# THE EFFECTS OF OTITIS MEDIA TREATED WITH VENTILATING TUBES ON THE DEVELOPMENT OF PRESCHOOLERS

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**Declaration**

I, Jennifer Ann McGuirk, declare that this research report is my own work. It is being submitted for the degree of Master of Science in Occupational Therapy in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

…… (Signature of Candidate)

day of 2011

**Abstract**

The effects of Otitis Media (OM) on the development of preschoolers are not fully known. This record review compared the Miller Assessment for Preschoolers (MAP) results of preschoolers with a history of OM treated with Ventilating Tubes (VTs) to preschoolers with no history of OM or VTs to investigate differences. No statistically significant differences were found, but the OM group were clinically more at risk for verbal delays. Children with a history of OM who are suspected of having developmental delays should be referred for an Occupational Therapy (OT) assessment. Occupational Therapists (OTs) consider the effects of OM and other risk factors for developmental delay holistically by looking at client factors, environments, performance skills and occupations. They can then intervene at all these different levels to maximise health and participation in life.

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## Definition of Terms

**Child Development**: A collection of processes that allow children to evolve and mature. Each of these follows a relatively predictable pattern and has its own milestones that serve to denote achievement (1).

**Complex Skills**: Combining sensory-motor and cognitive skills for the interpretation of visual-spatial information (2).

**Developmental delay**: A obstruction of maturation evident by a child performing significantly below their peers in one or more of sensory-motor, psycho-social, cognitive or adaptive behaviours (1).

**Fine Motor Skills**: The co-ordination of the small muscles of the hand to produce the refined movements required for tasks such as buttoning, drawing and writing (2).

**Gross Motor Skills**: The co-ordination of large muscle groups to produce whole body movements such as rolling, sitting, crawling and walking (2).

**Meringotomy**: A surgical procedure used to treat Otitis Media (OM). A tiny incision is created in the eardrum, so as to relieve pressure caused by the excessive build-up of fluid (3).

**Motor Co-ordination**: Learnt series of movements that combine to produce a smooth efficient action. These include gross motor, fine motor and oral motor skills (2).

**Neurological Foundations**: Postural development and sensory discrimination of the vestibular, proprioceptive and tactile sensory modalities (2).

**Non-Verbal Cognition**: The ability to process information and apply knowledge using memory, sequencing, visualisation and mental manipulations not requiring spoken language (2).

**Oral Motor Skills**: The discrete functions of the tongue, lips and mouth for speech production.(2)

**Otitis Media**: The presence of effusion (or fluid) in the middle ear. It can occur with, or without, a bacterial or viral infection (4).

**Prevalence**: The percentage of a total population who have a particular health-related condition (5).

**Proprioceptive Sense**: The sense which provides information about the orientation of the body or body parts in space, the rate and timing of movements, the amount of force exerted by muscles, and how much and how fast a muscle is being stretched. Muscle afferents and joint receptors are proprioceptive receptors (6).

**Record Review**: A research study in which the data of interest is derived from clinical records (7).

**Sensory Integration**: The organisation of sensory input for use. It includes sensory modulation, which is enhancing or inhibiting sensory input, and sensory discrimination, which is attaching meaning to sensory input (8).

**Speech and Language Ability**: The processes associated with the production and perception of sounds used in spoken language. These include verbal memory, sequencing, comprehension, association and expression (2).

**Tactile Sense**: The sense of touch. Tactile receptors are found throughout the skin. They are activated by externally applied stimuli such as touch, pressure, pain and temperature (6).

**Ventilating Tubes**: Small tubes which are inserted into the eardrum to treat OM by allowing for fluid drainage out of the middle ear (3).

**Vestibular Sense**: The sense which has a role in the subjective awareness of body position and movement in space, postural tone and balance, and stabilisation of the eyes during head movements. The vestibular receptors are hair cells located within the semicircular canals, utricle and saccule of the vestibular labyrinth in the inner ear (6).

## Abbreviations

EBP – Evidence-Based Practice
ENT – Ear, Nose and Throat specialist
MAP – Miller Assessment for Preschoolers
MOHO – Model of Human Occupation
OM – Otitis Media
OT – Occupational Therapy / Occupational Therapist
OT-SI – Occupational Therapy using a Sensory Integration approach
SBMD – Sensory-Based Motor Disorder
SDD – Sensory Discrimination Disorder
SI – Sensory Integration
SPD – Sensory Processing Disorder
VT – Ventilating Tubes

# CHAPTER 1: INTRODUCTION

## 1.1 INTRODUCTION

Otitis Media is diagnosed due to the presence of middle ear effusion. It can occur with, or without, a bacterial or viral infection of the middle ear (4). It is one of the most common childhood conditions and is the leading cause for children in developed countries to visit the doctor, consume antibiotics and undergo surgery (9). OM is generally treated by watchful observation, antibiotics, adenoidectomy or the insertion of ventilating tubes (VTs) (4).

Studies done worldwide show a wide range of prevalence rates between 2% and 52% for OM (10). The vastness of this range can be attributed to different definitions of OM, different diagnostic methods and the fact that samples are recruited from different population groups which have different levels of exposure to risk factors for OM (11).

Studies done in Gauteng province in South Africa found prevalence rates of 53,2% and 46% (12, 13). These studies suggest that the prevalence rate of OM amongst preschoolers in Gauteng province is within the higher end of the international range. Occupational therapists (OTs) working in Johannesburg, Gauteng therefore treat a large number of children with a history of OM.

Sensory Integration (SI) is a popular treatment frame of reference used by paediatric OTs working in private practices in Johannesburg. In fact, approximately 40% of the OTs who treat children with developmental delays in private practices in Gauteng are qualified in SI (14, 15). All the private OT practices that were involved in this study use SI as their main treatment modality.

SI theory postulates that deficits in sensory processing result in developmental delays and impaired learning (8). This is relevant because episodes of OM may affect both auditory and vestibular sensory processing. The auditory processing impairment is because OM is often accompanied by mild-to-moderate hearing loss (16, 17). The effect on vestibular processing is believed to be due to Labyrinthitis, which is the most common complication of OM. Labyrinthitis is the inflammation of the inner ear and its structures, including the vestibular apparatus (18). This inflammation may impair vestibular function leading to balance disturbances (18-21).

According to SI theory, disruptions in auditory processing can affect the development of speech and language abilities and disruptions in vestibular processing can affect the development of postural mechanisms and motor co-ordination (22). This study investigated the effects of OM on sensory processing, postural mechanisms, motor co-ordination and verbal ability, as well as non-verbal cognition and complex skills.

## 1.2 STATEMENT OF THE PROBLEM

A review of the literature did not reveal any research on the effects of OM on child development in the South African context. OM is an extremely prevalent childhood condition (9, 23-26), especially in Gauteng province in South Africa where it affects approximately 50% of preschoolers (12, 13). These children may present with impaired auditory (16, 17) and vestibular (18) processing during episodes of OM. Although these sensory processing impairments are hypothesised to affect child development (8), the long-term effects of OM on child development are not definitively known. Therefore OTs working with preschoolers with a history of OM do not know if there are specific developmental delays that these children are likely to present with.

There are studies on the effects of OM on speech and language ability and vestibular functions, but other domains of development have not been included in the literature. The research is conflicting and incomplete, highlighting the need for studies such as this one. The findings of these studies are important, because they have implications for the management of chronic OM. If children with a history of recurrent OM are at risk of developmental delays, they may benefit from more aggressive medical intervention, as well as a referral to OT and/or other therapies for developmental stimulation.

## 1.3 THE AIM OF THE STUDY

The aim of the study was to establish if there are any differences between the developmental profiles of preschoolers with a history of OM treated with VTs and those with no history, who are referred to OT private practices in Johannesburg because of suspected developmental delays.

## 1.4 THE OBJECTIVES OF THE STUDY

The objectives of the study were:

- To compare the demographics of the samples of preschoolers with, and without, a history of OM treated with VTs in terms of age and gender.

- To investigate the developmental profiles of preschoolers referred to OT for developmental delay, with and without a history of OM treated with VTs, compared to normative data from the MAP.

- To compare the MAP results of preschoolers, with and without a history of OM treated with VTs, in terms of overall development and the subsections of the MAP including:
  - Neurological Foundations
  - Motor Co-ordination
  - Verbal Ability
  - Non-verbal Cognition
  - Complex Skills

# CHAPTER 2: LITERATURE REVIEW

## 2.1 INTRODUCTION

This literature review will consider OM in terms of definition, diagnosis, risk factors, prevalence and management. It will discuss the assessment and treatment of developmental delay focussing on the use of the Miller Assessment for Preschoolers (MAP) and Occupational Therapy using a Sensory Integration approach (SI-OT). It will analyse the literature on the effects of OM on preschoolers' development and occupational performance. Finally, it will examine the use of record reviews as a research procedure.

## 2.2 OTITIS MEDIA

### 2.2.1 Definition

OM is defined as the presence of effusion (or fluid) in the middle ear (4). It can occur as acute OM or OM with effusion. Acute OM is a bacterial or viral infection of the middle ear. This presents as middle ear effusion in conjunction with symptoms of inflammation in the middle ear such as otalgia (earache), otorrhoea (discharge from the ear), fever or irritability (4, 27). OM with effusion is middle ear effusion without any symptoms of inflammation. OM with effusion can occur from the outset or as a sequel to acute OM (4, 27).

### 2.2.2 Diagnosis

Pneumatic otoscopy is the main method of diagnosing OM. This involves visualisation of the tympanic membrane with an otoscope. Abnormal findings that are suggestive of OM include the presence of middle ear effusion and a tympanic membrane that is opaque, bulging, red and has reduced mobility when positive and negative pressure are applied with a pneumatic otoscope (4, 28).

Tympanometry and acoustic reflectometry are adjunctive techniques used to diagnose OM. In tympanometry, a tone of 226Hz is generated by a tympanometer into the ear canal. Some of this sound is reflected back from the tympanic membrane and measured by the tympanometer. The reflected sound is then represented as a graph called a tympanogram. A type B (or flat) tympanogram is indicative of fluid in the middle ear. Acoustic reflectometry uses an acoustic otoscope to measure reflected sound from the tympanic membrane. The absence of an ipsilateral acoustic reflex is suggestive of OM (4, 28).

### 2.2.3 Risk Factors

At least 80% of children have had one or more episodes of acute OM by the age of three years (23, 24). However, certain “OM prone” children are at risk for severe and recurrent disease (29). The risk factors for being “OM prone” relate to age, gender, socio-economic status, race, family history, underlying disease, season, child care, breast feeding and exposure to passive smoke.

Teele, Klein and Rosner followed 498 children from birth until the age of seven years in the greater Boston area in America. They found that OM occurred most frequently in infants between the ages of six to eleven months (23, 24). The fact that infants’ immune systems are still developing makes them particularly susceptible to pathogens that cause OM. Furthermore, the anatomy and physiology of their Eustachian tubes obstructs drainage from the middle ear compounding their vulnerability to OM (30).

A child who has an episode of OM during the first six months of life is likely to experience recurrent infections. On the contrary, a child who has had few or no episodes of OM by the age of three years, is unlikely to experience subsequent severe or recurrent OM, unless a predisposing factor (such as a facial fracture or acquired immune deficiency) occurs (29). The prevalence study by Teele et al in the greater Boston area also found that OM occurred more frequently in males than females (23, 24). The reasons for this are not fully understood, but it is true for most infectious diseases of childhood (29).

Numerous studies have found that low socio-economic status is an important risk factor for OM (31-34). This is due to environmental factors such as crowded living conditions, poor sanitation and inadequate medical care, which have all been associated with severe and recurrent acute OM (29). However, other studies have found that high socio-economic status is statistically associated with a higher prevalence of OM (27, 35-41). Parents with a high socio-economic status are more likely to enrol their children in child care centres increasing their risk of cross infection with acute OM (27). Higher socio-economic groups may also appear to have higher OM rates because of better access to health care, which results in increased OM detection (30).

Children from select racial groups (including Native Americans, Native Alaskans, Inuits and Australian Aboriginals) have very high prevalence rates of severe OM (11, 29, 30). The reason for this is not categorically known, but it is thought to be related to differences in Eustachian tube physiology. Poverty (resulting in overcrowding, poor sanitation and lack of access to medical care) and exposure to extreme climates may also increase the risk of developing OM in these racial groups (42). Casselbrant, Mandel, Kurs-Lasky, Rockette and Bluestone followed 198 infants from birth until two years of age in Pittsburgh in America. Their study revealed no differences in the prevalence rate of OM in black and white infants (32). They concluded that differences that were reported by other studies are likely to be based on access to medical care (32, 34).

Research has demonstrated the clustering of OM in certain families. Sibling, maternal and paternal OM history have all been shown to be independently related to a child's OM risk. Shared OM history among siblings may be the result of exposure to the same environmental factors. However, this is not likely to be the case when both parent and child have a history of OM, because they resided in different environments during infancy which is the period of highest risk (30). A study by Casselbrant, Mandel, Fall, Rockette, Kurs-Lasky, Bluestone and Ferrell in Pittsburgh in America followed 126 same-sex twin sets from birth until the age of two years. The estimated heritability of OM was 73%. This suggests a strong genetic component to OM in children (43).

Children with anatomical defects such as cleft palate are more susceptible to OM. The cleft palate interferes with the muscles responsible for opening and closing the Eustachian tube resulting in increased risk of OM. Eustachian tube dysfunction is a major risk factor for OM because of ineffective clearing of bacteria from the middle ear. Children with conditions such as chronic granulomatous disease or AIDS are also more at risk for severe and recurrent OM because of their immune deficiencies. Allergies that lead to congestion of the respiratory mucosa, obstruction of the Eustachian tube and accumulation of secretions in the middle ear are also a predisposing factor for OM (29).

The time of year is also a strong determinant of the prevalence of acute OM. OM occurs most frequently in winter and autumn because upper respiratory tract infections are more common at these times of year compared to summer and spring. Upper respiratory tract infections can cause swelling of the Eustachian tube. Fluid then accumulates in the middle ear resulting in OM (11, 29).

Child care attendance has been established by numerous researchers and confirmed by meta-analysis as another major risk factor for OM (29, 30, 44, 45). Child care brings many children together in close contact, increasing their exposure to the pathogens that cause upper respiratory tract infections and acute OM. The number of children in the setting, hours spent in child care and age at entry all contribute to the risk (27).

Bottle feeding (as opposed to breast feeding) is also a risk factor for OM. Studies have found that exclusive breast feeding for three to six months, is associated with a lowered risk of acute OM in the first year of life (24, 45). This is thought to be due to the anti-microbial and immuno-modulating properties of breast milk. Another factor is the fact that lying flat during bottle feeding, may cause milk to reflux into the middle ear, increasing the risk of OM (27).

Exposure to passive smoke has been associated with an increased incidence of acute OM and an increased duration of middle ear effusion. Recent studies have used the biochemical marker, cotinine to measure exposure to passive smoke. Cotinine is a metabolite of nicotine, so the level of cotinine in a child's blood, saliva or urine is proportional to his exposure to passive smoke. Using cotinine levels as an indicator of exposure is more reliable than parental report. High levels of cotinine have been associated with OM risk because exposure to passive smoke can result in goblet cell hyperplasia, mucus hypersecretion, ciliostasis and decreased mucociliary transport which increase susceptibility to infections (29, 30).

Knowledge of the risk factors associated with being "OM prone" is necessary for the implementation of preventative strategies. These may include regular ear examinations for infants who have a family history of OM, the early identification and treatment of underlying diseases linked to OM, promotion of smaller child care groups and breast feeding and discouragement of household smoking (30).

### 2.2.4 Prevalence

A 1996 study by Paradise, Rockette, Colborn, Bernard, Smith and Kurs-Lasky investigated the prevalence of OM in the Pittsburgh area in America by monitoring a large sample group of 2253 socio-demographically diverse infants from before two months of age until at least two years of age. They found that the prevalence rate was 61% in urban infants and 37,9% in suburban infants. The urban infants were recruited from inner-city hospitals and had a generally low socio-economic status, while the suburban infants were from private paediatric practices and they had a generally high socio-economic status. Low socio-economic status was therefore associated with higher prevalence rates of OM (34).

This contradicts the findings of a 1997 study by Saim, Saim and Saim. They followed a sample of 1097 preschoolers aged between five and six years of age in an urban and a rural area of Malaysia. The prevalence rate was 17,9% in urban preschoolers and 9,48% in rural preschoolers. The urban preschoolers had a higher socio-economic status than the rural preschoolers. Therefore in this study, higher socio-economic status was associated with higher rates of OM. Saim et al acknowledged that OM is usually associated with poverty. However, they postulated that the association between higher socio-economic status and increased prevalence, may have been due to early exposure to child care centres and lower rates of breast-feeding in the urban group (27).

Saim et al's finding of lower prevalence rates in rural children compared to urban children in Malaysia, has been corroborated by South African studies. In 1985 Halama, Voogt and Musgrave examined 480 children, below the age of 15 years, from a remote rural community in Venda, South Africa. Their results indicated a prevalence rate of 8,2% (46). This figure is similar to the 9,48% prevalence rate that Saim et al found in rural Malaysia.

However, the 8,2% prevalence rate in rural Venda is significantly lower than Voogt, Halama and van der Merwe's findings in the urban area of Gauteng in South Africa in 1986. This study assessed 736 black children, between the ages of two and six years. The prevalence rate for OM was 46% in this group (47). This is higher than the rate amongst urban preschoolers in Malaysia. This may be because all the children in the South African study were attending child care centres and because the study was conducted in winter.

The rate of 46% among urban preschoolers in Gauteng is comparable to another Gauteng study that indicated a prevalence rate of 53,2%. This was found by Bennet in 2001 using a sample of preschoolers aged two to six years, in the urban area of Alberton in Johannesburg, Gauteng. However, this prevalence rate may not be accurate due to the small sample size of 153 children (48).

The results of the studies that have been discussed above, illustrate the wide range of prevalence rates. It is estimated that the worldwide prevalence ranges from 2 to 52% (27). The vastness of this range can be attributed to different definitions of OM, different diagnostic methods and samples from different population groups which have different levels of exposure to risk factors (11).

Whether prevalence studies include only acute OM, only OM with effusion, or both, obviously affects their findings. The use of different diagnostic methods also affects reported prevalence rates. Using only clinical examination with an otoscope has low sensitivity and specificity because it is a subjective method with substantial inter-observer difference (49, 50). The tympanometry test is a more objective screening tool and 85-100% of infants with OM will have a type B tympanogram (11, 50, 51). By combining an abnormal otoscopic finding, a type B tympanogram and the absence of an ipsilateral acoustic reflex in order to diagnose OM, researchers are able to bring the sensitivity and specificity for the presence of OM up to 90-93% (49).

The reported prevalence rate is also influenced by the sample size and the OM susceptibility of the sample members. The prevalence of OM is increased in children who are aged six to eleven months, are males, are from certain ethnic groups, have certain underlying diseases or a family history of recurrent OM. Environmental factors such as poor living conditions, day care attendance, bottle (not breast) feeding and exposure to passive smoke can also increase the prevalence of OM. OM is most common in winter and autumn, so studies done during these seasons tend to report higher prevalence rates than those done in summer or spring. The probability of OM diagnosis is also dependant on access to health care (11, 30).

### 2.2.5 Management

#### 2.2.5.1 Observation and Antibiotics

OM is generally managed by observation, antibiotics or surgical intervention (4). The use of antibiotics in the management of OM has become controversial over the last decade because the extensive use of antibiotics has led to antibiotic resistance and because most children recover spontaneously from OM (4, 52). In fact, three independent meta-analyses found that approximately 80% of children with acute OM recover spontaneously within two to fourteen days (53-55). A number of the studies included in these meta-analyses did not include children younger than two years. Studies of this population suggest a lower spontaneous resolution rate of approximately 30% (56). These rates only refer to acute OM. OM with effusion usually resolves within three months of an acute OM episode (4).

Antibiotic resistance and high rates of spontaneous recovery have resulted in the recommendation of initial observation for otherwise healthy children with OM, as long as they can be monitored and treated if there is limited improvement (4). Cates found that antibiotic use could be reduced by 31% if parents of children with non-severe OM were given a safety-net prescription for antibiotics which they only redeemed if the child did not improve within two days (57). Watchful observation should not be equated with no treatment. All children should receive adequate symptomatic treatment immediately after diagnosis. This should include analgesics but anti-histamines and decongestants have been found not to offer benefits (4).

The shift towards reducing antibiotic use was evident in the 2004 comprehensive clinical practice guideline on the diagnosis and management of OM issued jointly by the American Academy of Family Physicians, the American Academy of Otolaryngology and the American Academy of Pediatrics (58). The guideline recommended six months of watchful observation in otherwise typical children with bilateral OM and hearing loss. This marks a move towards more conservative management compared with the recommended three months of watchful observation in the guidelines published by the Agency for Health Care Policy and Research in America in 1994 (59).

Despite the increasing recommendations for first-line watchful observation and symptomatic treatment in selected children, this is not always put into practice. In 2010 Arguedas, Kvaerner, Liese, Schilder and Pelton did a cross-sectional survey of 1800 physicians across France, Germany, Spain, Poland, Argentina, Mexico, South Korea, Thailand and Saudi Arabia. They found that although concern over antibiotic resistance was widespread, antibiotics were still prescribed as the first-line treatment in an average of 81% of cases (52).

2.2.5.2 Surgery

The surgery to insert VTs is the second most common operation in the world after circumcision, but the use of VTs varies greatly between countries, regions and Ear, Nose and Throat (ENT) specialists (3). In fact, a ten-fold variation has been described (60). Numerous studies have shown that surgical intervention for children with OM can result in improved hearing, less middle ear effusion, reduced incidence of acute OM and reduced need for re-operation (61-67).

