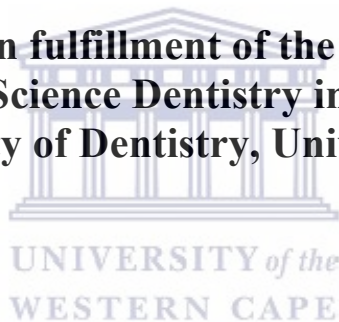


# **THE ORTHODONTIC TREATMENT NEEDS IN CHILDREN AGED 12-15 YEARS IN A SCHOOL IN KHOMAS REGION, NAMIBIA**

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**A Thesis submitted in fulfillment of the requirements for the  
degree of Master of Science Dentistry in the Department of  
Orthodontics, Faculty of Dentistry, University of the  
Western Cape.**



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**November 2018**

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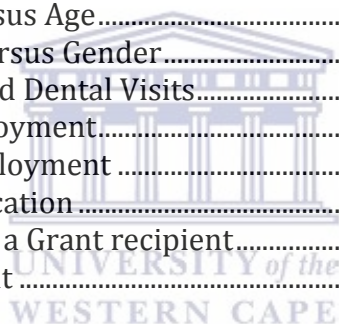
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## **Keywords**

Orthodontics

Khomas, Namibia

Children

Treatment need

Perceived need

Normative need

Index of Orthodontic Treatment need (IOTN)

Modified Dental Health Component

Aesthetic Component



## **Abstract**

In modern day dentistry, aesthetics forms an integral part of our social perception almost as much as functionality. Malocclusion has been brought to the forefront of developmental anomalies as it can affect mastication, speech as well as the appearance of the face. Furthermore, pre-pubertal and pubertal changes have compounded existing malocclusions in this growth period thus spiraling the need for orthodontic treatment. Therefore, it is essential to determine the normative and self-perceived need for orthodontic treatment in a population. The epidemiological data collected can be used to facilitate policy changes to manage malocclusion in Khomas, Namibia.

## **Aim**

The aim of this study was to determine the orthodontic treatment needs of a population of 12-15 year-old children attending a school in Khomas and to express it as percentages of those with subjective and objective orthodontic treatment need over the whole sample population. The objectives were to find associations between treatment needs and some demographic and socioeconomic factors.

## **Methodology**

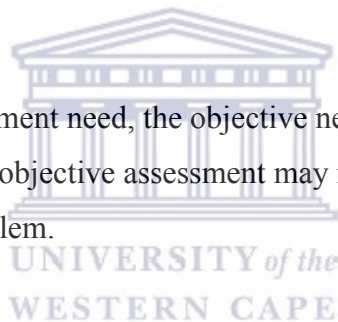
A cross sectional study was carried out on a sample population from a school in the Khomas region. Convenience sampling was used in subject selection. The Modified Index of Orthodontic Treatment Need (IOTN) was the index of choice that was used to capture the information needed to satisfy the aims. It has two very useful components for this study. The Dental Health Component (DHC) with which the normative need for orthodontic treatment is captured. It also has the Aesthetic Component (AC), which does well in capturing both the objective and subjective need for Orthodontic treatment. Data was collected and analyzed statistically to give results for the qualification of the aims and objectives.

### **Results:**

A total number of 102 participants were examined, of which 36.2% were males and 63.7 % were female. The objective need as measured by the DHC was 59.8%. The subjective need was 17.7% and 31.4% as measured by the Child rated AC and Examiner rated AC respectively. There was no significant association between Orthodontic treatment need and gender or age. There was minimal subjective need for orthodontic treatment with regards to the middle to high socioeconomic status of sample population, but a relatively high objective need for orthodontic treatment. Association between DHC and CRAC revealed that 88.8% of the children shown to have need according to the DHC also perceived need according to the CRAC. Of the 70 children with no need for treatment according to ERAC, 91.4% were in agreement according to the CRAC.

### **Conclusion:**

In assessing orthodontic treatment need, the objective need was higher than the perceived need. The expert's objective assessment may not always agree with the child's perception of the problem.



## Declaration

I declare that "The Orthodontic treatment need in children aged 12-15 years in a school in Khomas Region", is my own work, that it has not been submitted for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged by complete references.

Full Name: Catherine Serebe

Date: November 2018

Signed: *c serebe*





## **Acknowledgements**

To God Almighty for giving me the Grace to go through this process

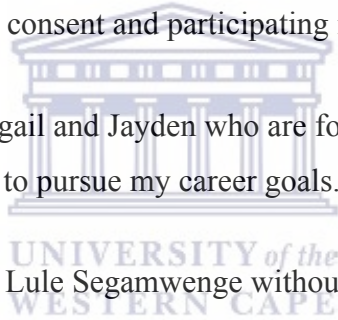
To my supervisor, Prof. Angela Harris, who has been more than supportive, encouraging and insightful during this journey.

To my co-supervisor and statistician Dr. Faheema Kimmie- Dhansay, who has gone the extra mile to nurture me in the art of scientific writing, for her mentorship and guidance.

To the Principal, Life-skills teacher and the learners of Amazing Kids Private School and Academy for giving their consent and participating in this study.

To my Children, Natalie, Abigail and Jayden who are forever understanding, supportive and make it easier to pursue my career goals.

