18. Participants (%) with mental/emotional problems that were difficult to deal with(Waves 1-4)

Diagnosis	Wave	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	1995	9 (33.3)	18 (34.6)	15 (28.3)	15 (29.4)	57 (31.1)
	1997	8 (25.8)	17 (27.9)	11 (16.7)	11 (17.2)	47 (21.2)
	1999	2 (9.1)	14 (23.7)	9 (13.4)	14 (18)	39 (17.3)
	2001	2 (13.3)	8 (14.8)	15 (22.1)	16 (19)	41 (18.6)
DS	1995	2 (16.7)	1 (3.8)	5 (26.3)	5 (55.6)	13 (19.7)
	1997	0 (0)	3 (8.3)	6 (16.7)	2 (11.1)	11 (10.2)
	1999	0 (0)	1 (3.4)	6 (13.3)	5 (21.7)	12 (10.9)
	2001	2 (28.6)	1 (4.3)	4 (8.3)	3 (12)	10 (9.7)

Table C-19. Participants (%) at baseline with increased aging related care difficulty.

Diagnosis	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	0 (0)	5 (6.76)	8 (12.31)	20 (30.77)	33 (13.52)
DS	1 (5)	5 (12.2)	7 (19.44)	9 (47.37)	22 (18.97)
All	1 (1.67)	10 (8.7)	15 (14.85)	29 (34.52)	55 (15.28)

Table C-20. Participants (%) 50+ with increased aging related care difficulty.

Diagnosis	1995	1997	1999	2001
Non-DS	16 (31.4)	15 (23.4)	30 (38.5)	24 (28.6)
DS	5 (55.6)	7 (38.9)	10 (43.5)	12 (48)
All	21 (35)	22 (26.8)	40 (39.6)	36 (33)

Table C-21. Participants (%) at baseline using an aging service.

Diagnosis	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	0 (0)	1 (1.4)	3 (4.6)	19 (29.2)	23 (9.4)
DS	0 (0)	1 (2.4)	1 (2.8)	5 (26.3)	7 (6)
All	0 (0)	2 (1.7)	4 (4)	24 (28.6)	30 (8.3)

Table C-22. Participants (%) 50 + using an aging service.

Diagnosis	1995	1997	1999	2001
Non-DS	15 (29.4)	13 (20.3)	14 (17.9)	18 (21.4)
DS	3 (33.3)	4 (22.2)	4 (17.4)	5 (20)
All	18 (30)	17 (20.7)	18 (17.8)	23 (21.1)

Table C-23. Participants (%) who used either specialized or generic aging services at baseline.

Diagnosis	Age<30	Age 30-39	Age 40-49	Age 50+	All ages
Non-DS	0 (0)	0 (0)	1 (1.5)	14 (21.5)	15 (6.1)
	0 (0)	1 (1.3)	2 (3.1)	5 (7.7)	8 (3.3)
DS	0 (0)	1 (2.4)	0 (0)	2 (10.5)	3 (2.6)
	0 (0)	0 (0)	1 (2.8)	3 (15.8)	4 (3.4)
All	0 (0)	1 (0.87)	1 (0.99)	16 (19)	18 (5)
	0 (0)	1 (0.87)	3 (3)	8 (9.5)	12 (3.3)

Table C-24. Participants (%) 50+ using a specific aging service

Diagnosis	Use of specific aging service	1995	1997	1999	2001
Non-DS	Specialized	10 (19.6)	12 (18.8)	9 (11.5)	8 (9.5)
	Generic	5 (9.8)	1 (1.6)	5 (6.4)	10 (11.9)
	Any	15 (29.4)	13 (20.3)	14 (17.9)	18 (21.4)
DS	Specialized	1 (11.1)	2 (11.1)	3 (13)	3 (12)
	Generic	2 (22.2)	2 (11.1)	1 (4.3)	2 (8)
	Any	3 (33.3)	4 (22.2)	4 (17.4)	5 (20)
All	Specialized	11 (18.3)	14 (17.1)	12 (11.9)	11 (10.1)
	Generic	7 (11.7)	3 (3.7)	6 (5.9)	12 (11)
	Any	18 (30)	17 (20.7)	18 (17.8)	23 (21.1)

Table C-25. Unadjusted hazards ratio (HR), or odds of dying by the end of the study period.

Parameter	P value	HR	95% CI for HR
Down syndrome diagnosis	0.29	1.4	0.75-2.60
Age in units of ten years (at baseline)	0	1.818	1.48-2.23
Sex (reference category female)	0.031	2.184	1.08-4.43
New Seizure during study	0.085	2.167	0.90-5.22
Epilepsy (baseline)	0.78	0.901	0.43-1.88
DMR-Short term memory deficits (baseline)	0.003	1.094	1.03-1.16
DMR-Long term memory deficits (baseline)	0.034	1.073	1.01-1.15
DMR-Spatial-temporal orientation deficits (baseline)	0.009	1.091	1.02-1.17
DMR- Speech deficits (baseline)	0.11	1.119	0.98-1.28
DMR- Mood problems (baseline)	0.001	1.24	1.09-1.40
DMR- Activity and interest deficits (baseline)	0.001	1.16	1.06-1.26
DMR- Behavioural disturbance (baseline)	0.001	1.22	1.08-1.37
DMR- Practical skills deficits(baseline)	0.001	1.11	1.04-1.17
Antipsychotic medication (baseline)	0.372	1.338	0.71-2.53
Antidepressant medication (baseline)	0.954	1.026	0.43-2.43
Anticonvulsant medication (baseline)	0.53	1.23	0.65-2.32
Thyroid medication (baseline)	0.462	1.382	0.58-3.28

VITA

Lilian Thorpe is a geriatric psychiatrist and professor of psychiatry (clinical) at the University of Saskatchewan. She obtained degrees in mathematics and physics before her MD degree in Toronto, which preceded her psychiatry training in Saskatoon. She completed her term as vice president of the Canadian Academy of Geriatric Psychiatry in 2003 but remains the Chair of the Section on Geriatric Psychiatry of the Canadian Psychiatric Association. Lilian Thorpe was a member of the Canadian Consensus Conference on Dementia in 1998-9 that developed the published dementia guidelines, and again participated in Spring 2006 in updating these guidelines. She also was a member of the national CanMat group developing with the CPA guidelines for psychiatrists for the treatment of depression committee (Lilian Thorpe coordinated the section on special populations).

Lilian Thorpe practices clinically in conjunction with Clinical Gerontology, Saskatoon Health Region, at Saskatoon City Hospital. She does active nursing home and community living outreach as well as outpatient and inpatient consultations, and works with many patients with cognitive impairment: early or late onset. Her special research interest is in aging of adults with intellectual disabilities. Ethical issues related to reduced competence are another major interest.

Lilian Thorpe has been involved in many medication research studies over the years, including medications for the treatment of dementia. Current research work largely centers on analysis of a ten-year provincial population study of the progression of cognitive, affective, functional and quality of life changes with aging in people with intellectual disabilities. Related to this is international work with the World Health Organization, preparing treatment guidelines for aging people with intellectual disabilities. In active progress is a three-year international study of vitamin E in aging adults with Down syndrome, and Saskatoon is one of the few Canadian sites in this study.

In September 2000 Lilian Thorpe changed her full-time academic position with the University of Saskatchewan to part-time, to facilitate graduate work in Community Health and Epidemiology. She has continued active clinical, research and teaching activities during this time.