The difficulty is choosing the right child for the right surgery. Surgical candidacy depends on the duration of OM with effusion, associated symptoms and the child's developmental risk (4). Lous recommends that VT insertion should only be performed after six months of bilateral OM with effusion and significant hearing loss in otherwise typical children. However, he concedes that there is a lack of evidence regarding children with speech and language delays, behaviour and learning difficulties and syndromes, and that further research is urgently required regarding these subgroups of children (3).

When a decision is made to proceed with surgery for OM, the evidence from methodologically-sound clinical trials indicates that myringotomy and VT insertion should be the first-line intervention (4). Myringotomy is the creation of a tiny incision in the eardrum, to relieve pressure caused by the excessive build-up of fluid. VTs are then inserted to allow for fluid drainage (3). Myringotomy alone, without VT insertion is ineffective, because the incision closes within several days, which is insufficient for mucosal recovery (65, 66).

Removal of the adenoids (adenoidectomy) is not indicated initially unless nasal obstruction is present. For repeat surgery, myringotomy (with or without VT placement) and adenoidectomy should be used irrespective of adenoid size (4). Tonsillectomy should be withheld for the treatment of OM unless other indications for this surgery exist (68, 69).

#### 2.2.5.3 Conclusion

In conclusion, although watchful observation and symptomatic treatment have become more popular in recent years, antibiotics are still used as the first-line treatment for OM in many countries. The need for surgical intervention depends on the duration of OM with effusion, associated symptoms and the child's developmental risk factors. The ideal intervention for OM would be non-toxic and have sustained efficacy for at least several months. Such an intervention does not yet exist, and there is an urgent need to explore new and creative treatments (4).

## 2.3 CHILD DEVELOPMENT AND DEVELOPMENTAL DELAY

The Education White Paper Five on Early Childhood Education defines child development as the processes by which children from birth to nine years grow and thrive (70). Domains of child development include sensory-motor, psychosocial and cognitive development; as well as occupational behaviours such as self-care and play; and roles such as preschooler and player (6). Each of these domains follows a relatively predictable pattern and has its own milestones (eg. standing, talking) that serve to denote achievement. Developmental delay is a term used to identify children with a delay in meeting these milestones in one or more of the domains of development (71).

The idea that the early childhood years are a “critical period” for attaining developmental milestones used to be widely accepted. It was thought that the brain stopped developing after the first few years of life and that the connections formed between the brain’s nerve cells during this early critical period were unchangeable. This implied that children must have certain stimulation experiences during the early childhood years and if they didn’t, later exposure would have little or no value. However, it is now recognised that the brain continues to reorganise itself by forming new neural connections throughout life. This neuroplasticity allows for learning and development throughout life (72).

Although the critical period theory in its purest form is unsubstantiated, there is evidence indicating that the younger a brain is, the more plastic it is. Therefore, early childhood is still considered a “sensitive period” for development and the earlier a child who is at risk for developmental delay receives intervention, the better (72). Reviews of the relevant research have found that intensive, comprehensive and high-quality early intervention programs can significantly alter the developmental trajectories and subsequent school success of children who present with developmental delays or are considered at risk for developmental delay (73). It is therefore vital that at-risk children are referred for a developmental assessment and appropriate intervention programs.

## 2.4 THE EFFECTS OF OTITIS MEDIA ON CHILD DEVELOPMENT

### 2.4.1 Speech and Language Abilities

Most of the research on the effects of OM on child development has focussed on the effect on speech and language abilities (16, 41, 44, 78, 79, 84-99). Episodes of OM are often accompanied by a mild-to-moderate fluctuating hearing loss. The research hypothesises that this hearing loss is a risk factor for speech and language delays (16, 17). The fact that episodes of OM occur frequently between the ages of zero to three years, a period that is considered sensitive for language development, is another reason that recurrent OM may be related to speech and language delays (99).

Despite the volume of research on this subject, the results remain controversial. Some studies have found an association between recurrent OM and reduced speech and language abilities (84, 92, 100), while others have concluded that there is no association (85, 86, 94). An initial report in 1969 appeared to show that there is an association between OM and speech and language delays (88). Since then there have been numerous other studies supporting this premise (101). However, many of these studies have been criticised for their retrospective design and the absence of measures of hearing impairment at the time of the OM (102).

More recently, a number of studies have been done using a prospective design and providing well-documented information regarding the number of OM episodes and the degree of associated hearing impairment (84, 92, 100). In 1988 Rach and van den Broek compared the language development of two to four year olds with, and without, a history of chronic OM. They found that receptive language was slightly reduced in the OM group and expressive language was significantly below the norm (92).

Zargi and Boltezar did a study in 1992. They compared thirty three children with a history of persistent OM before the age of two with a control group. Both groups were assessed using a battery of language, reading and writing tests when they were eight to ten years old. They found that 88% of the OM group had auditory perception disorders (84).

An association between chronic OM and speech and language development is also supported by a 1999 study by Ruben. He followed thirty children, from a low socio-economic background, from birth until they were nine years old. Eighteen of these children were classified as having had multiple episodes of OM during the first year of life and the remaining twelve had no or very little OM. The group with a history of OM scored significantly worse than the control group on a variety of language tests throughout the nine year follow-up (100).

However, there are also a number of compelling studies that have found that chronic OM has no effect on speech and language development. In 1988 Wright, Sell, McConnell, Sitton, Thompson and Vaughn followed 210 typical subjects longitudinally through the first two years of life. Pneumatic otoscopy and tympanometry were performed at every physician encounter. One hundred and fifty six of these children had a speech and hearing evaluation at two years of age. Thirty percent of the children with recurrent OM had a mild or moderate hearing loss. However, after multiple speech and language tests, they could not identify a delay in language acquisition in the OM-prone children (41).

Lous, Fiellau-Nikolajsen and Jeppesen also conducted a prospective cohort study in 1988. They followed children from the age of three until they were eight years old. At the age of eight, 26 children who had had constant signs of long-lasting secretary OM were tested using the Revised Peabody Picture Vocabulary Test and the verbal part of the Wechsler Intelligence Scale for Children. The results of the OM group were compared to those of 26 control children who were matched for sex, age, school, grade level, and controlled for classroom and social stratum. The OM group did not score lower than the controls on either of the tests (89).

A 2008 study by Serbetcioglu, Ugurtay, Kirkim and Mutlu compared 16 preschoolers with bilateral OM to 16 age-matched controls. They used the internationally standardised Denver-II test to evaluate the language development and found that there were no significant differences between the two groups (97).

In instances where there are numerous studies investigating a topic, a meta-analysis study is considered the best evidence because it has the capacity to obtain statistical consensus across numerous studies (5). Three meta-analyses of the effects of OM on speech and language were identified in the literature. In 2001, Casby performed a meta-analysis of 32 studies. He reported that the magnitude of the effect of OM on speech and language was markedly low (103). A 2003 meta-analysis of six cohort studies by Shekelle, Takata and Chan found no association between speech and language ability and a history of OM (104). Roberts, Rosenfeld and Zeisel also did a meta-analysis of 14 prospective studies on the effects of OM on speech and language in 2004. Their results showed that there are only small adverse effects, which may be unimportant in otherwise-healthy children (93).

Some of the contradictory findings in the literature can be explained by a cumulative risk theory. This theory proposes some developmental outcomes are produced by the interaction between a number of different risk factors (105). In this way, OM might only produce negative effects in combination with other risk factors.

Studies that support cumulative risk theory include an interesting study by Hemmer and Ratner done in 1994. They looked at the speech and language abilities of six sets of same-sex dizygotic twins that were two to four years of age. In each set, one twin had a strong history of recurrent OM, while the other had no history or a minimal history. The twins' speech and language abilities were tested using standardised tests and the elicitation of a spontaneous conversational speech sample during play. Overall there was negligible difference between the twins' scores. The findings of this study should be interpreted with extreme caution due to the small sample size. However, they suggest that there is no significant association between OM and speech and language development as long as the family and child care setting have been controlled for. Therefore, these results do seem to support the notion that a number of factors mediate the relationship between a history of OM and speech and language development (87).

Cumulative risk theory is also supported by the work of Vernon-Feagans, Emanuel and Blood published in 1997. They performed weekly ear examinations and regular hearing testing on 67 infants in child care centres for many years. The Sequenced Inventory of Communication Development was administered to all the children at two years of age. Children were divided into a group with chronic OM and a control group. In addition, half the children were in low quality child care and the other half in high quality child care. The number of children present, number of adults present, and the child-to-caregiver ratio were used to classify the child care as either high or low quality. Children in low quality child care who had chronic problems with OM had lower scores than controls. However, there were no differences between the chronic OM and control children on language performance in the high quality child care group. It appeared that high quality child care buffered children with chronic OM against adverse effects. Therefore, it may be important to view chronic OM as only one of many risk factors in early childhood that might produce adverse outcomes in combination with other risk factors (44, 99).

Lous, Burton, Felding, Ovesen, Rovers and Williamson did a systematic review on the effects of VT insertion on the speech and language development of children with OM (106). They found only four randomised studies that met their inclusion criteria (90, 91, 96, 107). These studies found that delaying the insertion of VTs for six to nine months, did not significantly affect the language development of three-year-old children. However, in all these studies, the children who were most affected by OM were excluded for ethical reasons. These children may have been the ones whose development would have been most severely compromised by delaying the VT insertion. A study by Maw, which did include children with more severe OM, did find a marginally significant effect of delayed VTs on language development (90).

### 2.4.2 Vestibular Functions

Research on the developmental sequelae of OM has focussed on the effects on speech and language abilities. However, increasing emphasis on the role of vestibular dysfunction in learning disabilities and developmental delays has led to research on the effects of OM on vestibular functions in recent years (20). SI theory supports the view that disruptions in vestibular processing can lead to postural and motor co-ordination delays (22).

In 1983 it was noted that there was no documentation on the effect of OM on the vestibular system (108). One of the earliest studies on this subject was conducted by two OTs named Denning and Mayberry in 1987. They found that preschool children with a history of OM had significantly lower percentile rank scores than their peers on the stepping and vertical writing items of the MAP. These two items are measures of vestibular function (109).

Since then, other researchers have used a variety of measurement instruments to prove that recurrent OM does affect vestibular functions in children. In 1990, Jones, Radomski, Prichard and Snashall used a fixed force plate body-sway platform to show that a group of 34 children with chronic OM had significantly poorer balance than a control group (110). In 1995, Casselbrant, Furman, Rubinstein and Mandel evaluated 41 children with OM using a moving-platform posturography. They found that OM affects balance leading to clumsiness and possibly impaired motor development (111). At the 1995 meeting of the American Academy of Otolaryngology–Head and Neck Surgery, Friedman, Lai, Duncan and Pellicer presented a study using the Peabody Developmental Motor Scales to assess children with OM. They found that 40% of these children performed significantly below the norm for their age-band on balance tasks (112).

In 1999, Koyuncu, Saka, Tanyeri, Sesen, Ünal and Tekat evaluated the vestibular function of 30 children with OM and compared the results to 15 controls who were matched for age and sex. They used a parental questionnaire, electro-nystagmography and the Romberg and Past-pointing tests. A statistically significant difference between the two groups was noted, leading to the conclusion that OM does impair vestibular function (18). A 2004 study by Gawron, Pospiech and Orendorz-Fraczkowska used posturography to investigate vesibulo-spinal reflexes in children with OM. They stated that the presence of fluid in the middle ear impairs the functioning of the balance system in children (19).

In all the above-mentioned studies (18, 19, 110-112), myringotomy and the insertion of VTs relieved any balance dysfunction. Snashall has therefore suggested that insertion of VTs should be considered in cases where OM is causing balance disturbances even if hearing is relatively unaffected (113).

## 2.5 OCCUPATIONAL PERFORMANCE

### 2.5.1 Occupational Science

According to the Occupational Therapy practice framework: Domain and process, second edition (Framework-II), the domain of OT is to support health and participation in life through engagement in occupation (114). In order to do this, it is necessary for OTs to consider the impact of an individual's client factors, performance skills and context on their occupational performance. The factors that are relevant to children are summarised in table 2.1 below.

**Table 2.1 Aspects of the Occupational Therapy Domain (adapted from the Occupational Therapy Practice Framework: Domain and process 2nd edition)**

| Areas of Occupation | Client Factors | Performance Skills | Context and Environment |
|---|---|---|---|
| • Activities of daily living<br>• Rest and sleep<br>• Education<br>• Play<br>• Leisure<br>• Social participation | • Values, beliefs and spirituality<br>• Body functions<br>• Body structures | • Sensory perceptual<br>• Motor and praxis<br>• Emotional regulation<br>• Cognitive<br>• Communication and social | • Cultural<br>• Personal<br>• Physical<br>• Social |

OM and developmental status are client factors that can potentially affect a child's occupational performance and health. The link between occupational engagement and health is described by the theories and models that OT is based on (115, 116). One such model is the Model of Human Occupation (MOHO), which was developed by Dr Gary Kielhofner. MOHO defines occupation as culturally-meaningful work, self-care, play and social activities within a temporal, physical and socio-cultural context (115, 116).

MOHO is a dynamic systems theory. It proposes that an individual's occupational performance is either afforded or pressed by three inter-related systems. These are the external, internal and feedback systems (115, 116). Preschoolers' external systems would include the physical and social characteristics of their home and child care environments. Their internal systems would include diagnosed conditions (such as OM, cleft palate, Down syndrome, pervasive developmental disorders, attention deficit disorders or intellectual impairments) and their developmental abilities (in terms of different domains such as sensory discrimination, postural mechanisms, motor co-ordination, speech and language and cognitive abilities) (116). MOHO therefore reinforces cumulative-risk theory by considering the interplay between an individual's environmental and biological factors when analysing the effect of OM on preschoolers' development and occupations.

### 2.5.2 The Effects of OM on Occupational Performance

The literature on the effects of OM on children describes restrictions in occupational performance. In 2005 Brouwer, Maille, Rovers, Grobbee, Sanders and Schilder did a systematic review of 13 studies on the health-related quality of life of children with OM. They found that self-care activities such as sleeping and eating were moderately to severely affected by OM. Play and social interactions (such as parent-child interactions) were also limited due to OM (117).

### 2.5.3 The Effects of Developmental Delay on Occupational Performance

Research by Leung, Chan, Chung and Pang found that participation in school, play and social activities was poorer in preschoolers with developmental delays compared to controls (118). These findings are in line with other research which found that developmental delays in terms of motor co-ordination (119), communication (120) and cognitive abilities (119) are all associated with reduced occupational performance.

The correlation between motor co-ordination and participation in the preschool setting is not surprising since classroom participation requires fine motor skills for activities such as drawing and cutting, and play activities require gross motor skills for tasks such as climbing or swinging. In terms of communication, adequate verbal skills are required for appropriate social interaction with peers, teachers and parents. Cognitive abilities are also needed in the classroom setting for activities such as participating in discussions, and for following rules appropriately (118).

It is clear from the theoretical framework of OT and from relevant research studies that developmental delays do affect a child's occupational performance. If OM is associated with developmental delays, it is important for OTs to know this so that they can intervene to improve occupational performance as well as developmental status.

## 2.6 OCCUPATIONAL THERAPY FOR DEVELOPMENTAL DELAYS

### 2.6.1 Assessment

A child who is referred to OT for a developmental delay is evaluated in terms of all the different domains of development (including sensory-motor, psychosocial and cognitive abilities) (1).

A developmental assessment usually includes:

- An interview covering background information such as medical, developmental and social history.
- Observations of the child engaging in occupations such as play, self-care or scholastic activities.
- A standardised assessment measure (1).

The results of a developmental assessment determine if a child's developmental status is typical or if he presents with a developmental delay. In the case of a developmental delay, the assessment results will give information about the severity of the delay and the child's strengths and weaknesses in terms of the various domains of development. Recommendations for intervention are based on the assessment results (2).

#### 2.6.1.1 The Miller Assessment for Preschoolers

The MAP is a standardised assessment which OTs use to evaluate a child's developmental status. It evaluates preschoolers between the ages of 33 months and 68 months for mild, moderate and severe developmental delays. The results of the MAP are typically reported in terms of percentile ranks. A percentile rank of 26 and above is considered average or above average. A percentile rank ranging from 6 to 25 is defined as probable at-risk status. A percentile rank of 5 and under is considered definite at-risk status (2, 74). Percentile ranks are obtained for five subtests, as well as for overall development. The MAP therefore provides valuable statistical information regarding a preschooler's overall development as well as development in specific domains.

In terms of predictive validity, the MAP was able to identify typically-developing versus delayed children in 80 to 90% of cases in three different studies. The test-retest reliability is 80% and the inter-rater reliability is 98%. Its psychometric properties are therefore regarded as excellent (75, 76). The MAP was developed in America, but is appropriate for use in the South African context as it has been found to be one of the most “culture-free” tests as most items are neurologically-based (75).

A study of sex and race differences in the identification of communication disorders, found that the MAP Verbal Index is not biased against males when determining at-risk children (77). Other studies have found that typically-developing girls produce more language of higher quality during the preschool years than boys (78-80). However, it is probable that while young boys’ language abilities are less well developed than their female peers, their performance is not so much lower as to put them in the at-risk category on the MAP (77). The MAP Verbal Index was also found to be less culturally-biased against older preschoolers than the Peabody, Carrow, or Boehm tests. The MAP places more reliance on items such as sentence and digit repetition rather than vocabulary. It may therefore not reflect the values of specific cultures (77).

### 2.6.2 Intervention using Sensory Integration Occupational Therapy

Almost a quarter of South African OTs focus their practice on the treatment of children with developmental delays (81). Forty percent of all OTs (listed in the Occupational Therapy Association of South Africa directory) who treat children with developmental delays in private practices in Gauteng are qualified in SI (14, 15).

SI was founded and pioneered by Dr A. Jean Ayres. She postulated that adequate processing of sensory information provides an important basis for a child’s development and participation in self-care, play and scholastic activities (6). According to SI theory, disruptions in sensory processing can affect the development of the following domains: postural mechanisms, motor co-ordination, visual perception, speech and language and occupational performance, as illustrated in the figure 2.1 (22).

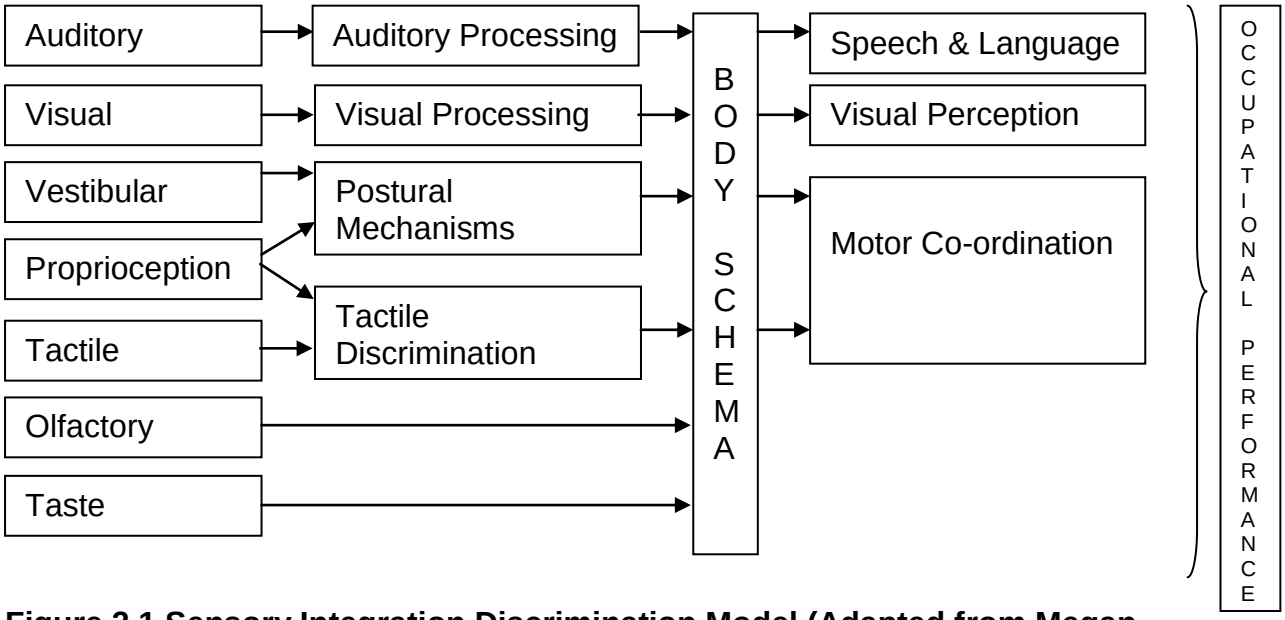



**Figure 2.1 Sensory Integration Discrimination Model (Adapted from Megan Faure 2001)**

The MAP is an appropriate assessment tool for OTs using a SI approach because it provides information about a child's sensory processing and the developmental domains that are affected by sensory processing difficulties (2). If a child presents with sensory processing difficulties that impair occupational performance, then a diagnosis of Sensory Processing Disorder (SPD) can be made. Miller, Anzalone, Lane, Cermak and Osten reviewed the work of many theorists and researchers and proposed the different diagnostic categories of SPD that are represented in figure 2.2 (82).

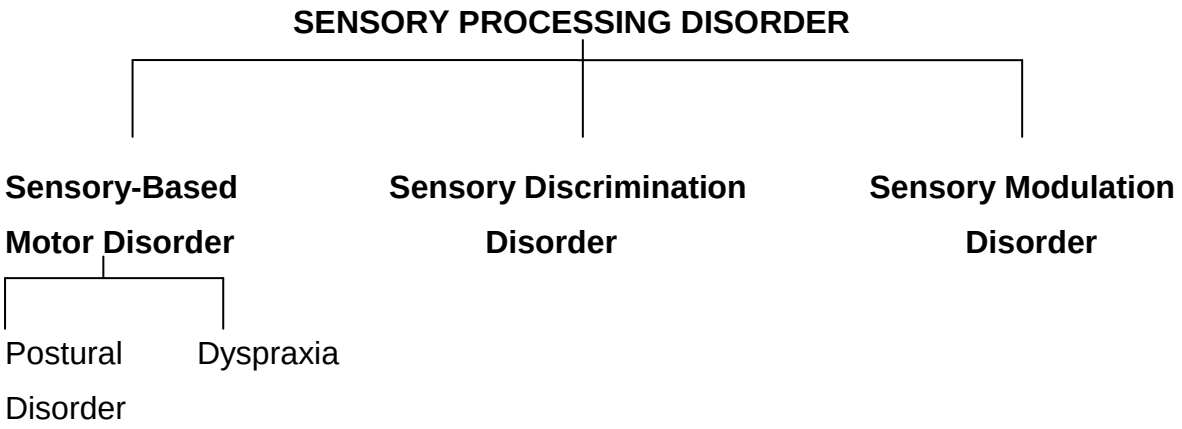



**Figure 2.2 Diagnostic categories of Sensory Processing Disorder**

The MAP results can be suggestive of a Sensory-Based Motor Disorder (SBMD) or a Sensory Discrimination Disorder (SDD). In terms of the SBMDs, figure 2.1 illustrates that a Postural Disorder is based on poor vestibular and proprioceptive processing. Poor scores for postural development, vestibular processing and proprioceptive processing on the MAP are therefore associated with a Postural Disorder. According to figure 2.1, a Dyspraxia is a motor co-ordination disorder that is based on poor vestibular, proprioceptive and tactile processing. Poor scores for motor co-ordination and vestibular, proprioceptive and tactile processing on the MAP are therefore suggestive of a Dyspraxia. A SDD can be a diagnosed in terms of any of the sensory systems (82). Poor scores on the MAP verbal index may be linked to an Auditory Discrimination Disorder which is causing Speech and Language problems as shown in Figure 2.1. In this case, referral to a speech therapist would be recommended, but OT using an SI approach (OT-SI) is indicated for all other forms of SPD (82).

OT-SI is based on the SI principles that the nervous system is capable of development (neuroplasticity) and that this development is shaped by an individual's sensory-motor interactions with the environment. The therapist therefore uses the child's cues to create a challenging (yet achievable) activity within a sensory-rich environment. The challenge should entice the child to participate actively in play and facilitate him to adapt his behaviour with new and useful strategies, thus furthering development. For example an appropriate challenge for a child with motor co-ordination delays might be to complete an unfamiliar obstacle course consisting of climbing up a rope ladder, jumping onto large pillows with a variety of textures, then pulling himself out of the pillows using a rope attached to the opposite wall (83).

## 2.7 RECORD REVIEW AS A RESEARCH TOOL

This study required that the researcher code information relating to clients' demographics and medical history as well as their scores on a standardised assessment tool. This information was available from almost all of the records sourced from the private OT practices that participated in the study. The therapists working at these practices are directed by the Health Professions Council of South Africa "guidelines with regard to the records of patients". These guidelines state that personal particulars, medical history, assessment of the client's condition and test results are compulsory in each client's records and that records may not be altered and additional entries need to be dated and signed (121).

Although record reviews seldom provide definite answers, they can suggest valuable hypotheses to be tested in prospective studies (122, 123). Clinical records can provide valuable information about clients, such as their socio-demographic characteristics, medical diagnoses, and performance on assessment tools (5, 7). This information is gathered during the course of ordinary medical or therapeutic interventions, which eliminates the publicity, heightened expectations and sometimes skewed results of well-funded clinical control trials. Overall, record reviews provide an excellent opportunity for clinician-researchers to use existing data to make clinically-relevant findings (7).

## 2.8 SUMMARY

The literature revealed that OM is an extremely prevalent childhood infection (9, 23-26). The fact that it occurs most frequently during the years that are important for child development, means that it may result in significant adverse effects (23-26, 99). It is very important to investigate these effects, since enhanced knowledge about the possible causes of developmental delay, can assist OTs to identify at-risk individuals and assess and treat them accordingly.

There is an ever-increasing demand for clinicians to make evidence-based decisions (5). However, it is difficult for medical and therapy practitioners to do this with regards to OM and child development, because the current literature is conflicting and only focuses on speech and language ability and vestibular functions (84-86, 88, 92, 94, 100, 101, 124). There is therefore a need for more research on OM and child development, designed to guide practice in clinical fields. A review of the literature did not reveal any studies on the effects of OM that were done in South Africa. For this reason, there is a need to explore this topic in the South African context.

A record review of existing MAP score sheets from OT private practices was used in this study. The MAP was identified as a tool that is commonly used to assess preschoolers in OT private practices in the northern suburbs of Johannesburg. It was appropriate for the purposes of this study, because it provides information about overall development, as well as a variety of individual domains of development (2). It has excellent standardisation and is considered to be one of the most “culture-free” tests as most items are neurologically-based (2,75). It is therefore suitable for use in South Africa.

The effect of OM treated with VTs on the development of preschoolers was considered an important topic from an OT perspective. OTs assist clients to maximise their engagement in occupations such as work, play, self-care and social activities (125). Chronic conditions, including OM and developmental delay, are relevant to OT because they influence occupational performance.

Occupational science models, such as MOHO, emphasise the importance of a holistic dynamic-systems approach to examining the interactions between factors that affect occupational performance. These may include internal factors, such as a preschooler’s medical health and developmental status, as well as external factors, such as the physical and social environments (115, 116). SI highlights the significance of accurate sensory discrimination for development and learning (1, 22). It is therefore relevant to investigate conditions, such as OM, which may impair auditory and vestibular processing.

# CHAPTER 3: RESEARCH METHODOLOGY

## 3.1 INTRODUCTION

Chapter three examines the key constructs of the methodology of this record review. The research design and sample selection will be explained. The measurement instrument and the collection and analysis of the data will be also be discussed. Finally, the ethical considerations will be examined.

## 3.2 RESEARCH DESIGN

There is a need for more clinically-relevant research to be done so that OT practice can be more evidence-based (126). One way of ensuring that research is clinically relevant is to analyse existing data from clinically-relevant settings to make hypotheses regarding best practice (7). For this study, a record review with descriptive and analytical components was used to analyse the background information and MAP results of preschoolers assessed at OT private practices.

The records of preschoolers with a history of OM treated with VTs (OM group), were compared to those with no history of OM (non-OM group). The preschoolers in both of these groups were referred to OT with suspected developmental delays. The reason that this sample group was used, was to see if there was a specific pattern to the developmental profiles of the OM group that could be attributed to their history of OM treated with VTs, as opposed to other unknown aetiological factors.

A quantitative approach was chosen so that statistical analysis could be employed. This allowed the researcher to determine if any adverse effects on development could be attributed to a history of OM treated with VTs rather than to chance. A record review was a quicker and more cost-effective way of exploring the effects of OM on child development than using a prospective design and it allowed for information to be collected from a larger number of subjects.

## 3.3 SAMPLE SELECTION AND DATA COLLECTION

Four OT private practices in the Johannesburg northern suburbs were identified as sources of appropriate records. The records that were used consisted of a background information form completed by a parent or guardian before his child's initial OT assessment and the child's MAP results. All records were reviewed and suitable records were identified according to the following criteria.

Inclusion criteria:

- Aged between 33 months and 68 months.
- Assessed using the MAP at one of four selected private practices in the Johannesburg northern suburbs.
- Assessed by an OT with a minimum of one year of clinical experience. (Even though some of the OTs only had one or two years of experience, these inexperienced therapists were supervised by therapists who had more experience.)
- Assessed during the period from the beginning of 2005 to the end of 2009.
- Scores were added correctly and percentile ranks recorded correctly.

Exclusion criteria:

- Incomplete, conflicting or illegible records.
- A history of OM that was not severe enough to be treated with VTs.
- Diagnosis with a specific disorder (such as Down syndrome, pervasive developmental disorders, attention deficit disorders or intellectual impairments) which would affect developmental outcomes.
- Previous therapy (e.g. OT, Speech therapy or Physiotherapy) prior to the assessment with the MAP.

All records that met all the inclusion criteria, but did not meet any of the exclusion criteria, were used. They were then divided into an OM group and a non-OM group as follows.

The OM group had:

- A History of OM (according to parental report).
- A History of VT insertion (according to parental report).

The non-OM group had:

- No history of OM (according to parental report).
- No History of VT insertion (according to parental report).

The same person collected all the data to ensure that there was consistency with regards to what was extracted from records. All data was recorded according to a standard format.
See Appendix C for a tick sheet of inclusion criteria.

### 3.3.1 Rationale for the Inclusion and Exclusion Criteria

The practices were chosen because children with similar demographic histories are referred to them. This is important as demographic variables may impact on the development of the children that are referred for OT (1). The similarities between the practices include that they are geographically close to each other, are all situated in areas with a high socio-economic status, all use SI as their primary treatment framework and all the use the MAP as an assessment tool.

Apart from demographic variables, diagnosis with a specific disorder and previous therapy would also affect the developmental profiles of the preschoolers. These extraneous variables were eliminated by excluding the records of any children with a specific diagnosis. However, it is possible that some of the preschoolers that were included in this study may be diagnosed with conditions such as attention deficit disorder in the future, as this condition is often only diagnosed in older children. Children who had received any therapy that would affect their development prior to their assessment with the MAP were also excluded.

The developmental status of preschoolers, as opposed to older children, was investigated as OM occurs most frequently between the ages of six to eleven months (23, 24) and is therefore postulated to affect early childhood development (29). The Education White Paper Five on Early Childhood Education defines early childhood development as the processes by which children from birth to nine years grow and thrive (70). Research has demonstrated that the preschool years are an important period because they are characterised by rapid physical, intellectual, emotional and social development (70). The MAP assesses children between the ages of 33 months and 68 months. This age band was chosen as suitable for this study, as it fits within the sensitive period for child development (72).

The quality of the records was ensured by only using MAP results of children who were assessed by experienced OTs, or OTs who were supervised by experienced OTs. The researcher checked that the scores were added correctly and percentile ranks were recorded correctly. Incomplete, conflicting or illegible records were excluded.

Records were assigned to the OM or non-OM group according to whether or not the child had history of OM. The records did not include any information about objective measurements of OM, so this was determined by parental report (as recorded on the background information form). This background form did not document the number or severity of the episodes of OM, so only children who had a history of OM that was surgically treated by VT insertion, were included in the OM group. Although the treatment of OM varies between different practitioners, it is generally recommended that VT insertion should only be performed after six months of bilateral OM with effusion and significant hearing loss in otherwise typical children (3). Children who had undergone VT insertion were therefore deemed to have had a significant enough history of OM, to be included in the OM group. The children who were included in the non-OM group had no history of OM or VT insertion.

## 3.4 MEASUREMENT INSTRUMENT

The MAP evaluates preschoolers for mild, moderate and severe developmental delays. It is a well-organised test that is easy to administer and score. Administration takes 25 to 45 minutes. This is done by a professional who observes a child and scores his or her performance on 27 items. Children generally enjoy performing the various “games” or items (2).

The 27 items are divided into five subtests, each of which assesses a specific domain of development. The five subtests are:

- neurological foundations
- motor co-ordination
- verbal ability
- non-verbal cognition
- complex skills (2)

Neurological foundations refers to postural development and sensory processing of the vestibular (movement), proprioceptive (body position) and tactile (touch) sensory modalities. The motor co-ordination subtest assesses gross motor, fine motor and oral motor skills. Verbal ability includes verbal memory, sequencing, comprehension, association and expression. Non-verbal cognition looks at the ability to process information and apply knowledge using memory, sequencing, visualisation and mental manipulations not requiring spoken language. Finally the complex skills subtest evaluates the ability to integrate sensory-motor and cognitive skills for the interpretation of visual-spatial information (2).

The MAP was developed in America in the 1970s and early 1980s. Validity was maximised by conducting an extensive review of preschool tests, research and theory, as well as by testing and reviewing preliminary versions of the test. The final test was standardised on a sample of 1200 children stratified according to age, race, sex, community size and social-economic status. It was then published in 1982. In terms of predictive validity, the MAP was able to identify typically-developing versus delayed children in 80 to 90% of cases in three different studies. The test-retest reliability is 80% and the inter-rater reliability is 98%. Its psychometric properties are therefore regarded as excellent (75, 76).

The MAP is regarded as being appropriate for use in the South African context. It has been found to be one of the most "culture-free" tests as most of the items are neurologically-based. A study of sex and race differences in the identification of communication disorders, found that the MAP Verbal Index is not biased against males when determining at-risk children. The MAP Verbal Index was also found to be less culturally-biased against older preschoolers than the Peabody, Carrow, or Boehm tests (77).

See Appendix D for a MAP Record Booklet and Item Score Sheet.

## 3.5 SAMPLE SIZE

The results of the MAP are typically reported in terms of percentile ranks. A percentile rank of 26 and above is considered average or above average. A percentile rank ranging from 6 to 25 is defined as probable at-risk status. A percentile rank of 5 and under is considered definite at-risk status (2, 74). The distribution of total scores (measuring overall developmental status) was anticipated from personal clinical experience. It was expected to be distributed as shown in Table 3.1.

**Table 3.1 Anticipated history of OM (%) used to determine sample size**

| Developmental Status | Positive History | No History |
|---|---|---|
| Average or Above Average | 10% | 35% |
| Probable At-risk Status | 60% | 55% |
| Definite At-risk Status | 30% | 10% |

It was determined that if the sample size was 46 for each of the two groups, a 0,05 level Chi-square test would have an 85% power to distinguish between the groups when the proportions in the three categories are characterised by an effect size of 0,1205 based on the expected outcome in the table 3.1 above. All suitable records were included until a minimum of 46 was reached for each of the groups. In the end, the OM group consisted of 46 records and the non-OM group of 69 records.

## 3.6 DATA ANALYSIS

The first stage of the data analysis was the comparison of the demographics of the OM group and non-OM group using descriptive statistics. The frequency and percentage of males and females in each group were compared and the chi-square test was used to determine if there was a statistically significant difference in the gender distribution of the two groups. The age distribution of the OM and non-OM groups was also compared and the Mann-Whitney test was performed to establish if there was a statistically significant difference between the two groups in this regard. The two groups were compared in terms of age range and gender and the Mann-Whitney test was once again used to see if there was a statistically significant difference between the ages when compared by gender.

Thereafter, the MAP results (in terms of total, neurological foundations, co-ordination, verbal, non-verbal cognition and complex tasks scores) of the OM and non-OM groups were compared to the norm sample of the MAP to give an indication of the developmental profiles of each group. It was not possible to investigate the developmental profiles of the OM and non-OM groups using their mean percentile ranks for the different MAP subtests because the MAP does not give exact percentile ranks for scores above the fiftieth percentile on the different subtests. The MAP is structured this way because it aims to identify developmental delays, not distinguish between average and above average performance. Since many of the preschoolers' exact percentile ranks were unknown, the distribution of the various scores of the OM and non-OM groups were compared to the norm sample using the chi-square test. This gave an indication of the developmental profiles of each of the groups in terms of their strengths and weaknesses compared to the norm sample.

The MAP scores of the OM group were then compared to the non-OM using the chi-square test at the 0,05 level of significance to determine whether there were statistical differences between them. Comparisons were made with respect to overall development and the five individual areas of development. Data summary employed cross tabulation, frequencies, proportions and 95% confidence intervals. Finally, a relative risk ratio was used to establish if there were clinical differences between the OM and non-OM groups. This allowed the researcher to determine if the preschoolers from the OM group were more at risk for developmental delays, even if there were no statistically significant differences between the two groups.

## 3.7 ETHICAL CONSIDERATIONS

Ethical clearance was obtained through the University of the Witwatersrand Ethics Committee of Research on Human Subjects (Appendix A). An information sheet and consent form (Appendix B) was sent to the OT private practices and written permission was obtained from each of the head OTs to use their records. Practices were informed that they could withdraw permission at any time and that feedback on the results of the research would be given on request.

Relevant information from the records was noted down on spreadsheets (Appendix E and Appendix F). The information recorded was:

- History (or lack thereof) of OM treated with VTs.
- Date of Assessment.
- Date of Birth.
- Age.
- Gender.
- Total Score on the MAP.
- Scores for each of the five sub-sections of the MAP.

Confidentiality was assured by the fact that each record was assigned an identification number and the researcher did not record any of the subjects' names or contact details.

# CHAPTER FOUR: RESULTS

## 4.1 INTRODUCTION

Chapter four presents the results of the record review. The records from four OT private practices in the Johannesburg northern suburbs were reviewed for this study. All the records were from preschoolers who had been referred to OT because of suspected developmental delays. The records were divided into two groups. The first group consisted of the records of 46 preschoolers who had a history of OM treated with VTs (OM group). The second group comprised of the records of 69 preschoolers who had no history of OM or VTs (non-OM group).

The first section of the results chapter compares the demographics of the OM group to the non-OM group using descriptive statistics. Thereafter, the MAP results (in terms of total, neurological foundations, co-ordination, verbal, non-verbal cognition and complex tasks scores) of the OM and non-OM groups are compared to the norm sample of the MAP to give an indication of their developmental profiles. The MAP scores of the OM group are then compared to the non-OM group to determine if there were statistical and/or clinical differences. This was done to see if a history of OM treated with VTs did affect the preschoolers' development or not.

## 4.2 DEMOGRAPHICS

The OM and non-OM groups were compared in terms of demographics. This was done to establish if the groups were similar, with no significant differences other than a history of OM treated with VTs and no history of OM or VTs.

### 4.2.1 Gender

Forty six records of preschoolers with OM treated with VTs, and 69 records of preschoolers with no history of OM or VTs were reviewed. Table 4.1 illustrates the gender distribution of the two groups.

**Table 4.1 Gender distribution of the two groups**

| Gender | Frequency (Percentage) | |
|---|---|---|
| | **OM group (n=46)** | **Non-OM group (n=69)** |
| Males | 35 (76%) | 44 (64%) |
| Females | 11 (24%) | 25 (36%) |

The chi-square test was performed to see if there was a difference in the gender distribution of the two groups. There was no statistically significant difference [Chi-square = 1,41; Probability (p) = 0,24] between the two groups for this variable.

### 4.2.2 Age

The MAP divides preschoolers into to six different age groups. The age distribution of the groups is represented in Table 4.2 and Figure 4.1.

**Table 4.2 Age distribution of the two groups**

| Age | Frequency (Percentage) | |
|---|---|---|
| | **OM group (n=46)** | **Non-OM group (n=69)** |
| 33-38 months | 2 (4%) | 4 (6%) |
| 39-44 months | 7 (15%) | 10 (14%) |
| 45-50 months | 11 (24%) | 15 (22%) |
| 51-56 months | 15 (33%) | 23 (33%) |
| 57-62 months | 11 (24%) | 15 (22%) |
| 63-68 months | 0 (0%) | 2 (3%) |
| Mean age (and standard deviation) in months | 50,46 (6,76) | 51,12 (7,37) |

The ages ranged between 33 months and 68 months. They fell into a normal distribution skewed slightly to the older preschoolers with the median being at 51-56 months.

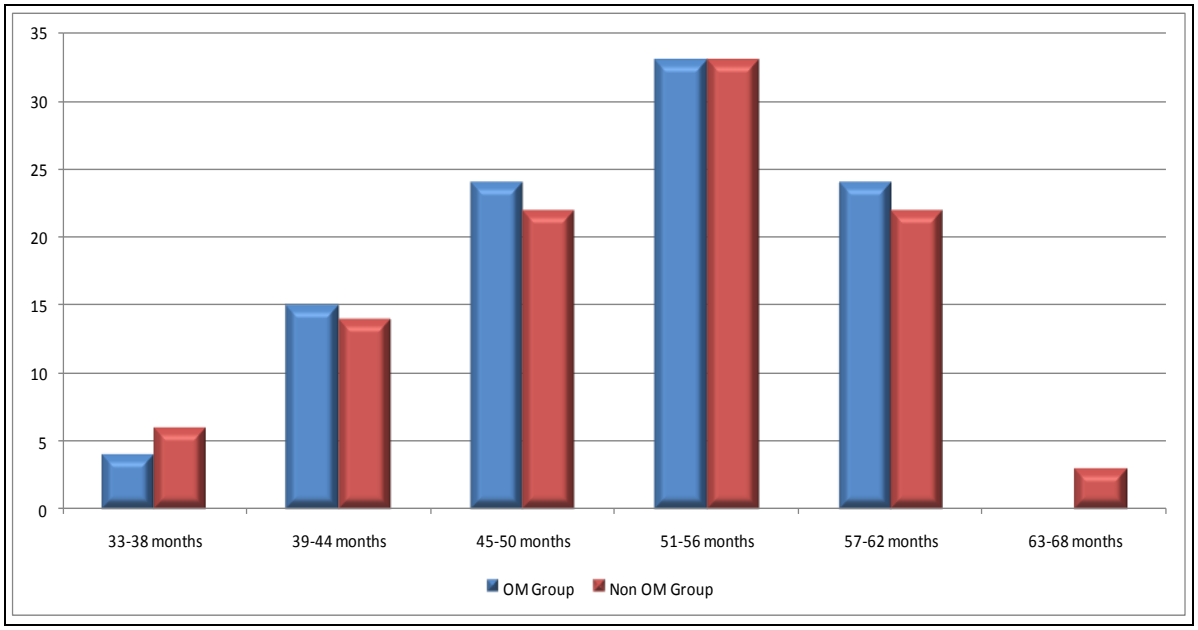



**Figure 4.1 Percentage representation of the age distribution of the two groups**

The Mann-Whitney test was performed to see if there was a difference in the average age of the two groups. No statistically significant difference was found [Mann-Whitney W = 4111,5; p = 0,53] between the age distribution in the OM and non-OM group.

### 4.2.3 Gender and Age

The OM and non-OM groups were compared in terms of gender and age range in Table 4.3.

**Table 4.3 Gender and age range**

| Gender | Age Range | Mean (Standard Deviation) | Age Range | Mean (Standard Deviation |
|---|---|---|---|---|
| | OM Group (n=46) | | Non-OM Group (n=69) | |
| Males | 34 – 62 | 50,17 (6,80) | 34 – 63 | 51,00 (7,43) |
| Females | 39 – 59 | 51,36 (7,20) | 34 – 64 | 51,32 (7,40) |

The age range of the female participants was slightly smaller in the OM group compared to the non-OM group, but there were no statistically significant differences between the ages when compared by gender [Mann-Whitney W = 1113; p = 0,41].

## 4.3 RESULTS OF THE MILLER ASSESSMENT FOR PRESCHOOLERS

The MAP results consist of six scores: a total score and scores for five different subtests. Percentile ranks were obtained for each of these six scores. A percentile rank of 26 and above is considered average or above average. A percentile rank ranging from 6 to 25 is defined as probable at-risk developmental status. A percentile rank of 5 and under is considered definite at-risk developmental status (2, 74).

The percentage of preschoolers that scored within each of these developmental status categories was calculated for the OM and non-OM groups. These descriptive percentages were then used to compare the OM and non-OM group with the norms provided by the authors of the test and with each other.

The chi-square test was used to determine if there were statistically significant differences between the distribution of the scores of the norm sample compared to the OM group and the non-OM group. The chi-square test was also used to determine if there were statistical differences between the results of the OM and non-OM groups. Then relative risk ratios were used to establish if there were clinical differences between the risk of delay in the OM group compared to the non-OM group.

### 4.3.1 Total Score

The total score on the MAP was analysed to indicate the number and percentage of preschoolers in the norm sample and the OM and non-OM groups that fell into the various developmental status categories (Table 4.4).

**Table 4.4 Total score results**

| Developmental Status as indicated by Percentile Ranks | Frequency (Percentage) | | |
|---|---|---|---|
| | **Norm Sample (n=1200)** | **OM Group (n=46)** | **Non-OM Group (n=69)** |
| **Average or Above Average** | 900 (75%) | 27 (59%) | 42 (61%) |
| **Probable At-risk** | 240 (20%) | 17 (37%) | 19 (27%) |
| **Definite At-risk** | 60 (5%) | 2 (4%) | 8 (12%) |
| **Total At-risk (Combined Probable and Definite At-risk)** | 300 (25%) | 19 (41%) | 27 (39%) |
| **Comparison between Groups** | **OM Group and Norm Sample** | **Non-OM Group and Norm Sample** | **OM Group and Non-OM Group** |
| **Chi-Square** | $\chi^2 = 7,79$ | $\chi^2 = 8,86$ | $\chi^2 = 2,47$ |
| **p – value** | p = 0,01 | p = 0,02 | p = 0,29 |
| **Significance** | Significant | Significant | Not Significant |

Table 4.4 shows that the OM and non-OM groups scored worse than the norm sample in terms of the total number of preschoolers that were classified at risk for their total scores on the MAP. However, there was very little difference between the total percentage of the OM and non-OM group who scored at risk.

The chi-square test was used to establish if there were differences between the total scores of each of the two groups and the norm sample. The results indicated a statistically significant difference between the total scores of the OM group and the norm sample (p = 0,01) and the non-OM group and the norm sample (p = 0,02). Both groups scored significantly lower than the norm sample in terms of their total scores on the MAP. The chi-square test was also performed to see if there was a difference between the total score results of preschoolers with a history of OM treated with VTs and those without. There was no statistically significant difference (p = 0,29) between the total MAP score results of the OM and non-OM groups.

The total percentages of preschoolers that scored at risk (combined probable and definite at risk) in terms of their total scores for the norm sample and each of groups are compared in Figure 4.2.

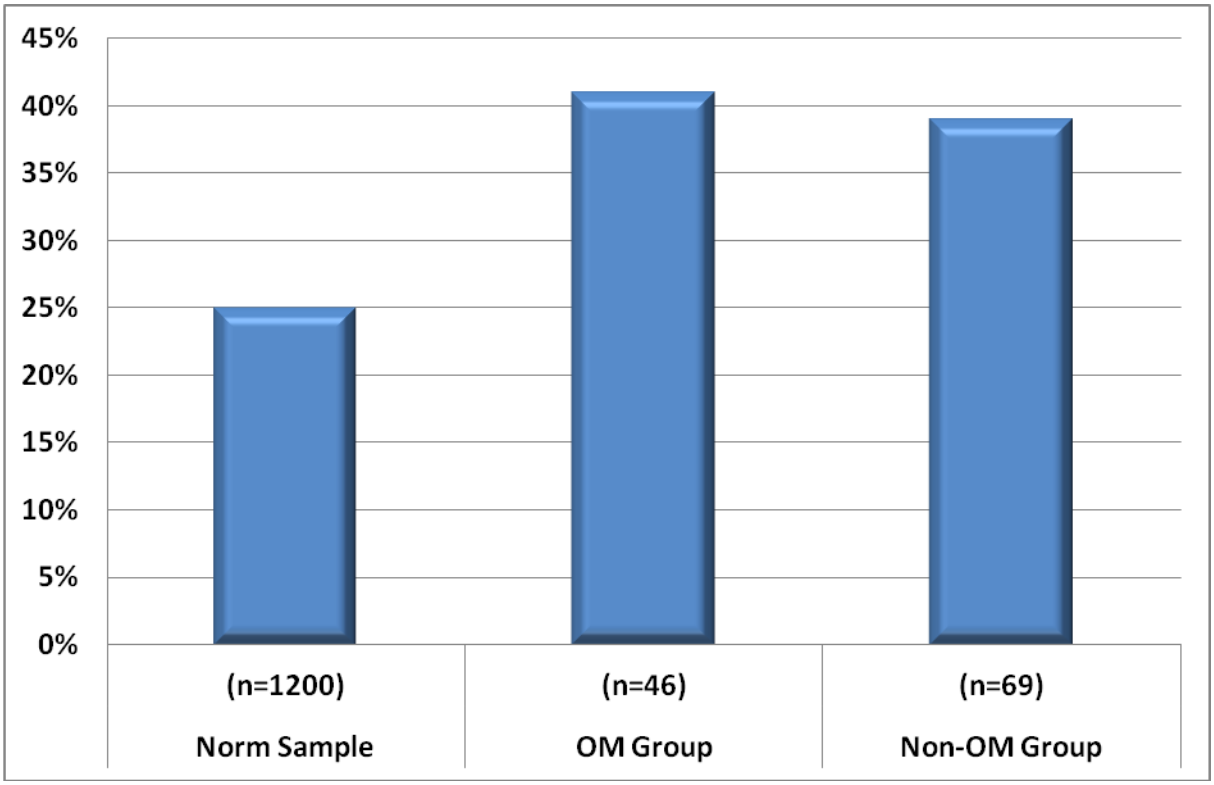



**Figure 4.2 Percentages of preschoolers who scored at risk for total scores on the Miller Assessment for Preschoolers**

Since there were no statistical differences between the total scores of the OM and non-OM groups, a relative risk ratio was used to establish if either the OM or non-OM group was clinically more at risk for delay as measured by the total MAP scores. (Table 4.5).

**Table 4.5 Relative risk, relative risk reduction and absolute risk reduction of the total score**

| At-risk in OM Group | At-risk in Non-OM group | Relative risk | Relative risk Reduction | Absolute risk reduction | Number need to assess to ensure a difference |
|---|---|---|---|---|---|
| 41% | 39% | 0,95 (95%) | 0,05 (5%) | 2% | 50 |

Thirty nine percent of preschoolers from the non-OM group were at risk of developmental delays compared to 41% of preschoolers from the OM group. The absolute risk of having a developmental delay was only 2% more in preschoolers that had a history of OM treated with VTs. The risk of having a developmental delay in the non-OM group was 95% of the risk in the OM group. That is to say that having a history of OM treated with VTs increased the risk of having a developmental delay by 5%. Fifty preschoolers would have to be assessed for there to be one more preschooler from the OM group, than from the non-OM group, to be classified at risk of developmental delays in terms of their total scores. Overall, the relative risk ratios indicate that there was a very small clinical difference between the total scores of the two groups.

### 4.3.2 Neurological Foundations Score

The neurological foundations score includes postural development as well as discrimination of the vestibular, proprioceptive and tactile sensory modalities (2). The neurological foundations scores of the norm sample as well as the two groups are shown in Table 4.6.

**Table 4.6 Neurological foundations score results**

| **Developmental Status as indicated by Percentile Ranks** | **Frequency (Percentage)** | | |
|---|---|---|---|
| | **Norm Sample (n=1200)** | **OM Group (n=46)** | **Non-OM Group (n=69)** |
| **Average or Above Average** | 900 (75%) | 22 (48%) | 35 (51%) |
| **Probable At-risk** | 240 (20%) | 18 (39%) | 21 (30%) |
| **Definite At-risk** | 60 (5%) | 6 (13%) | 13 (19%) |
| **Total At-risk (Combined Probable and Definite At-risk)** | 300 (25%) | 24 (52%) | 34 (49%) |
| **Comparison between Groups** | **OM Group and Norm Sample** | **Non-OM Group and Norm Sample** | **OM Group and Non-OM Group** |
| **Chi-Square** | $\chi^2 = 18,83$ | $\chi^2 = 33,81$ | $\chi^2 = 1,22$ |
| **p – value** | p = 0,01 | p = 0,01 | p = 0,54 |
| **Significance** | Significant | Significant | Not Significant |

Both the OM and non-OM groups scored worse than the norm sample in terms of their neurological foundations scores on the MAP. The distribution of the neurological foundations scores of the OM and non-OM groups were similar.

The chi-square test revealed that there were statistically significant differences between the neurological foundations scores of the norm sample and the OM group (p = 0,01) and between the norm sample and the non-OM group (p = 0,01). Both groups scored significantly lower than the norm sample in terms of their neurological foundations scores on the MAP. The chi-square test was also used to see if there were differences between the neurological foundations scores of the OM and non-OM groups. There was no statistically significant difference (p = 0,54).

Figure 4.3 illustrates the differences in the percentages of preschoolers that scored at risk for the neurological foundations score on the MAP.

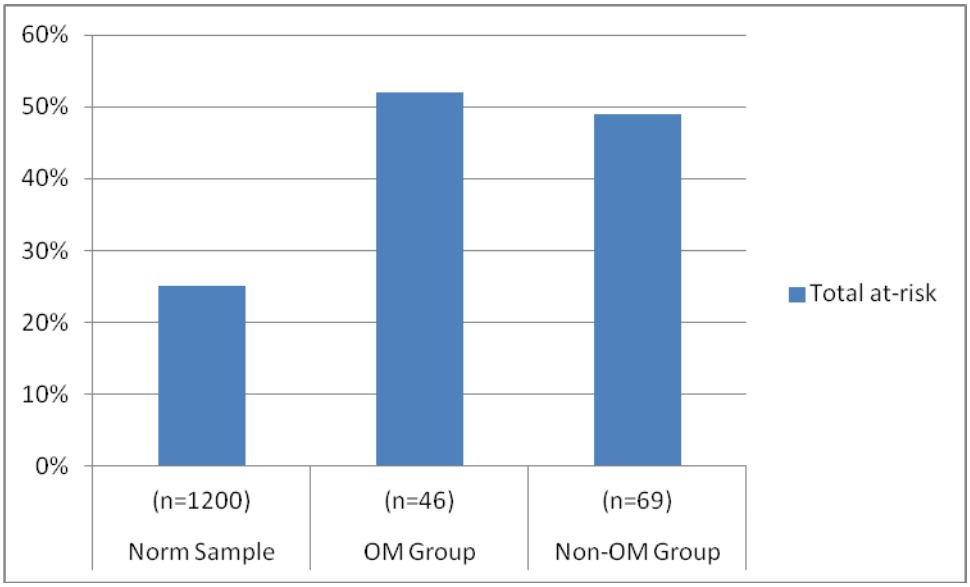



**Figure 4.3 Percentages of preschoolers who scored at-risk for neurological foundations scores on the Miller Assessment for Preschoolers**

A relative risk ratio was analysed to determine if there were clinical differences between the OM and non-OM groups since there were no statistical differences between their neurological foundations scores (Table 4.7).

**Table 4.7 Relative risk, relative risk reduction and absolute risk reduction of the neurological foundations score**

| At-risk in OM Group | At-risk in Non-OM group | Relative risk | Relative risk Reduction | Absolute risk reduction | Number need to assess to ensure a difference |
|---|---|---|---|---|---|
| 52% | 49% | 0,94 (94%) | 0,06 (6%) | 3% | 33 |

The combined percentage of preschoolers that scored at a probable and definite at-risk status in the two groups was similar. The absolute risk of having a neurological foundations delay was only 3% more in preschoolers who had a history of OM treated with VTs. The relative risk of preschoolers from either group being classified at risk for the neurological foundations score was similar at 94%. This means that having a history of OM treated with VTs only increased the risk of scoring at risk, in terms of neurological foundations, by 6%. Thirty three preschoolers would need to be assessed for one more with a history of OM and VTs to classified at risk for neurological foundations compared to those with no history. The clinical difference between the two groups is very small.

### 4.3.3 Co-ordination Score

The co-ordination score on the MAP refers to learnt series of movements that combine to produce a smooth efficient action. These include gross motor, fine motor and oral motor skills (2). The distribution of the norm sample and the OM and non-OM group's scores for the co-ordination subtest is shown in Table 4.8.

**Table 4.8 Co-ordination score results**

| Developmental Status as indicated by Percentile Ranks | Frequency (Percentage) | | |
|---|---|---|---|
| | **Norm Sample (n=1200)** | **OM Group (n=46)** | **Non-OM Group (n=69)** |
| **Average or Above Average** | 900 (75%) | 24 (52%) | 34 (49%) |
| **Probable At-risk** | 240 (20%) | 16 (35%) | 26 (38%) |
| **Definite At-risk** | 60 (5%) | 6 (13%) | 9 (13%) |
| **Total At-risk (Combined Probable and Definite At-risk)** | 300 (25%) | 22 (48%) | 35 (51%) |
| **Comparison between Groups** | **OM Group and Norm Sample** | **Non-OM Group and Norm Sample** | **OM Group and Non-OM Group** |
| **Chi-Square** | $\chi^2 = 14,57$ | $\chi^2 = 23,38$ | $\chi^2 = 0,11$ |
| **p – value** | p = 0,01 | p = 0,01 | p = 0,95 |
| **Significance** | Significant | Significant | Not Significant |

A higher percentage of the OM and non-OM groups were at risk for co-ordination delays than the norm sample. The distribution of the co-ordination scores was very similar for the OM and non-OM groups.

The chi-square test was performed to determine if there were differences between the co-ordination scores of each of the two groups and the norm sample. There was a statistically significant difference between the co-ordination scores of the norm sample and the OM group (p = 0,01) and the norm sample and the non-OM group (p = 0,01). Both groups scored significantly lower than the norm sample in terms of their co-ordination scores. The chi-square test was also used to compare the con-ordination results of the OM group to the non-OM group. No statistically significant difference was found (p = 0,95).

Figure 4.4 shows that a similar percentage of preschoolers from the OM and non-OM groups were at risk for co-ordination delays. The OM and non-OM groups both scored worse than the norm sample on the co-ordination subtest of the MAP.

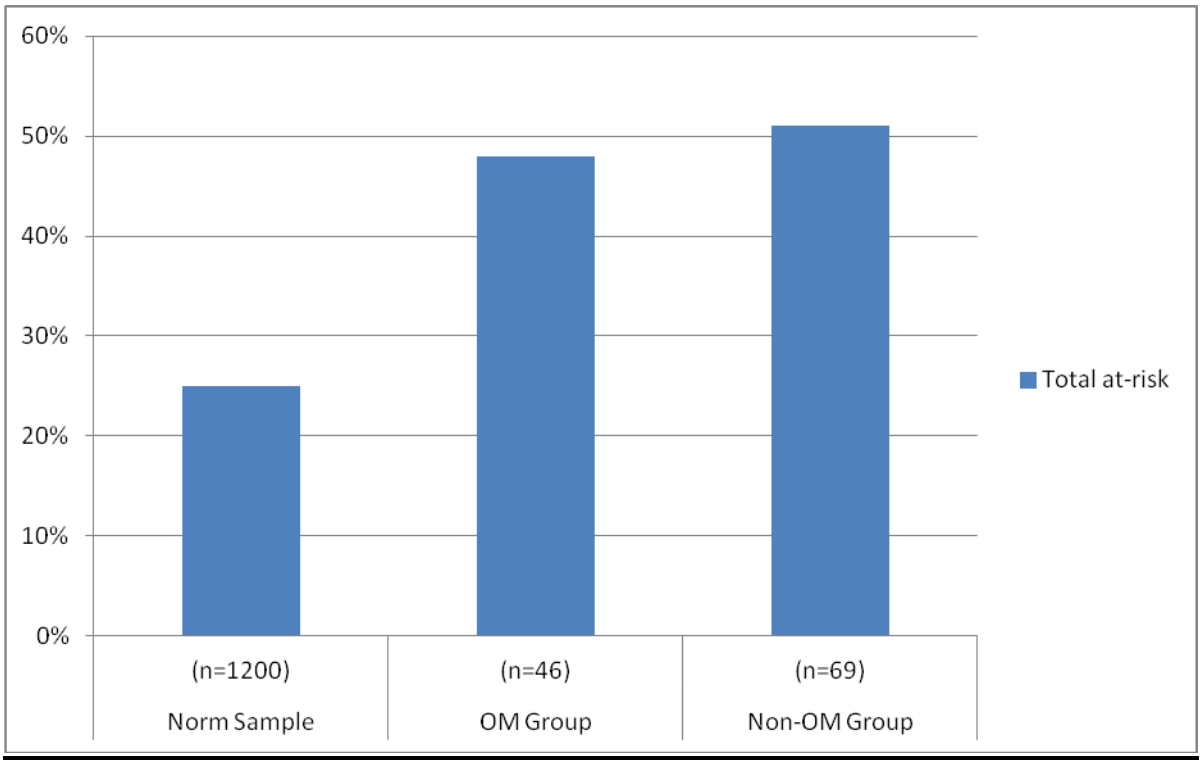



**Figure 4.4 Percentages of preschoolers who scored at-risk for co-ordination scores on the Miller Assessment for Preschoolers**

Since there was no statistically significant difference between the OM and non-OM groups, clinical differences in the risk of co-ordination delays between the OM and non-OM groups were investigated using the a relative risk ratio (Table 4.9).

**Table 4.9 Relative risk, relative risk reduction and absolute risk reduction of the co-ordination score**

| At-risk in OM Group | At-risk in Non-OM group | Relative risk | Relative risk Reduction | Absolute risk reduction | Number need to assess to ensure a difference |
|---|---|---|---|---|---|
| 48% | 51% | 0,94 (94%) | 0,06 (6%) | 3% | 33 |

The percentage of preschoolers that were at-risk for co-ordination delays was very similar in the two groups with the difference between them being only 3%. The risk of having a co-ordination delay in the OM group was 94% of the risk in the non-OM group. Therefore having a history of OM treated with VTs did not increase the risk of having a co-ordination delay. Thirty three preschoolers would need to be assessed with the MAP, for one more from the non-OM group to score at-risk for co-ordination delays compared to the OM group. Overall, the clinical differences between the two groups were very small.

### 4.3.4 Verbal Score

The verbal score index of the MAP measures the processes associated with the production and perception of sounds used in spoken language. These include verbal memory, sequencing, comprehension, association and expression (2). The results of the norm sample and the OM and non-OM groups are represented in table 4.10.

**Table 4.10 Verbal score results**

| **Developmental Status as indicated by Percentile Ranks** | **Frequency (Percentage)** | | |
|---|---|---|---|
| | **Norm Sample (n=1200)** | **OM Group (n=46)** | **Non-OM Group (n=69)** |
| **Average or Above Average** | 900 (75%) | 31 (67%) | 52 (75%) |
| **Probable At-risk** | 240 (20%) | 15 (33%) | 16 (23%) |
| **Definite At-risk** | 60 (5%) | 0 (0%) | 1 (2%) |
| **Total At-risk (Combined Probable and Definite At-risk)** | 300 (25%) | 15 (33%) | 17 (25%) |
| **Comparison between Groups** | **OM Group and Norm Sample** | **Non-OM Group and Norm Sample** | **OM Group and Non-OM Group** |
| **Chi-Square** | $\chi^2 = 6,10$ | $\chi^2 = 2,04$ | $\chi^2 = 1,82$ |
| **p – value** | p = 0,05 | p = 0,36 | p = not given due to small cell counts |
| **Significance** | Significant | Not Significant | Not Significant |

There were some differences in the distribution of verbal scores of the OM and non-OM groups. A greater percentage (33%) of preschoolers from the OM group were at-risk for verbal delays compared to the non-OM group (25%) and the norm sample (25%).

The chi-square test indicated that there was a statistically significant difference between the verbal scores of the OM group and the norm sample (p = 0,05), but there was no statistically significant difference between the non-OM group and the norm sample (p = 0,36). The OM group scored significantly lower than the norm sample in terms of their verbal scores on the MAP. The chi-square test was also used to determine if the differences between the verbal scores of the OM and non-OM groups was statistically significant. It revealed that the difference was not statistically significant.

A relative risk ratio was used to determine the risk of verbal delays in the OM and non-OM groups since there were no statistical differences between them. The relative risk analysis (Table 4.11) indicated the OM group was more at risk than the non-OM group for verbal delays.

**Table 4.11 Relative risk, Relative risk reduction and Absolute risk reduction of the verbal score**

| At-risk in OM Group | At-risk in Non-OM group | Relative risk | Relative risk Reduction | Absolute risk reduction | Number need to assess to ensure a difference |
|---|---|---|---|---|---|
| 33% | 25% | 0,76 (76%) | 0,24 (24%) | 8% | 13 |

The absolute risk of having a verbal delay was 8% more in preschoolers with a history of OM treated with VTs. Although these results are not statistically significant they do indicate a clinical difference with a history of OM treated with VTs increasing the risk of having a verbal delay by 24%.

Figure 4.5 shows that the OM group is more at risk for verbal delays compared to the non-OM group and the norm sample.

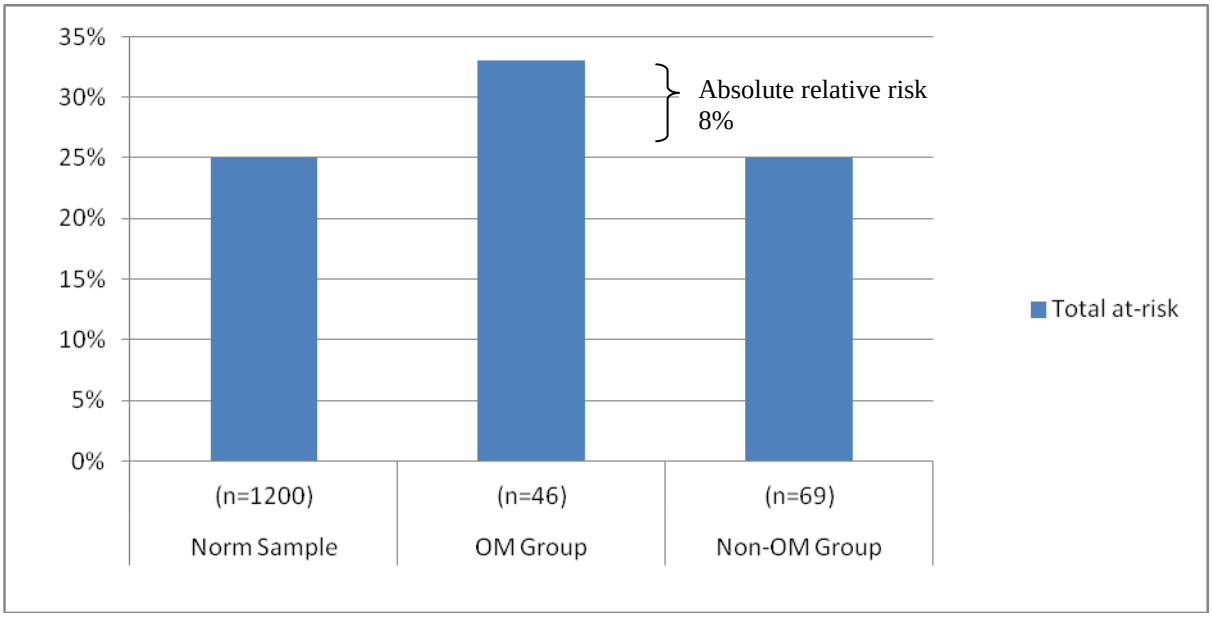



**Figure 4.5 Percentages of preschoolers who scored at-risk for verbal scores on the Miller Assessment for Preschoolers**

### 4.3.5 Non-Verbal Cognition Score

The non-verbal score on the MAP includes the ability to process information and apply knowledge using memory, sequencing, visualisation and mental manipulations not requiring spoken language (2). Table 4.12 shows the non-verbal cognition score results.

**Table 4.12 Non-verbal cognition score results**

| **Developmental Status as indicated by Percentile Ranks** | **Frequency (Percentage)** | | |
|---|---|---|---|
| | **Norm Sample (n=1200)** | **OM Group (n=46)** | **Non-OM Group (n=69)** |
| **Average or Above Average** | 900 (75%) | 43 (94%) | 65 (94%) |
| **Probable At-risk** | 240 (20%) | 2 (4%) | 2 (3%) |
| **Definite At-risk** | 60 (5%) | 1 (2%) | 2 (3%) |
| **Total At-risk (Combined Probable and Definite At-risk)** | 300 (25%) | 3 (6%) | 4 (6%) |
| **Comparison between Groups** | **OM Group and Norm Sample** | **Non-OM Group and Norm Sample** | **OM Group and Non-OM Group** |
| **Chi-Square** | $\chi^2 = 8,32$ | $\chi^2 = 13,76$ | $\chi^2 = 0,23$ |
| **p – value** | p = 0,02 | p = 0,01 | p = 0,89 |
| **Significance** | Significant | Significant | Not Significant |

There were notably smaller percentages of preschoolers from the OM and non-OM who scored at-risk for non-verbal cognition delays compared to the percentage from the norm sample. The distribution of the scores of the OM and non-OM groups was extremely similar.

The chi-square test showed that there were statistically significant differences between the non-verbal cognition scores of the OM group and the norm sample (p = 0,02) and the non-OM group and the norm sample (p = 0,01). Both groups scored significantly higher than the norm sample in terms of their non-verbal cognition scores on the MAP. There were no statistically significant differences between the non-verbal cognition scores of the OM and non-OM groups (p = 0,89).

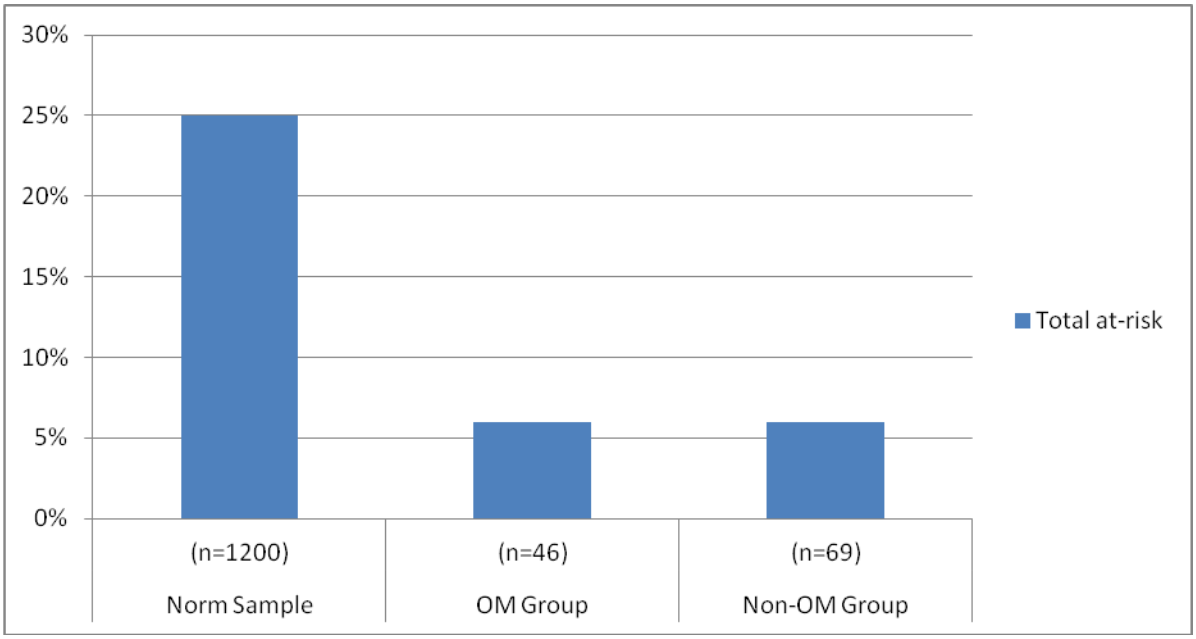



**Figure 4.6 Percentages of preschoolers who scored at-risk for non-verbal cognition scores on the Miller Assessment for Preschoolers**

There were no differences in the percentage of preschoolers that were at risk for non-verbal cognition as illustrated in Figure 4.6. It also shows that the percentage of at-risk preschoolers from the norm sample was considerably higher than from the two groups.

The relative risk of non-verbal delays between the OM and non-OM groups is represented in table 4.13.

**Table 4.13 Relative risk, Relative risk reduction and Absolute risk reduction of the non-verbal cognition score**

| At-risk in OM Group | At-risk in Non-OM group | Relative risk | Relative risk Reduction | Absolute risk reduction | Number need to assess to ensure a difference |
|---|---|---|---|---|---|
| 6% | 6% | 1 (100%) | 0 (0%) | 0% | Infinite |

The same percentage of preschoolers in each group were at risk for non-verbal delays. A preschooler with a history of OM and VTs therefore had the same chance of being classified at risk as a preschooler with no history. This shows that there were no clinical differences between the two groups in terms of non-verbal results.

### 4.3.6 Complex Tasks Score

The complex tasks score on the MAP assesses the ability to combine sensory-motor and cognitive skills for the interpretation of visual-spatial information (2). The complex tasks score results of the norm sample and the two groups are compared in table 4.14.

**Table 4.14 Complex tasks score results**

| **Developmental Status as indicated by Percentile Ranks** | **Frequency (Percentage)** | | |
|---|---|---|---|
| | **Norm Sample (n=1200)** | **OM Group (n=46)** | **Non-OM Group (n=69)** |
| **Average or Above Average** | 900 (75%) | 34 (74%) | 50 (72%) |
| **Probable At-risk** | 240 (20%) | 11 (24%) | 13 (19%) |
| **Definite At-risk** | 60 (5%) | 1 (2%) | 6 (9%) |
| **Total At-risk (Combined Probable and Definite At-risk)** | 300 (25%) | 12 (26%) | 18 (28%) |
| **Comparison between Groups** | **OM Group and Norm Sample** | **Non-OM Group and Norm Sample** | **OM Group and Non-OM Group** |
| **Chi-Square** | $\chi^2 = 1,06$ | $\chi^2 = 1,81$ | $\chi^2 = 2,28$ |
| **p – value** | p = 0,59 | p = 0,40 | p = 0,32 |
| **Significance** | Not Significant | Not Significant | Not Significant |

The percentages of preschoolers that were classified in the different developmental categories were similar for all three samples.

The chi-square test revealed that there were no statistically significant differences between the complex tasks scores of the OM group and the norm sample (p = 0,59) and the non-OM group and the norm sample (p = 0,40). Slightly more preschoolers from the non-OM group than the OM group scored as being at risk in terms of their complex tasks scores. However, the chi-square test showed that there were no statistically significant differences between the OM and non-OM group's scores (p = 0,32).

Figure 4.7 shows the percentages of at-risk preschoolers in terms of complex tasks from the norm sample and the OM and non-OM groups.

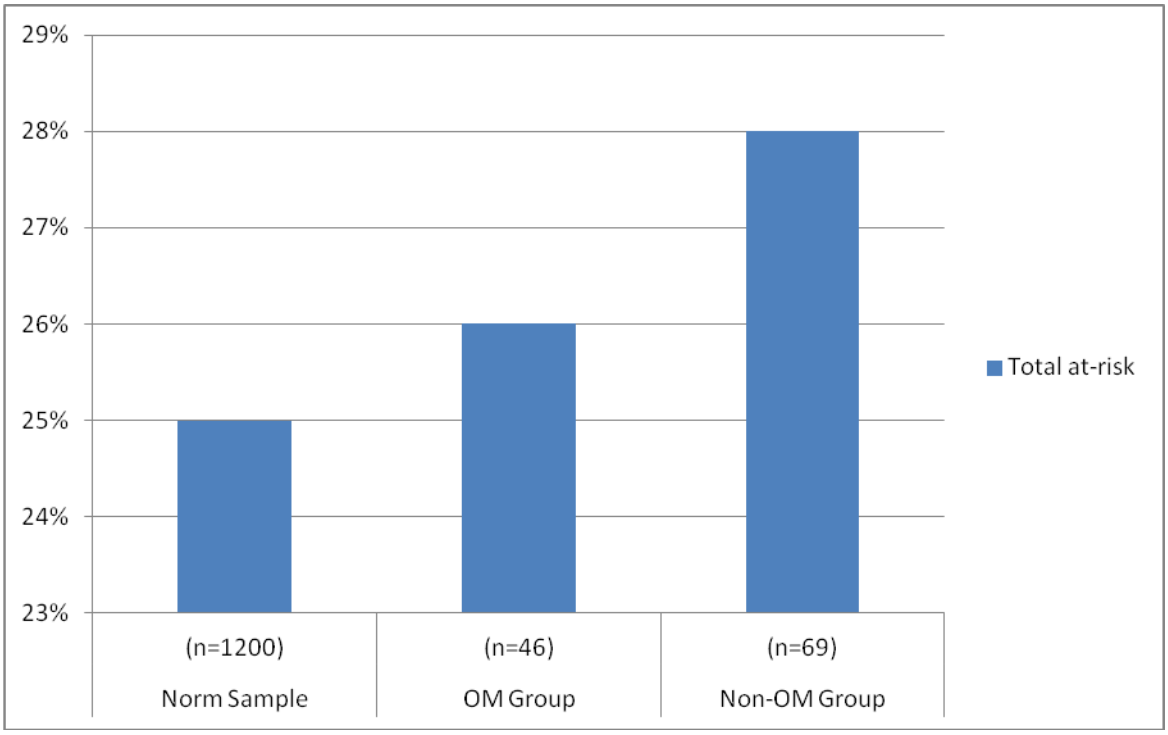



**Figure 4.7 Percentages of preschoolers who scored at risk for complex tasks scores on the Miller Assessment for Preschoolers**

A relative risk analysis of the OM and non-OM group's complex tasks score results is shown in table 4.15.

**Table 4.15 Relative risk, relative risk reduction and absolute risk reduction of the complex tasks score**

| At-risk in OM Group | At-risk in Non-OM group | Relative risk | Relative risk Reduction | Absolute risk reduction | Number need to assess to ensure a difference |
|---|---|---|---|---|---|
| 26% | 28% | 0,93 (93%) | 0,07 (7%) | 2% | 50 |

The percentage of preschoolers that were at risk for delays in terms of their complex tasks scores was similar in the two groups with an absolute risk reduction of only 2% between them. Having a history of OM did not increase the risk of having delayed complex tasks. Fifty preschoolers would need to be assessed with the MAP, for one more from the non-OM group to score at-risk in terms of complex tasks compared to the OM group. Overall, the clinical differences between the two groups were very small.

### 4.3.7 Comparison of the Otitis Media Group and the Non-Otitis Media Group to the Norm Sample in terms of Developmental Profiles

The percentages of preschoolers that scored at risk from the OM and non-OM groups were compared to the norm sample of the MAP in order to indicate their strengths and weaknesses in terms of their developmental profiles (Figure 4.8).

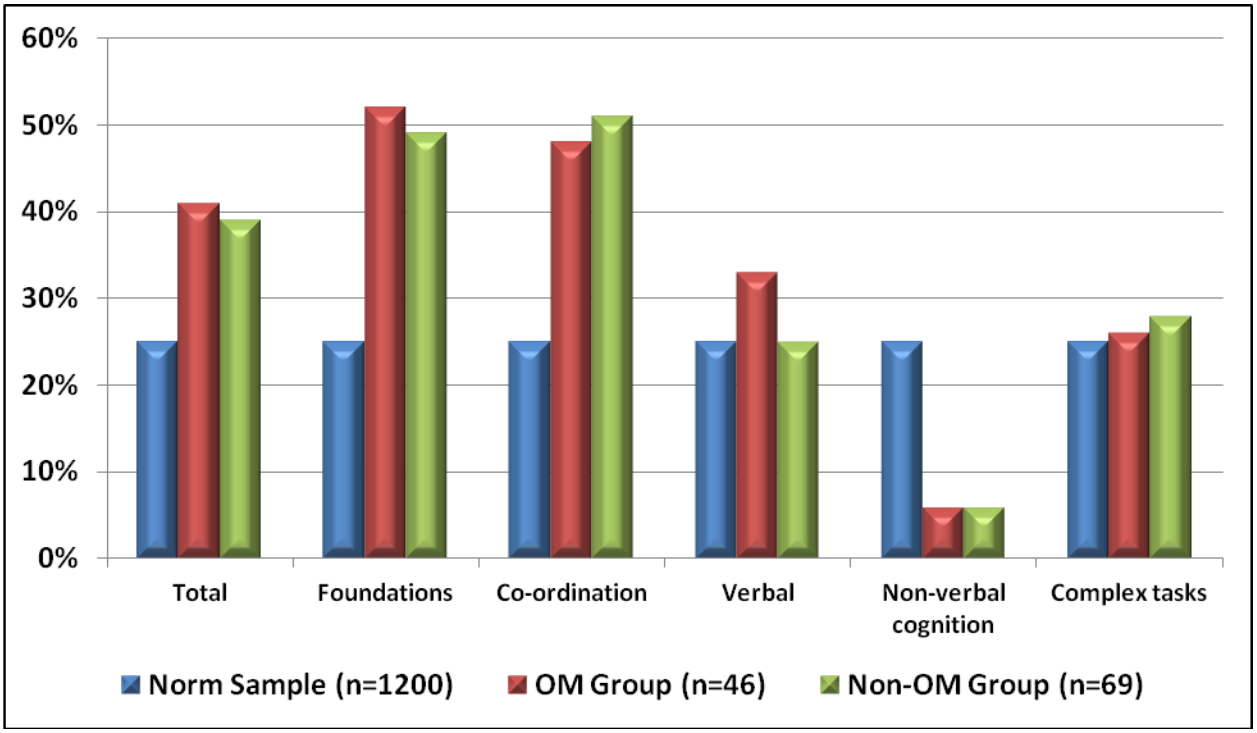



**Figure 4.8 Percentages of preschoolers from the norm sample, OM group and non-OM group that scored at-risk for developmental delay in terms of the various Miller Assessment for Preschoolers scores.**

Figure 4.8 illustrates that the OM group presented with weaknesses in terms of total, neurological foundations, co-ordination and verbal scores, but non-verbal cognition was an area of strength. The non-OM group had weaknesses in terms of total, neurological foundations and co-ordination scores, but non-verbal cognition was strength. The developmental profiles of the two groups were therefore similar, except for the fact that preschoolers from the OM group were more at risk for verbal delays.

## 4.4 SUMMARY

In summary, the demographics of the OM and non-OM groups were similar. There were no statistically significant differences between the gender distribution or average age of the two groups. Both groups consisted mostly of males and the age distribution of both groups was slightly skewed towards older preschoolers in terms of the MAP age ranges.

The results of the chi-square tests showed that there were no statistically significant differences between the total, neurological foundations, co-ordination, verbal, non-verbal cognition or complex tasks scores of the OM group and non-OM groups.

Relative risk analyses of the results of the OM and non-OM groups revealed no clinical difference in terms of non-verbal scores and very small clinical differences in terms of total scores, neurological foundations scores, co-ordination scores and complex tasks scores. There was a clinical difference between the verbal scores, with preschoolers from the OM group being more at risk than those from the non-OM group for verbal delays.

# CHAPTER 5: DISCUSSION

## 5.1 INTRODUCTION

Chapter five begins by examining the demographics of the samples used. The developmental profiles of the OM and non-OM groups are presented. The effects of OM treated with VT on the development of preschoolers are then discussed. Finally, the implications of the findings are presented from an OT perspective.

## 5.2 DEMOGRAPHICS

### 5.2.1 Gender

The gender distribution of the non-OM group was 64% males and 36% females. This distribution differs from data from Statistics South Africa which estimates that 51% of preschoolers in Gauteng are male and 49% are female (127). The fact that there was a higher percentage of males in the non-OM sample than in the general population, may be linked to the fact that all the preschoolers in the non-OM group were referred to OT with suspected developmental delays. Data on the gender distribution of children with developmental delays in South Africa was not available. However, data from the national registry in Taiwan from 2003 to 2008 found that the gender distribution of developmentally-delayed children below the age of 72 months, was 65% males and 35% females (128). This is very similar to the 64% males and 36% females in the non-OM group, suggesting that the high proportion of males in the non-OM group may have been because developmental delay occurs more frequently in males than females (128).

The gender distribution in the OM group was 76% males and 24% females. The OM group were also referred to OT with suspected developmental delays. Therefore, the higher proportion of males in this group than in the general population could also be related to the fact that these children were likely to be developmentally delayed. However, further explanation is needed to account for the fact that there was a higher percentage of males in the OM group (76%) than in the non-OM group (64%). The higher percentage of males in the OM group may also be due to the fact that OM is more prevalent in males than in females (23, 24). The reasons for the higher prevalence among males are not fully known, but this pattern is true for most infectious diseases of childhood (29).

Even though there was a higher percentage of males in the OM group, the difference in the gender distributions of the two groups was not statistically significant. This is important because it shows that gender was accounted for as a possible extraneous variable and it did not affect the developmental scores of the two groups.

### 5.2.2 Age

The MAP assesses preschoolers aged from 33 to 68 months. All appropriate records from preschoolers within this age-range were included in the OM and non-OM groups. The age range in the OM group was 34 to 62 months, with the average age being 50,55 months. The age range in the non-OM group was 34 to 64 months, with the average age being 51,12 months.

The fact that the age range in both groups started at 34 months was in line with the literature, because “OM-prone” children are likely to have a history of recurrent OM by the time they reach this age. OM occurs most frequently between the ages of six to eleven months (23, 24) because of the anatomy and physiology of infants’ Eustachian tubes and because their immune systems are still developing (30). A child who has had few or no episodes of OM by 36 months, is unlikely to experience subsequent severe or recurrent OM (29).

The age range used in this study was similar to that used in most of the studies on the effects of OM that were reviewed in the literature review. Six of the studies on the effects of OM on speech and language (87, 89, 92, 97, 99, 100) and five of the studies on the effects on vestibular functions (19, 109-112) included preschoolers. The focus on preschoolers is noteworthy because it highlights the importance of the early identification and treatment of developmental delays. Although the concept of neuroplasticity allows for development and learning throughout life, the preschool years are still considered a sensitive period for child development (72). Research has shown that intervention programs that begin during the preschool years can significantly alter the developmental trajectories and subsequent school success of children who present with developmental delays or are considered at risk for developmental delay (73). It was appropriate that this research focussed on the effects of OM on preschoolers, so that if adverse effects were identified, intervention could begin within this sensitive period.

The fact that no significant difference was found between the average age of the OM and non-OM groups is important because it shows that age did not impact on the developmental scores of the groups.

## 5.3 DEVELOPMENTAL PROFILES OF THE OM AND NON-OM GROUPS

The percentages of preschoolers, from the OM and non-OM groups, that scored at risk were statistically different to the norm sample for some of the subtests of the MAP. It is possible that these differences were due to demographic variations, since the MAP was standardised on a sample of American children stratified according to race, sex, age and social-economic status. The preschoolers in this study had a different nationality and may have been from different racial groups to the preschoolers in the norm sample. However, this is not likely to have had a considerable impact on their scores since the MAP is one of the most “culture free” assessments as most of the items are neurologically-based and therefore do not reflect the values of specific cultures (75).

The samples in this study had higher percentages of males than females and their age distributions were slightly skewed towards older preschoolers. This is not a major concern as the MAP has been standardised on male and female preschoolers of all different ages between 33 months and 68 months (2). The MAP verbal index has been found not to be biased against males when determining at-risk children (77) and it has also been found to be less culturally-biased against older preschoolers than the Peabody, Carrow, or Boehm tests (77).

In terms of socio-economic status, the MAP norm sample was found to have a disproportionally high number of children of well-educated, professionally-employed parents (129). Although the socio-economic status of the preschoolers in this study was not specifically quantified, it is likely that a considerable number of them also had well-educated professional parents because they all had access to private OT practices in high socio-economic areas. Overall, the differences in the demographics of the samples in this study compared to the norm sample seem to be minor and are not likely to have had a considerable impact on their scores.

The statistical differences in the percentages of preschoolers that scored at risk, are therefore expected to be due to different developmental abilities rather than demographic differences. All the preschoolers in this study were referred to OT because of suspected developmental delays. The pattern of these delays, in both the OM and non-OM groups, was that neurological foundations and motor co-ordination were weaknesses, but non-verbal cognition and complex tasks were relative strengths. This pattern of scores is consistent with a Sensory-Based Motor Disorder (SBMD) (1, 2, 82). A SBMD is a form of Sensory Processing Disorder (SPD) which should be treated using OT-SI. Therefore, it was appropriate that the preschoolers were referred to the SI OT practices that were involved in this study.

Although the developmental profiles of both the OM and non-OM groups were consistent with a SBMD, there was one difference between them. A higher percentage of the OM group scored at risk for verbal delays compared to the norm sample, whereas the same percentage of preschoolers from the non-OM group scored at risk as in the norm sample. This fits with the finding that there was a clinical difference between the verbal scores of the OM and non-OM groups, with preschoolers from the OM group being more at risk for verbal delays.

## 5.4 THE EFFECT OF OTITIS MEDIA ON VERBAL ABILIITIES

Although the OM group were clinically more at risk for verbal delays, there were no statistical differences between the verbal scores of the OM and the non-OM groups. This finding was generally supported by the literature. Although there are studies that support an association between OM and delayed verbal ability (84, 88, 92, 100), Wright et al, Lous et al and Serbetcioglu et al all found that there was no significant difference between the verbal scores of OM-prone children and controls (41, 89, 97). This finding is also in-line with the results of the three meta-analyses (93, 103, 104) which concluded that there were no (or markedly low) adverse effects on verbal ability which may be unimportant in otherwise healthy children.

The reasons for the lack of significant adverse effects on verbal abilities are believed to be linked to cumulative risk (44, 93, 99, 103). A cumulative risk model proposes that OM will only have a negative impact in the presence of other risk factors (105). This theory is supported by the research of Hemmer and Ratner who found that controlling for family and child care settings may minimise the statistical association between OM and speech and language development (87).

Vernon-Feagans et al also found that child care settings are an important factor. Their research showed that children in low quality child care who had chronic problems with OM had lower scores on language performance than controls. However, there were no differences between children with chronic OM and control children if they were in high quality child care. They proposed that high quality child care buffered children with chronic OM against adverse effects because the children in these settings received more individual attention and language stimulation. Therefore, it may be important to view chronic OM as only one of many risk factors in early childhood that might produce adverse outcomes in combination with other risk factors (44, 99).

Other risk factors which may contribute towards a child with OM presenting with verbal delays have been suggested by Rovers et al, Klein and Casby. They propose that the negative effects of OM on development and learning, may be worse in children who are already developmentally at risk due to diagnosed conditions (such as cleft palate, Down syndrome, pervasive developmental disorders, attention deficit disorders or intellectual impairments), who have a low socio-economic status, who are in less responsive home environments, or who are not adequately medically managed (4, 29, 103).

Children with diagnosed conditions which affect development were excluded from this study. Although the preschoolers' home and child care environments weren't formally quantified, the fact that they all had access to therapy at private practices situated in high socio-economic areas, suggests that they were likely to be from home and child care settings where the quality of developmental stimulation was high. All the preschoolers in the OM group had VTs inserted, suggesting that their OM was adequately medically managed. The fact that the preschoolers with a history of OM did not present with any other identified risk factors, may have protected them from significant adverse effects on their verbal development.

## 5.5 THE EFFECT OF OTITIS MEDIA ON SENSORY PROCESSING, POSTURAL DEVELOPMENT AND MOTOR CO-ORDINATION

The OM and non-OM groups both scored significantly lower than the norm sample in terms of neurological foundations. This is to be expected, since the OM and non-OM groups were both referred to OT with suspected developmental delays. When comparing the OM and non-OM groups, slightly more preschoolers from OM group scored at risk for neurological foundations delays and slightly more from the non-OM group scored at risk for co-ordination delays. This does not imply that a not having a history of OM predisposed children to co-ordination delays. This result merely occurred because both groups were referred to OT with suspected developmental delays and were thus both at risk for co-ordination delays.

There were no statistically significant differences between the neurological foundations and co-ordination scores of the OM and non-OM groups. This indicates that a history of OM treated with VTs did not have an adverse effect on sensory processing, postural development or motor co-ordination. The literature indicates that OM that is not surgically treated does affect vestibular processing causing balance dysfunction and clumsiness (18, 19, 110-112). This motor dysfunction is thought to be due to inflammation of the vestibular apparatus that happens during Labyrinthitis which is the most common side-effect of OM (20).

This makes sense from an SI perspective because Labyrinthitis would cause disruptions to the vestibular system. The functions of the vestibular system are to provide subconscious awareness of body position and movement, to maintain muscle tone and influence postural mechanisms and to stabilise the visual field. Disturbed vestibular processing can therefore lead to impaired postural mechanisms (including balance) and eye movements. If vestibular dysfunction is not treated, it can result in problems with bilateral motor co-ordination, body scheme, visual-spatial processing and praxis (1, 22). OM-induced pain and lethargy may also deter a child from engaging in motor activities, leading to less motor stimulation and compounding motor delays (103).

The fact that there were no adverse effects on sensory processing, postural development and motor co-ordination in this study, is thought to be due to the fact that all the preschoolers in the OM group had VTs inserted. This assumption is supported by all the articles on the effects of OM on vestibular functions that were reviewed. All these studies (18, 19, 110-112) found that OM did impair vestibular functions, but the insertion of VTs relieved any dysfunction. Treatment of OM (including surgical treatment with VTs) can also alleviate OM-induced pain and lethargy, so that a child is more willing to engage in motor activities, thereby stimulating motor development (103).

## 5.6 THE EFFECT OF OTITIS MEDIA ON NON-VERBAL COGNITION AND COMPLEX TASKS

The same percentage of preschoolers from the OM and non-OM groups scored at risk for non-verbal cognition delays, but slightly more preschoolers from the non-OM group scored at risk for complex tasks delays compared to the OM group. Once again, this does not imply that not having a history of OM predisposed children to complex tasks delays, it is merely a function of the fact that the preschoolers in both groups were at risk of delays because they were all referred to OT.

There were no statistical differences between the OM and non-OM groups for non-verbal cognition or complex tasks. This indicated that a history of OM treated with VTs did not adversely affect non-verbal cognition or complex tasks. The literature suggests that OM may affect hearing and vestibular processing, but neither of these are directly linked to non-verbal cognition (1, 22). If the preschoolers in this study had verbal and motor delays, this could have limited their engagement in stimulation activities, indirectly leading to cognitive delays. However, since verbal and motor abilities were not significantly adversely affected, it is reasonable that cognition was also unaffected. The complex tasks score tests the ability to combine sensory-motor abilities with cognition (2). Since sensory processing, motor co-ordination and cognition were not adversely affected by OM treated with VTs, it is logical that complex tasks were not affected either.

## 5.7 IMPLICATIONS FOR OCCUPATIONAL THERAPY

Although there were no statistically significant adverse effects on the developmental outcomes of the children with a history of OM treated with VTs in this study, the literature suggests that there may be adverse developmental effects on children who are considered at risk. The risk factors include diagnosed conditions which affect development, low socio-economic status, less responsive home or child care environments and inadequate medical management (4, 29, 103). The literature also provides evidence that OM affects children's occupational performance (117).

Doctors and ENT specialists who treat children with OM need to be aware of these risk factors, so that they can treat OM in at-risk children more aggressively and make appropriate referrals. If there are any concerns that a child's development or occupational engagement is being restricted because of recurrent OM and/or any of the other risk factors mentioned in the previous paragraph, then that child should be referred for an OT assessment.

OTs are ideally suited to assess and treat children whose development and occupational performance are affected by any of these risk factors. This is outlined in the Occupational Therapy Practice Framework: Domain and Process 2nd edition which states that aspects of the OT domain include client factors, environmental factors, performance skills and occupations (114). OM may cause restricted development or occupational performance in children that are at risk because of factors relating to any of these levels.

An OT assessment would involve gathering information about client factors. This would include features of OM and other possible co-morbid conditions that affect development. OTs have the knowledge to recognise the features of different childhood conditions and make referrals to appropriate specialists for diagnosis. If a child had already been diagnosed, an OT would be able to advocate for adequate medical management, especially if a child's development and occupational engagement were being compromised. Lastly, an OT would be able to treat the developmental and occupational implications of any childhood condition.

An OT assessment would also consider a child's environment. If a home or school environment was suspected of being unsatisfactory, an OT would be able to visit to assess the physical and social aspects of these contexts. She would then be able to alter or adapt the environments to make them more responsive to the child's needs.

In terms of performance skills, an OT can use a range of standardised assessment tools, such as the MAP, to assess a child's development in terms of the sensory, motor, emotional, cognitive, communication and social domains. If delays were detected, she would be able to treat them using treatment frameworks such as SI. She would also be able to refer on to other relevant professionals, such as speech therapists if verbal skills were delayed. If the OT found vestibular and motor delays in children with OM that was not treated with VTs, she could motivate for surgical treatment because the literature indicates that this leads to the resolution of these delays (18, 19, 110-112).

Finally, the core purpose of OTs is to support health and participation in life through engagement in occupation (114). An OT would therefore be able to use skills such as activity analysis to assess a child's occupational performance. This would include activities of daily living, such as sleeping and eating, as well as play and social interactions which are known to be affected by OM (117). She would then be able to maximise occupational engagement by improving the performance skills needed for a specific activity and/or by altering or adapting the environment to facilitate engagement.

The OT philosophy is very holistic. OTs are guided by principles such as the interplay between dynamic systems e.g. the internal system (client) and external system (environment) which are emphasised by MOHO. The attitudes, knowledge and skills of OTs are therefore well-matched to assessing and treating children who present with developmental delays or restricted occupational performance because of a history of OM and other risk factors.

# CHAPTER SIX: CONCLUSION

## 6.1 INTRODUCTION

Chapter six will present the limitations of this study and make recommendations for further research. It will then summarise the main conclusions that were drawn from this study.

## 6.2 LIMITATIONS OF THE STUDY AND DIRECTIONS FOR FURTHER STUDY

### 6.2.1 Record Review

Lowenstein identifies three limitations of using record reviews as a research tool. The first of these is that there is often no protocol for the medical or therapeutic intervention, and individual differences therefore occur (7). This is irrelevant to this study, as the records used were scoring sheets from the MAP which has standardised procedures for conducting the assessment.

The second limitation is that there are often no definite rules for recording client information and data entries are sometimes missing, illegible or conflicting (7). The MAP has standardised scoring sheets and set rules as to how they should be completed. However, the background information forms that were used, did not record comprehensive demographic information. Therefore age and sex were the only two demographic variables that were analysed in this study. Records that were uncodable because information was missing, illegible or conflicting were excluded from this study.

The third disadvantage is that errors or peculiarities can be compounded during the abstraction process (7). The researcher performed this study alone, so there was no monitoring of the abstraction process. This meant that errors may have occurred, which would limit the accuracy of the data and the conclusions that were drawn from this data. However, the opportunity for error was reduced due to the researcher undergoing training on the abstraction process as part of her MSc coursework, by having a protocol for the data collection process and by double-checking that data was coded correctly.

### 6.2.2 Ventilating Tubes

A record review relies on existing data which was not gathered specifically for research purposes. The records that were reviewed for this study did not include objective indicators of OM (such as abnormal otoscopic findings, type B tympanograms or the absence of an ipsilateral acoustic reflex). The researcher relied on background information questionnaires completed by parents to establish whether or not a child had a history of OM and whether or not the OM was treated with VTs. Since the duration and severity of the OM was not specifically documented, the researcher decided only to include children who had a history of OM that was significant enough to warrant surgical treatment with VTs in the OM group.

As previously discussed, there are variations in the use of VTs but it is generally recommended that they should only be inserted after six months of bilateral OM with effusion and significant hearing loss in otherwise typical children (3). Although this decision allowed for some standardisation of the severity of the OM that was experienced by the OM group, it resulted in a significant limitation in the results of the study. No significant association was found between OM treated with VTs and child development, but it is not known whether there were no adverse effects due to OM, or whether there were adverse effects that resolved after the insertion of VTs.

There is therefore a need for prospective cohort studies where preschoolers are consistently monitored for signs of OM using the objective diagnostic measures mentioned above. They could then be assigned to an OM or non-OM group accordingly. Members of the OM group that require VT insertion should then be assessed using a standardised developmental assessment, such as the MAP, prior to the surgery and at specific intervals after the surgery. The results would indicate whether recurrent OM does affect child development, whether possible adverse effects resolve with the insertion of VTs, and how long it takes for the adverse effects to resolve.

This information would have valuable implications for treatment. At present, the decision to insert VTs is based on the length of episodes of OM and the severity of associated hearing loss. More research on the effects of VT insertion would allow ENTs also to consider the probability of improvements in developmental outcomes (such as sensory discrimination, balance, postural control, motor co-ordination, verbal ability and cognition) when deciding whether or not to recommend surgical intervention.

### 6.2.3 Developmental Delay

The preschoolers in the OM and non-OM groups in this study were all referred OT because of suspected developmental delays. This sample group was used in order to see if there are any differences between the developmental profiles of developmentally delayed preschoolers with a history of OM treated with VTs, and developmentally delayed preschoolers with no history of OM or VTs. If there were statistical differences between their scores for some domains of development, but not other domains, this would allow the researcher to postulate that a history of OM affects certain aspects of development and thus causes preschoolers with a history of OM to present with specific developmental profiles.

However, the fact that the preschoolers from both groups were developmentally delayed (compared to the norm sample of the MAP) was a limitation of the study. This is because it is not known whether the developmental delays, that the OM group presented with, were as a result of a history of OM or due to unknown aetiological factors (as was the case with the non-OM group). More studies that compare preschoolers with a history of OM that are assumed to be developing typically to the norm sample of the MAP or another suitable developmental assessment are needed to clarify this issue.

### 6.2.4 Diagnosed Conditions

This study excluded children who were diagnosed with a specific condition, in order to eliminate extraneous variables that would affect development. However, expert opinion suggests that the development of these at-risk children, may be the most severely affected by OM (4, 29, 129).

There is only one study comparing the outcomes after VT insertion in children who were developmentally at risk to those who were not at risk. It was a historical cohort study by Rosenfeld, Jang and Tarashansky, that was published in 2011. The researchers identified 229 eligible children aged six months to thirteen years from a paediatric otolaryngology practice in New York. Most of the children (55%) had at least one condition (such as such as cleft palate, Down syndrome, a pervasive developmental disorder, permanent hearing loss or blindness) which placed them at risk for developmental delays. After VT insertion, caregivers reported favourable outcomes regardless of their child's at-risk status, but children that were at risk for delays had better reported outcomes for speech, language, learning, and school performance. Caregivers of at-risk children also reported improved progress after VT insertion for 82% of children attending speech therapy, 71% attending physical therapy, and 65% attending OT. There is a need for more studies on the effects of OM on children with diagnosed conditions, especially prospective studies that use objective outcome measures (130).

### 6.2.5 Other Risk Factors

Research into the effects of OM on verbal abilities has suggested that children who have low socio-economic backgrounds, and are from low quality home and child care settings, may experience more severe adverse effects on their development as a result of recurrent OM (44, 87, 99). All the records used in this study were recruited from private OT practices in high socio-economic areas. However, the information from the records did not allow for demographic factors, such as socio-economic status or the quality of home or child care environments, to be specifically quantified. This meant that the cumulative effects of demographic risk factors and a history of OM could not be measured.

More studies, that divide children who have a history of significant OM into at-risk and not at-risk groups in terms of these risk factors, are needed. This could be done according to measures of socio-economic status such as household income and parental occupations and education levels. Home and child care settings could be assessed qualitatively and by looking at factors such as child to caregiver ratios. Such studies could provide more accurate information regarding the risk factors for developmental delay in the presence of OM. They could also provide insights about whether all aspects of development are affected equally by reduced stimulation, or if aspects (such as verbal and cognitive development) which rely more heavily on interactions with caregivers are more significantly affected than other domains (such as sensory discrimination or motor co-ordination).

### 6.2.6 Occupational Performance

This study looked at the effects of OM on child development, and used the results to make inferences about the need for an OT referral for children with recurrent OM treated with VTs. However, OT is not only indicated in cases of developmental delay, but also when a condition such as OM restricts a child's occupational performance. This means that a child should be referred to OT if OM is affecting his ability to engage in culturally-meaningful school, play, self-care and/or social activities (115, 116). Therefore, another limitation of this study, from an OT perspective, is that it only assessed developmental status and not occupational performance.

As previously mentioned, a systematic review of the literature by Brouwer et al found that OM affects children's occupational performance by limiting their engagement in self-care, play and social activities. Sleeping and eating were moderately to severely affected and play and social interactions (such as parent-child interactions) were also reduced due to OM (117). However, Brouwer et al found that the measurement instruments used in these studies were inadequate. They were all "health-related quality of life" or "functional health status" questionnaires that focussed on physical and behavioural functioning and did not address emotional, social and occupational functioning adequately. Furthermore, there was no convincing evidence regarding their reliability or validity (117). There is therefore a need to explore the impact of OM on occupational performance from an OT perspective, using a valid and reliable tool. Such a study would provide important information about the role of OT in the treatment of children with recurrent OM.

## 6.3 SUMMARY OF THE FINDINGS

In terms of demographics, the results of this study support the literature which states that more males than females are at risk for developmental delays (128) and chronic OM (23, 24). The age range of the participants was appropriate. They were old enough to have a history of OM treated with VTs (23, 24) but young enough that they were still in a sensitive period for child development (72) and could therefore gain maximum benefits from intervention (73). It is important that there were no significant differences between the demographics of the OM and non-OM groups. This means that any differences in their developmental profiles could be attributed to the fact that they either had a history of OM treated with VTs or had no history.

The developmental profiles of the OM and non-OM groups were similar and they indicated that the preschoolers had been referred to OT-SI appropriately. The only difference was that a higher percentage of the OM group scored at risk for verbal delays compared to the norm sample, whereas the same percentage of preschoolers from the non-OM group scored at risk as in the norm sample. This fits with the finding that there was a clinical difference between the verbal scores of the OM and non-OM groups, with preschoolers from the OM group being more at risk for verbal delays.

Although there was a clinical difference, this study did not find a statistically significant difference between the verbal scores of the OM and non-OM groups. This is in line with the literature that there are no (or markedly low) adverse effects on verbal abilities in otherwise-healthy children (93, 103, 104). There weren't any statistically significant adverse effects on sensory processing, postural development or motor co-ordination either. However, it is possible that there were adverse effects due to chronic OM that resolved with the insertion of VTs. This was the case in all the relevant literature that was reviewed (18, 19, 110-112). There weren't any significant differences between the OM and non-OM groups in terms of non-verbal cognition and complex tasks scores. This is probably due to the fact that these domains are not directly affected by OM.

Although this record review did not provide definite answers about the effects of OM on child development, it did suggest valuable hypotheses to be tested in prospective studies (122, 123). These include: The effects of VT insertion on the development of preschoolers with a history of chronic OM; The effects of OM and VT insertion on children who are assumed to be developing typically; The effects of OM and VT insertion on children with diagnosed conditions which affect development; The effects of low socio-economic status and low quality home and child care on the development of preschoolers with a history of chronic OM and The effects of OM and VT insertion on the occupational performance of preschoolers.

More information is needed on the factors that place children with a history of OM at risk for developmental delays and occupational performance difficulties. If developmental delays and occupational performance difficulties are suspected, OTs are ideally suited to assess and treat these children because they consider all the relevant factors holistically. These include client factors, environments, performance skills and occupations. OTs can intervene at all these different levels to maximise health and participation in life (114).

## Appendices

## APPENDIX A: Ethical Clearance

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Miss Jennifer Luther

| | |
|---|---|
| CLEARANCE CERTIFICATE | M090338 |
| PROJECT | The Effects of Otitis Media Treated with Ventilated Tubes on the Development of Preschoolers |
| INVESTIGATORS | Miss Jennifer Luther. |
| DEPARTMENT | Occupational Therapy Department |
| DATE CONSIDERED | 09.03.27 |
| DECISION OF THE COMMITTEE* | Approved unconditionally |

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 09.03.31 CHAIRPERSON .....
(Professor P E Cleaton Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : F Adams

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

Jennifer Luther
09.06.07

## APPENDIX B: Information Sheet and Consent Form

Dear Occupational Therapist

My name is Jennifer McGuirk. I am a partner at the Child Integration Centre Occupational Therapy practice in Lonehill. I am studying for a masters degree in Occupational Therapy at the University of the Witswatersrand. As part of my postgraduate studies, I am investigating the effects of ear infections treated with grommets on the development of pre-schoolers. I would be most grateful if you would allow me to review your assessment records for this study.

**Why am I doing this?**

Ear infections occur most frequently during the years of brain maturation and are often chronic. They may therefore be a barrier to typical development. Studies have linked ear infections to a range of developmental delays, in areas such as speech and language, gross motor skills, behaviour and vestibular functions. However, other studies suggest that a history of ear infections does not impair development. These inconsistencies highlight the need for further research in this area. I was unable to find any research on this topic that has been done in South Africa and would therefore like to investigate it further.

**What is expected of you?**

I plan to compare the results obtained on the Miller Assessment for Preschoolers (MAP) of preschoolers with a history of ear infections treated with grommets to the results of children without a history to ear infections. To be able to do this, I would really appreciate access to your records of the MAP and the background information form of preschoolers assessed at your practice over the last 5 years.

**Are there benefits to you?**

Feedback on the results of the study will be given to you on request.

**May you withdraw from the study?**

You may withdraw from the study at any time without having to give a reason. The study is completely voluntary and not taking part in it, or withdrawing from it, carries no penalty of any sort.

**What about confidentiality?**

I would be very grateful if you delete the child's name and personal details before giving me a copy of their records. I will reimburse you for copying costs. I will then assign numbers to the records for identification.

If you have any queries or would like more information, please contact me on 083 248 1246 or email me at jen28@webmail.co.za

If you are happy to participate in the study, please read and sign the consent form below.

**Consent Form**

I agree to allow the researcher access to my records as outlined in the information sheet above.

Name: _____

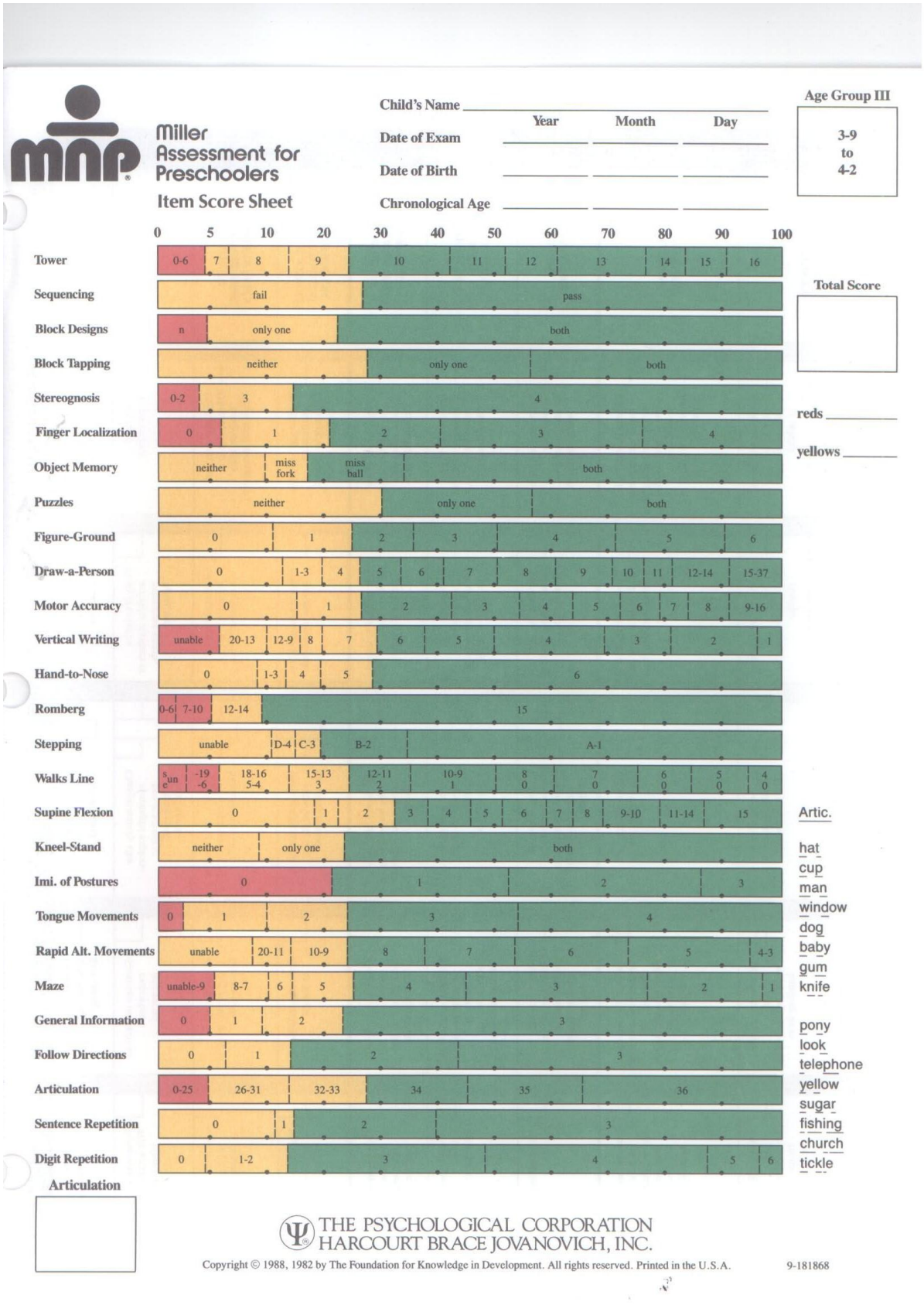
Signature: _____

Date: _____

## APPENDIX C: Tick Sheet of Inclusion Criteria

| Criteria | ✓/× |
|---|---|
| Aged between 33 months and 68 months. | |
| Assessed using the MAP at one of four selected private practices in the Johannesburg northern suburbs. | |
| Assessed by an OT with a minimum of one year of clinical experience. | |
| Assessed during the period from the beginning of 2005 to the end of 2009. | |
| Scores were added correctly and percentile ranks recorded correctly. | |
| Complete and legible records. | |
| Not diagnosed with a specific disorder which would affect developmental outcomes. | |
| Has not had any therapy prior to the assessment with the MAP. | |

## APPENDIX D: MAP Item Score Sheet and Record Booklet



Miller Assessment for Preschoolers

Item Score Sheet

Child's Name _____

Date of Exam _____ Year _____ Month _____ Day

Date of Birth _____

Chronological Age _____

Age Group III: 3-9 to 4-2

| | 0 | 5 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tower | 0-6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | |
| Sequencing | fail | | | | pass | | | | | | | |
| Block Designs | n | only one | | | both | | | | | | | |
| Block Tapping | neither | | | | only one | | | both | | | | |
| Stereognosis | 0-2 | 3 | | | 4 | | | | | | | |
| Finger Localization | 0 | 1 | | | 2 | | 3 | | | 4 | | |
| Object Memory | neither | miss fork | | | miss ball | | | both | | | | |
| Puzzles | neither | | | | only one | | | both | | | | |
| Figure-Ground | 0 | 1 | | | 2 | | 3 | | 4 | | 5 | 6 |
| Draw-a-Person | 0 | 1-3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12-14 | 15-37 |
| Motor Accuracy | 0 | 1 | | | 2 | | 3 | 4 | 5 | 6 | 7 | 8 | 9-16 |
| Vertical Writing | unable | 20-13 | 12-9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | |
| Hand-to-Nose | 0 | 1-3 | 4 | 5 | 6 | | | | | | | |
| Romberg | 0-6 | 7-10 | 12-14 | 15 | | | | | | | | |
| Stepping | unable | D-4 | C-3 | B-2 | A-1 | | | | | | | |
| Walks Line | sun | -19 -6 | 18-16 5-4 | 15-13 3 | 12-11 2 | 10-9 1 | 8 0 | 7 0 | 6 0 | 5 0 | 4 0 | |
| Supine Flexion | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9-10 | 11-14 | 15 |
| Kneel-Stand | neither | only one | | | both | | | | | | | |
| Imi. of Postures | 0 | | | 1 | | | 2 | | | 3 | | |
| Tongue Movements | 0 | 1 | | 2 | | 3 | | | 4 | | | |
| Rapid Alt. Movements | unable | 20-11 | 10-9 | 8 | 7 | 6 | 5 | 4-3 | | | | |
| Maze | unable-9 | 8-7 | 6 | 5 | 4 | 3 | 2 | 1 | | | | |
| General Information | 0 | 1 | 2 | 3 | | | | | | | | |
| Follow Directions | 0 | 1 | 2 | 3 | | | | | | | | |
| Articulation | 0-25 | 26-31 | 32-33 | 34 | 35 | 36 | | | | | | |
| Sentence Repetition | 0 | 1 | 2 | 3 | | | | | | | | |
| Digit Repetition | 0 | 1-2 | 3 | 4 | 5 | 6 | | | | | | |

Total Score

reds _____

yellows _____

Artic.

hat
cup
man
window
dog
baby
gum
knife
pony
look
telephone
yellow
sugar
fishing
church
tickle

Articulation

THE PSYCHOLOGICAL CORPORATION
HARCOURT BRACE JOVANOVICH, INC.

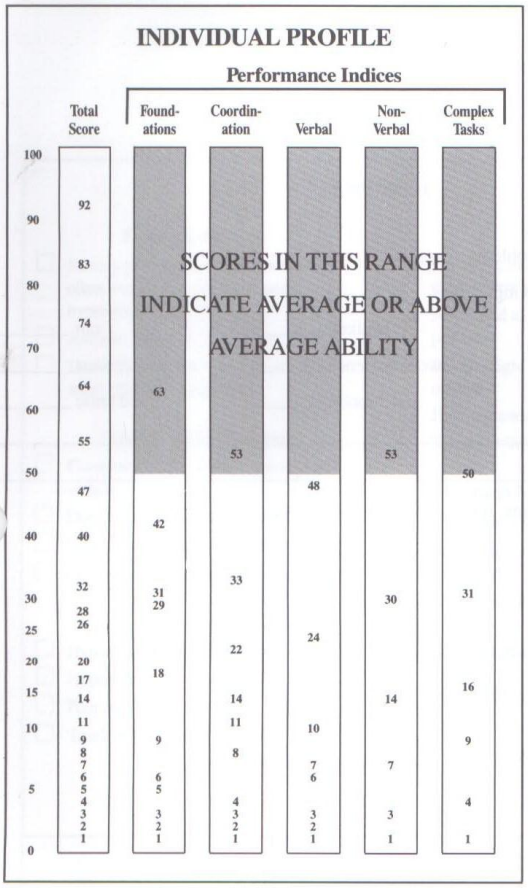


9-181868

# Miller Assessment for Preschoolers

# Record Booklet

## INDIVIDUAL PROFILE




CHILD'S NAME _____

FAMILY CONSTELLATION: names and ages

Mother: _____

Father: _____

Siblings: _____

_____

_____

_____

Address: _____

_____

Home Phone: _____

Mother's Work Phone: _____

Father's Work Phone: _____

| | Year | Month | Day |
|---|---|---|---|
| Date of Exam | | | |
| Date of Birth | | | |
| Chronological Age | | | |

Final Recommendation: _____

_____

_____

_____

_____

THE PSYCHOLOGICAL CORPORATION
HARCOURT BRACE JOVANOVICH, INC.



9-181918

## Developmental History

### PRENATAL HISTORY

**Previous pregnancies:** number and problems

**History of pregnancy with this child:** use of medication, health of mother, complications or problems

**Length of pregnancy:** number of weeks, length of labor

**History of pregnancy:** type of delivery, complications

### EARLY HISTORY

**Condition of newborn:** Apgar scores, weight, height, problems

**Feeding:** method, duration, weaning, eating patterns, problems

**Sleep:** patterns, problems

**Activity level:** child's favorite pastimes, reaction to movement

**Toilet training:** age, method, duration, problems

**Medical history:** hospitalizations, allergies, ear infections, other problems

**Developmental milestones:** age at which child completed the following:

sat alone _____ crawled _____ walked _____ ran _____

used words _____ 2-word sentence _____ 3- to 4-word sentence _____ asked questions _____

drank from a cup _____ dressed self _____ used spoon _____ used knife _____

Describe general coordination: _____

Describe ability to communicate: _____

**Any unusual behaviors or problems:** head banging, temper tantrums, rocking, breath holding, *etc.*

### PRESENT STATUS

**Current medications:**

**Frequency and types of illnesses:**

**Sleep:** **Toileting:**

**Eating:** **Activity level:**

**Interaction with other children:**

**Attendance at preschool or day care:** behavior, preacademic performance, socialization, play patterns

**Describe coordination:**

**Describe language:**

**Note any problems:**

**Name / address of physician:**

**Name / address of other specialists treating child:**

| FAMILY HISTORY: | Mother | Father |
|---|---|---|
| Profession | | |
| Location | | |
| Hrs. per week | | |
| Length of time employed | | |
| Marital status | | |

**History of family since birth of child:** moves, changes, significant traumas, problems

**Note if any siblings are having or have had problems:**

## Supplemental Observations Sheet

Miller Assessment for Preschoolers

☐ Preferred Hand

### VISION

- ☐ Obvious crossed eyes
- ☐ Red or watery eyes
- ☐ Crusty eyelids
- ☐ Rubs eyes excessively
- ☐ Abnormal head posture/movement
- ☐ Squints or frowns when looking at objects
- ☐ Gets very close to work
- ☐ Abnormal eye movements, *i.e.*, restrictions, nystagmus

### TOUCH

- ☐ Rubs, scratches area touched
- ☐ Negative verbal reaction to touch
- ☐ Uses fingertips rather than palms to manipulate objects
- ☐ Hands tend to be fisted
- ☐ Tendency to walk on toes when shoes are off

### MOVEMENT

#### Extension/Flexion

- ☐ Resting postures and position changes often incorporate excessive neck hyperextension
- ☐ Anterior pelvic tilt
- ☐ Uses only some muscle groups actively when flexing — may "fix"

#### Weight Shifting/Rotation

- ☐ Compensates by "fixing" when shifts weight
- ☐ Does not use diagonal movements
- ☐ Uses lateral flexion rather than rotation
- ☐ Loses balance during rotation activities

#### Appearance

- ☐ Hypotonic muscle tone
- ☐ Hypertonic muscle tone
- ☐ Poor mouth closure
- ☐ Trunk or facial asymmetry

#### Stability

- ☐ Excessive internal or external rotation at shoulders and/or hips
- ☐ Arms tend to go into high guard position
- ☐ Bears weight medially or laterally on feet
- ☐ Hyperextends knee when walking
- ☐ Tends to "W" sit

#### Postural/Movement Patterns

- ☐ Overflow or associated movements
- ☐ Falls frequently; clumsy or awkward movements
- ☐ Movement always initiated to same direction
- ☐ Frequent postural readjustments in chair
- ☐ Holds body rigidly; seems unwilling to move quickly
- ☐ Primitive grasp
- ☐ Does not automatically assist with alternate hand

### SPEECH AND LANGUAGE

#### Expression

- ☐ Uses inappropriate vocabulary
- ☐ Does not use grammatical sentence structure
- ☐ Difficulty finding words
- ☐ Uses many vague or indefinite words or circumlocutions
- ☐ Tends to respond in simple sentences and short phrases
- ☐ Voice quality inappropriate for age or sex, *i.e.*, harsh, hoarse, pitch too high or low, volume too soft or loud
- ☐ Dysfluent (stutters, repeats words or sounds, prolongs sounds, tension in body when speaks)
- ☐ Echoes or shadows directions vocally or subvocally
- ☐ Excessive nonverbal response; nods, smiles, etc.
- ☐ Sounds reversed within words
- ☐ Words reversed within sentences

#### Auditory Ability

- ☐ Needs directions repeated
- ☐ Needs volume of directions increased
- ☐ Watches lips excessively
- ☐ Wears hearing aid
- ☐ Difficulty in localizing sound (turning in direction of voice or sounds)
- ☐ Seems to have difficulty discriminating similar sounds, *e.g.*, penny, pencil; gum, come; wait, wade

#### Intelligibility

- ☐ Difficult to understand
- ☐ Words run together
- ☐ Talks too fast/too slow
- ☐ Many articulation errors

#### Comprehension

- ☐ Responses usually delayed
- ☐ Need directions reworded
- ☐ Difficulty understanding task

### DRAW-A-PERSON

- ☐ Body parts not attached
- ☐ Sides strikingly dissimilar
- ☐ Draws monster, dinosaur, *etc.*
- ☐ Much scribbling
- ☐ Not identifiable as human figure
- ☐ Shape of parts grossly inappropriate
- ☐ Part usually drawn at older age present (*i.e.*, toes, fingers, eyebrows) but elementary part missing (*i.e.*, trunk, head, arms)
- ☐ Much detail to one part at expense of total picture
- ☐ Bizarre, disturbing quality
- ☐ Unenclosed (facial features with no head)
- ☐ Vague overall shape but individual parts hard to distinguish
- ☐ Body parts definitely out of proportion

## Performance Indices

| | FOUNDATIONS INDEX Percentile Score | COORDINATION INDEX Percentile Score | VERBAL INDEX Percentile Score | NON-VERBAL INDEX Percentile Score | COMPLEX TASKS INDEX Percentile Score |
|---|---|---|---|---|---|
| R = # Red<br>Y = # Yellow | R Y | R Y | R Y | R Y | R Y |
| | **Sensory & Motor Abilities** | | **Cognitive Abilities** | | **Combined Abilities** |
| **Tower** | | _____ Tower | | | |
| **Sequencing** | | | | _____ Sequencing | |
| **Block Designs** | | | | | _____ Block Designs |
| **Block Tapping** | | | | _____ Block Tapping | |
| **Stereognosis** | _____ Stereognosis | | | | |
| **Finger Local.** | _____ Finger Local. | | | | |
| **Object Memory** | | | | _____ Object Memory | |
| **Puzzle** | | | | _____ Puzzle | |
| **Figure-Ground** | | | | _____ Figure-Ground | |
| **Draw-a-Person** | | | | | _____ Draw-a-Person |
| **Motor Accuracy** | | _____ Motor Accuracy | | | |
| **Vertical Writing** | _____ Vertical Writing | _____ Vertical Writing | | | |
| **Hand-to-Nose** | _____ Hand-to-Nose | | | | |
| **Romberg** | _____ Romberg | | | | |
| **Stepping** | _____ Stepping | | | | |
| **Walks Line** | _____ Walks Line | _____ Walks Line | | | |
| **Supine Flexion** | _____ Supine Flexion | | | | |
| **Kneel-Stand** | _____ Kneel-Stand | | | | |
| **Imi. of Postures** | | | | | _____ Imi. of Postures |
| **Tongue Movements** | | _____ Tongue Mvts. | | | |
| **Rapid Alt. Mvts.** | _____ Rap. Alt. Mvt. | _____ Rap. Alt. Mvt. | | | |
| **Maze** | | | | | _____ Maze |
| **General Info.** | | | _____ General Info. | | |
| **Follow Directions** | | | _____ Follow Dir. | | |
| **Articulation** | | _____ Articulation | | | |
| **Sentence Repetition** | | | _____ Sentence Rep. | | |
| **Digit Repetition** | | | _____ Digit Repetition | | |

## APPENDIX E: Data from OM Group

| ID | OM | DOA | DOB | Age group | Age in months | Sex | Total | % | Foundation | % | Co-ord | % | Verbal | % | Cognition | % | Complex | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 201 | 2 | 27.6.08 | 15.8.03 | 5 | 58 | 2 | 2 | 11 | 2 | 18 | 2 | 22 | 2 | 7 | 1 | 30 | 1 | 50 |
| 202 | 2 | 26.7.8 | 29.8.3 | 5 | 58 | 2 | 1 | 47 | 1 | 63 | 1 | 53 | 2 | 24 | 1 | * | 1 | 31 |
| 203 | 2 | 7.6.07 | 10.01.03 | 4 | 52 | 2 | 3 | 1 | 3 | 1 | 3 | 3 | 2 | 7 | 1 | 30 | 1 | 50 |
| 204 | 2 | 8.5.07 | 24.10.02 | 4 | 54 | 2 | 2 | 7 | 2 | 18 | 2 | 8 | 2 | 10 | 1 | 30 | 1 | 50 |
| 205 | 2 | 27.8.07 | 7.12.03 | 3 | 45 | 1 | 1 | 55 | 1 | 63 | 1 | 53 | 1 | 48 | 1 | 53 | 1 | 50 |
| 206 | 2 | 31.8.07 | 18.01.03 | 4 | 55 | 1 | 1 | 74 | 1 | * | 1 | 53 | 1 | * | 1 | * | 1 | 31 |
| 207 | 2 | 9.3.06 | 3.5.01 | 5 | 58 | 1 | 1 | 20 | 1 | 29 | 1 | 33 | 1 | 48 | 1 | 53 | 2 | 16 |
| 208 | 2 | 6.4.6 | 10.5.1 | 5 | 59 | 1 | 2 | 7 | 2 | 9 | 2 | 14 | 2 | 24 | 1 | 53 | 1 | 31 |
| 209 | 2 | 02.06.10 | 28.12.05 | 4 | 53 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 6 | 1 | 30 | 1 | 50 |
| 210 | 2 | 15.03.10 | 10.12.05 | 4 | 51 | 2 | 1 | 28 | 2 | 18 | 1 | 33 | 2 | 24 | 1 | 53 | 1 | 50 |
| 211 | 2 | 13.08.07 | 12.11.02 | 5 | 57 | 1 | 2 | 17 | 2 | 18 | 1 | 33 | 1 | 48 | 1 | 30 | 2 | 16 |
| 212 | 2 | 15.1.08 | 8.3.05 | 1 | 34 | 2 | 1 | * | 1 | 63 | 1 | 53 | 1 | 48 | 1 | * | 1 | * |
| 213 | 2 | 27.5.10 | 12.9.05 | 4 | 56 | 1 | 2 | 9 | 3 | 1 | 2 | 22 | 1 | 48 | 1 | * | 1 | 31 |
| 214 | 2 | 3.13.10 | 20.9.05 | 4 | 52 | 2 | 2 | 6 | 2 | 18 | 2 | 8 | 2 | 6 | 2 | 7 | 1 | 50 |
| 215 | 2 | 3.2.06 | 8.11.01 | 4 | 51 | 2 | 2 | 9 | 1 | 63 | 1 | 53 | 2 | 7 | 3 | 3 | 2 | 9 |
| 216 | 2 | 11.3.05 | 31.01.01 | 3 | 49 | 2 | 1 | 28 | 1 | 29 | 1 | 53 | 1 | * | 1 | 30 | 2 | 16 |
| 217 | 2 | 12.04.07 | 7.11.02 | 4 | 53 | 2 | 1 | 47 | 1 | 63 | 1 | * | 1 | * | 1 | * | 1 | * |
| 218 | 2 | 20.10.06 | 14.6.02 | 4 | 52 | 2 | 2 | 11 | 2 | 6 | 3 | 4 | 2 | 10 | 1 | * | 2 | 16 |
| 219 | 2 | 26.4.06 | 6.3.01 | 5 | 62 | 2 | 1 | 83 | 1 | * | 1 | * | 1 | * | 1 | 53 | 1 | 50 |
| 220 | 2 | 8.8.8 | 12.9.3 | 5 | 59 | 1 | 1 | 40 | 1 | 29 | 1 | 53 | 1 | * | 1 | * | 2 | 16 |
| 221 | 2 | 9.4.8 | 25.4.5 | 1 | 35 | 2 | 1 | * | 1 | * | 1 | * | 1 | * | 1 | * | 1 | * |
| 222 | 2 | 8.9.6 | 18.2.3 | 2 | 43 | 2 | 1 | 32 | 1 | 63 | 1 | 53 | 1 | * | 1 | 53 | 3 | 4 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 223 | 2 | 31.8.7 | 7.8.3 | 3 | 49 | 2 | 1 | 55 | 1 | 42 | 1 | * | 1 | * | 1 | * | 1 | 50 |
| 224 | 2 | 30.3.10 | 31.5.5 | 5 | 58 | 2 | 1 | 47 | 2 | 18 | 1 | * | 1 | * | 1 | * | 1 | 50 |
| 225 | 2 | 5.3.10 | 23.6.6 | 2 | 44 | 2 | 1 | 83 | 1 | 63 | 1 | * | 1 | * | 1 | 53 | 1 | * |
| 226 | 2 | 17.3.3 | 2.7.3 | 4 | 56 | 2 | 1 | 40 | 2 | 18 | 1 | 33 | 1 | 48 | 1 | * | 1 | * |
| 227 | 2 | 25.11.5 | 30.8.2 | 2 | 39 | 1 | 2 | 17 | 2 | 9 | 2 | 11 | 2 | 24 | 1 | 53 | 1 | 50 |
| 228 | 2 | 13.01.10 | 08.03.06 | 3 | 46 | 2 | 2 | 9 | 3 | 5 | 3 | 4 | 2 | 24 | 1 | * | 1 | 50 |
| 229 | 2 | 19.04.10 | 21.04.06 | 3 | 48 | 2 | 2 | 17 | 2 | 9 | 3 | 4 | 1 | * | 1 | * | 2 | 9 |
| 230 | 2 | 04.09.06 | 10.12.01 | 5 | 57 | 2 | 2 | 6 | 3 | 5 | 2 | 11 | 2 | 10 | 1 | 30 | 1 | 31 |
| 231 | 2 | 05.12.06 | 12.02.03 | 3 | 46 | 2 | 2 | 20 | 2 | 9 | 2 | 11 | 1 | 48 | 1 | 53 | 1 | 50 |
| 232 | 2 | 11.02.08 | 24.06.04 | 2 | 43 | 2 | 2 | 7 | 2 | 18 | 3 | 2 | 1 | 48 | 2 | 14 | 2 | 16 |
| 233 | 2 | 13.03.07 | 11.07.02 | 4 | 56 | 2 | 1 | 26 | 2 | 9 | 2 | 22 | 1 | 48 | 1 | 53 | 1 | 31 |
| 234 | 2 | 05.05.06 | 10.01.02 | 4 | 52 | 2 | 2 | 7 | 3 | 2 | 2 | 14 | 2 | 24 | 1 | 30 | 1 | 50 |
| 235 | 2 | 07.08.06 | 24.10.01 | 5 | 58 | 2 | 2 | 9 | 2 | 9 | 2 | 14 | 1 | * | 1 | 53 | 2 | 9 |
| 236 | 2 | 20.08.08 | 04.12.03 | 4 | 56 | 2 | 1 | 55 | 1 | 63 | 1 | 53 | 1 | 48 | 1 | * | 1 | 31 |
| 237 | 2 | 14.01.10 | 08.03.06 | 3 | 46 | 1 | 1 | 32 | 2 | 18 | 1 | 33 | 1 | * | 1 | 53 | 1 | 50 |
| 238 | 2 | 22.10.09 | 23.05.06 | 2 | 41 | 2 | 1 | 47 | 1 | 42 | 2 | 22 | 1 | * | 1 | 53 | 1 | 50 |
| 239 | 2 | 1.11.08 | 20.9.04 | 3 | 49 | 2 | 2 | 7 | 2 | 6 | 2 | 14 | 1 | 48 | 1 | 53 | 2 | 9 |
| 240 | 2 | 02.07.10 | 10.10.06 | 3 | 45 | 1 | 1 | 55 | 1 | 63 | 1 | 53 | 1 | 48 | 1 | * | 1 | 31 |
| 241 | 2 | 9.2.07 | 9.4.03 | 3 | 46 | 1 | 1 | 64 | 1 | * | 1 | 33 | 1 | 48 | 1 | * | 1 | * |
| 242 | 2 | 21.4.08 | 18.11.04 | 2 | 41 | 2 | 1 | 28 | 1 | 29 | 2 | 11 | 2 | 24 | 1 | 53 | 1 | * |
| 243 | 2 | 2.2.09 | 12.3.04 | 5 | 59 | 2 | 1 | 64 | 1 | 63 | 1 | 53 | 1 | * | 1 | 53 | 1 | 50 |
| 244 | 2 | 17.1.07 | 28.10.02 | 4 | 51 | 2 | 1 | 32 | 2 | 18 | 2 | 14 | 1 | * | 1 | * | 2 | 16 |
| 245 | 2 | 24.05.08 | 7.10.04 | 2 | 43 | 2 | 1 | 83 | 1 | * | 1 | 53 | 1 | * | 1 | * | 1 | 50 |
| 246 | 2 | 21.4.08 | 18.6.03 | 3 | 46 | 2 | 1 | 47 | 1 | 42 | 2 | 22 | 1 | * | 1 | * | 1 | 50 |

## APPENDIX F: Data from non-OM Group

| ID | OM | DOA | DOB | Age | Age in months | Sex | Total | % | Foundation | % | Co-ord | % | Verbal | % | Cognition | % | Complex | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 27.7.09 | 18.11.05 | 2 | 44 | 1 | 1 | 64 | 1 | 42 | 1 | 33 | 1 | * | 1 | * | 1 | 50 |
| 2 | 1 | 20.7.09 | 31.10.05 | 2 | 44 | 2 | 2 | 20 | 2 | 9 | 2 | 22 | 1 | * | 1 | 30 | 2 | 16 |
| 3 | 1 | 28.1.10 | 10.1.06 | 3 | 49 | 2 | 1 | 55 | 1 | 29 | 1 | 33 | 1 | 48 | 1 | * | 1 | * |
| 4 | 1 | 9.3.10 | 23.8.5 | 4 | 55 | 1 | 1 | 28 | 2 | 18 | 2 | 22 | 2 | 24 | 1 | * | 1 | * |
| 5 | 1 | 26.6.09 | 23.6.04 | 5 | 60 | 1 | 1 | 40 | 1 | 29 | 1 | 33 | 1 | 48 | 1 | 53 | 1 | * |
| 6 | 1 | 12.10.09 | 21.9.05 | 3 | 49 | 1 | 3 | 4 | 3 | 2 | 2 | 22 | 2 | 24 | 1 | 30 | 3 | 4 |
| 7 | 1 | 12.8.08 | 23.6.03 | 5 | 61 | 2 | 1 | 26 | 2 | 18 | 2 | 11 | 2 | 24 | 1 | 53 | 1 | 50 |
| 8 | 1 | 9.6.08 | 31.5.03 | 5 | 60 | 2 | 3 | 1 | 3 | 1 | 2 | 8 | 3 | 2 | 1 | 53 | 2 | 16 |
| 9 | 1 | 14.8.08 | 6.7.04 | 3 | 49 | 2 | 2 | 6 | 3 | 1 | 2 | 22 | 2 | 7 | 1 | 53 | 1 | * |
| 10 | 1 | 13.3.07 | 22.10.02 | 4 | 53 | 2 | 1 | 64 | 1 | 29 | 1 | 33 | 1 | * | 1 | * | 1 | * |
| 11 | 1 | 7.06.07 | 25.10.02 | 4 | 55 | 2 | 1 | 26 | 1 | 29 | 1 | 53 | 1 | 48 | 1 | 30 | 1 | 31 |
| 12 | 1 | 4.8.08 | 6.10.03 | 5 | 58 | 2 | 1 | 64 | 1 | 63 | 2 | 53 | 1 | * | 1 | 53 | 1 | * |
| 13 | 1 | 17.6.08 | 26.4.04 | 3 | 49 | 1 | 1 | 64 | 1 | 42 | 1 | 33 | 1 | * | 1 | * | 1 | * |
| 14 | 1 | 13.5.10 | 12.1.05 | 6 | 64 | 1 | 2 | 11 | 3 | 5 | 2 | 22 | 2 | 24 | 1 | 53 | 1 | 50 |
| 15 | 1 | 31.3.10 | 15.12.04 | 6 | 63 | 2 | 2 | 17 | 2 | 18 | 1 | 33 | 2 | 24 | 1 | 53 | 2 | 16 |
| 16 | 1 | 15.4.10 | 1.8.05 | 4 | 56 | 2 | 1 | 47 | 2 | 18 | 1 | 33 | 1 | * | 1 | 53 | 1 | * |
| 17 | 1 | 12.4.10 | 12.1.07 | 2 | 39 | 2 | 2 | 20 | 2 | 6 | 3 | 4 | 1 | * | 1 | * | 1 | 31 |
| 18 | 1 | 12.5.06 | 1.10.01 | 4 | 55 | 2 | 1 | 92 | 1 | 63 | 1 | 53 | 1 | * | 1 | * | 1 | * |
| 19 | 1 | 6.10.6 | 21.9.01 | 5 | 61 | 2 | 2 | 20 | 2 | 9 | 2 | 14 | 1 | 48 | 1 | * | 1 | * |
| 20 | 1 | 19.8.04 | 6.9.99 | 5 | 59 | 2 | 1 | 83 | 1 | 42 | 1 | * | 1 | * | 1 | * | 1 | * |
| 21 | 1 | 11.8.06 | 17.8.01 | 5 | 60 | 1 | 1 | 74 | 1 | * | 1 | * | 1 | 48 | 1 | * | 1 | 31 |
| 22 | 1 | 2.2.7 | 20.1.04 | 1 | 36 | 1 | 1 | 40 | 1 | 31 | 1 | 53 | 2 | 24 | 1 | 53 | 1 | 50 |
| 23 | 1 | 18.2.08 | 12.2.05 | 1 | 36 | 2 | 1 | 64 | 1 | 31 | 1 | 53 | 1 | * | 1 | * | 1 | 50 |
| 24 | 1 | 16.2.07 | 23.8.02 | 4 | 54 | 1 | 1 | 55 | 1 | 31 | 1 | 33 | 1 | * | 1 | * | 1 | 31 |
| 25 | 1 | 15.8.8 | 21.10.05 | 1 | 34 | 1 | 1 | 92 | 1 | * | 1 | * | 1 | * | 1 | 53 | 1 | * |
| 26 | 1 | 12.1.6 | 21.8.1 | 4 | 53 | 2 | 1 | 55 | 1 | 63 | 1 | * | 1 | * | 1 | 53 | 2 | 16 |
| 27 | 1 | 3.10.8 | 20.5.04 | 4 | 52 | 1 | 1 | 26 | 2 | 18 | 1 | 53 | 1 | 48 | 1 | 53 | 1 | 50 |
| 28 | 1 | 26.3.08 | 11.8.03 | 4 | 55 | 1 | 1 | 32 | 1 | 31 | 1 | 53 | 1 | 48 | 1 | 30 | 1 | 31 |
| 29 | 1 | 16.5.8 | 15.7.4 | 3 | 46 | 2 | 1 | 28 | 1 | 31 | 2 | 22 | 2 | 24 | 1 | * | 2 | 9 |
| 30 | 1 | 27.11.9 | 3.11.5 | 3 | 49 | 2 | 1 | 63 | 1 | 29 | 1 | 53 | 1 | * | 1 | * | 1 | * |
| 31 | 1 | 03.07.09 | 11.09.06 | 1 | 34 | 2 | 2 | 11 | 2 | 9 | 2 | 14 | 2 | 24 | 1 | 30 | 1 | 31 |
| 32 | 1 | 18.08.09 | 23.09.04 | 5 | 59 | 2 | 2 | 9 | 3 | 3 | 3 | 4 | 1 | * | 1 | 53 | 2 | 16 |
| 33 | 1 | 28.08.09 | 01.10.05 | 3 | 47 | 1 | 2 | 20 | 2 | 18 | 2 | 22 | 1 | * | 1 | 53 | 2 | 9 |
| 34 | 1 | 04.06.10 | 18.07.05 | 5 | 59 | 2 | 3 | 5 | 3 | 3 | 2 | 14 | 2 | 24 | 1 | 53 | 3 | 1 |
| 35 | 1 | 10.09.08 | 06.08.04 | 3 | 49 | 1 | 2 | 14 | 3 | 5 | 2 | 14 | 1 | * | 1 | 53 | 2 | 9 |
| 36 | 1 | 08.08.08 | 11.12.03 | 4 | 56 | 1 | 1 | 40 | 2 | 18 | 2 | 22 | 1 | * | 1 | 53 | 1 | * |
| 37 | 1 | 22.08.08. | 07.11.03 | 5 | 57 | 2 | 2 | 9 | 1 | 9 | 3 | 4 | 1 | 48 | 1 | 53 | 1 | 50 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38 | 1 | 20..04.06 | 02.11.01 | 4 | 53 | 2 | 3 | 2 | 3 | 1 | 3 | 3 | 1 | * | 1 | 53 | 3 | 4 |
| 39 | 1 | 08.04.08 | 15.12.04 | 2 | 40 | 2 | 1 | 47 | 2 | 18 | 1 | 33 | 1 | * | 1 | * | 1 | 50 |
| 40 | 1 | 29.05.06 | 14.10.01 | 4 | 56 | 2 | 2 | 9 | 3 | 3 | 2 | 14 | 1 | * | 2 | 14 | 1 | 50 |
| 41 | 1 | 18.04.07 | 9.04.03 | 3 | 48 | 1 | 2 | 9 | 1 | 29 | 2 | 22 | 1 | 48 | 2 | 7 | 2 | 9 |
| 42 | 1 | 07.05.08 | 02.06.03 | 5 | 59 | 1 | 2 | 14 | 2 | 18 | 2 | 22 | 1 | 48 | 1 | 53 | 2 | 9 |
| 43 | 1 | 24.10.08 | 22.03.04 | 4 | 55 | 1 | 1 | 64 | 1 | 31 | 1 | 33 | 1 | * | 1 | * | 1 | 50 |
| 44 | 1 | 03.03.08 | 10.04.04 | 3 | 47 | 2 | 1 | 47 | 1 | 42 | 2 | 22 | 1 | * | 1 | * | 2 | 16 |
| 45 | 1 | 24.04.06 | 19.03.02 | 3 | 49 | 2 | 2 | 8 | 2 | 9 | 2 | 22 | 1 | 48 | 1 | 30 | 3 | 1 |
| 46 | 1 | 31.03.06 | 30.03.01 | 5 | 60 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 1 | 48 | 3 | 3 | 3 | 4 |
| 47 | 1 | 01.09.08 | 03.11.03 | 5 | 58 | 2 | 1 | 26 | 2 | 9 | 3 | 4 | 1 | * | 1 | * | 1 | 50 |
| 48 | 1 | 19.11.08 | 06.08.04 | 4 | 51 | 2 | 1 | 32 | 1 | 31 | 1 | 33 | 1 | * | 1 | 53 | 1 | 31 |
| 49 | 1 | 13.10.08 | 04.05.04 | 4 | 53 | 2 | 2 | 14 | 2 | 6 | 2 | 11 | 2 | 10 | 1 | 53 | 1 | 50 |
| 50 | 1 | 29.09.08 | 01.11.04 | 3 | 47 | 2 | 1 | 55 | 1 | 63 | 1 | * | 1 | * | 1 | * | 2 | 9 |
| 51 | 1 | 29.08.06 | 16.05.02 | 2 | 39 | 2 | 1 | 55 | 1 | 31 | 1 | 53 | 1 | * | 1 | * | 1 | 31 |
| 52 | 1 | 04.07.06 | 27.11.01 | 4 | 55 | 2 | 3 | 9 | 3 | 3 | 3 | 4 | 1 | * | 1 | * | 2 | 16 |
| 53 | 1 | 06.12.06 | 23.01.02 | 5 | 58 | 2 | 2 | 9 | 1 | 29 | 2 | 22 | 2 | 24 | 1 | 53 | 1 | 31 |
| 54 | 1 | 26.09.06 | 28.04.03 | 2 | 41 | 2 | 1 | 32 | 2 | 6 | 2 | 11 | 1 | * | 1 | * | 1 | 50 |
| 55 | 1 | 23.06.08 | 19.01.04 | 4 | 53 | 2 | 2 | 14 | 3 | 3 | 2 | 11 | 2 | 10 | 1 | * | 1 | 50 |
| 56 | 1 | 06.12.07 | 03.12.03 | 3 | 48 | 2 | 1 | * | 1 | * | 1 | * | 1 | * | 1 | * | 1 | * |
| 57 | 1 | 15.07.09 | 15.04.05 | 4 | 51 | 2 | 3 | 1 | 3 | 1 | 3 | 1 | 2 | 10 | 1 | 30 | 3 | 4 |
| 58 | 1 | 07.07.05 | 15.11.01 | 2 | 44 | 1 | 1 | 74 | 1 | 63 | 1 | 53 | 1 | 48 | 1 | * | 1 | 50 |
| 59 | 1 | 20.06.07 | 07.06.02 | 5 | 60 | 1 | 1 | 40 | 1 | 42 | 1 | 53 | 2 | 24 | 1 | 30 | 1 | * |
| 60 | 1 | 15.07.08 | 07.04.04 | 4 | 51 | 1 | 2 | 17 | 2 | 9 | 2 | 11 | 1 | * | 1 | 30 | 1 | 31 |
| 61 | 1 | 15.09.05 | 20.06.02 | 2 | 39 | 2 | 3 | 2 | 1 | 1 | 3 | 1 | 1 | 3 | 3 | 1 | 1 | 1 |
| 62 | 1 | 15.04.10 | 22.12.05 | 4 | 52 | 1 | 1 | 32 | 2 | 9 | 1 | 33 | 1 | * | 1 | * | 1 | 50 |
| 63 | 1 | 6.2.09 | 9.9.04 | 4 | 52 | 1 | 1 | 28 | 2 | 18 | 1 | 33 | 1 | * | 1 | 30 | 1 | 50 |
| 64 | 1 | 24.7.07 | 17.7.03 | 3 | 48 | 2 | 1 | 55 | 1 | 42 | 1 | 33 | 1 | * | 1 | 53 | 1 | 50 |
| 65 | 1 | 10.06.10 | 25.4.06 | 3 | 49 | 2 | 1 | 28 | 1 | 18 | 1 | 53 | 1 | 48 | 1 | * | 1 | 50 |
| 66 | 1 | 24.2.09 | 14.06.04 | 4 | 56 | 1 | 1 | 64 | 1 | 47 | 1 | * | 1 | * | 1 | * | 1 | 31 |
| 67 | 1 | 27.8.07 | 23.05.03 | 4 | 51 | 2 | 1 | 47 | 1 | 29 | 2 | 22 | 1 | * | 1 | * | 1 | * |
| 68 | 1 | 9.4.08 | 30.9.04 | 2 | 43 | 2 | 1 | 83 | 1 | * | 1 | * | 1 | * | 1 | * | 1 | 31 |
| 69 | 1 | 10.4.06 | 3.10.2002 | 2 | 42 | 1 | 1 | 28 | 2 | 18 | 1 | 33 | 2 | 10 | 1 | * | 1 | * |

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