To my husband, Dr. Innocent Lule Segamwenge without whose love, encouragement and belief in me, this would not have been possible.



## List of Abbreviations

IOTN	Index of Orthodontic Treatment Need
DHC	Dental Health Component
AC	Aesthetics Component
WHO	World Health Organization
ERAC	Examiner-rated Aesthetic Component
CRAC	Child-rated Aesthetic Component
DAI	Dental Aesthetics Index



## **Definition of terms**

### **Objective need**

Need for orthodontic treatment as defined by the expert/examiner using the Dental Health Component (DHC) of the IOTN.

### **Subjective need**

Need for orthodontic treatment as defined using the Aesthetic Component (AC) of the IOTN.

### **Child rated Aesthetic Component (CRAC)**

The orthodontic treatment need assessed by the child using the Aesthetic Component.

### **Examiner rated Aesthetic Component (ERAC)**

The orthodontic treatment need assessed by the expert/examiner using the Aesthetic Component.



## Chapter 1: Introduction

Namibia has a population of approximately 2,113,007 million people according to the 2011 census (Namibiastatisticsagency, 2011). More than a quarter of the overall population is under the age of 15 (Mafwila, 2015). Furthermore, 5-14 year olds constituted 26% of the population nationally with Khomas region being home to 18% of this population (Mafwila, 2015). Therefore, a significant population of 45,047 exists within this age bracket of 5-14 years.

Information on the treatment needs of malocclusion is very important for Oral Health practitioners as well as policymakers to develop a baseline, create proper strategies and interventions, which are scientifically sound and evidence-based (MOHSS, 2011).

Currently, there is no significant data in Namibia about occlusal anomalies or Orthodontic treatment need. However, the Dental Aesthetic Index (DAI), which assesses the normative (objective) orthodontic need of a population, was determined for a population in Namibia. Although Uusiku, reported that the calculated DAI score showed no abnormality or only minor malocclusion, it does not assess the self-perceived need of the population (Uusiku, 2018). It is therefore imperative to understand the difference between subjective and objective orthodontic treatment needs. This will be the first orthodontic treatment needs study to be performed in Namibia.

## Chapter 2: Literature Review

Malocclusion is defined as an irregularity of the teeth or a mal-relationship of the dental arches beyond the range of what is accepted as normal (Walther, 1994). In general, it is an improper relationship of the teeth when the upper and lower jaws are in occlusion. Occlusion is the way in which teeth in upper and lower jaws relate with each other in all mandibular positions and movements (Ash and Ramfjord, 1982). Several orofacial structures are involved in the control of the components of the mastication systems (Ash and Ramfjord, 1982).

A good occlusion is characterized by an optimal occlusal status (Ross, 1970). This is generally described by two major characteristics: intra-arch relationship which is how the teeth are related to each other within each arch to a smoothly curving line of occlusion, and inter-arch relationship which is the pattern of occlusal contacts between the upper and lower teeth (Proffit, 1986). Therefore, not only does it matter how well the upper and lower teeth intercusate, but also how well the teeth align in each individual arch (MOHSS, 2011).

Physiologic occlusion happens with efficiently functioning components in a generally good state of health and devoid of pain thus differing from pathological occlusion (Ross, 1970). Angle clearly defined normal occlusion when the upper and lower molars are in a relationship such that the mesiobuccal cusp of the upper molar occludes in the buccal groove of the lower molar and the teeth are arranged in a smoothly curving line of occlusion (Angle, 1899). Any deviation from Angle's definition is then classified as a malocclusion.

Malocclusion is classified under handicapping dentofacial anomalies by the World Health Organization (WHO, 1987). A dentofacial anomaly is defined as an anomaly that causes disfigurement or which impedes function and requires treatment if the disfigurement or functional defect was likely to be an obstacle to the patient's physical or emotional well-being. Therefore, occlusion must affect the persons oral health function and aesthetics to bring about a self-perceived treatment need (WHO,

1987). Proffit (1986) elaborated that malocclusion might be associated with one or more of the following:

- a) Malalignment of individual teeth in each arch: a tooth in an arch may occupy a position deviating from the smooth curve of line by being; tipped, displaced, rotated, in infra-occlusion, in supra-occlusion and transposed.
- b) Malrelationship of the dental arches relative to the normal occlusion: may occur in any of the three planes of spaces: anteroposterior, vertical or transverse.

Today, malocclusion occurs in most populations. It is neither a normal nor an unhealthy condition (Fields, 2000). Malocclusion is a significant deviation from the ideal occlusion that may render aesthetics unsatisfactory thus further implying that most people with normative occlusal anomalies do not perceive a problem unless it interferes with function, causes pain, affects self-esteem or makes a person self-conscious because of appearance (Houston, 1992) .

The prevalence of malocclusion in all the stages of dentition varied widely across studies and populations because of differences in races/ethnicity sample sizes, age range of the surveyed children, and methods of measurement (Thilander *et al.*, 2001, Ayhab, 2014). Data from an oral survey by the World Health Organization shows that malocclusion is the third most important condition in the ranking of oral health problems, outranked only by caries and periodontal disease. However, with the reduction of caries in children and adolescents in recent decades, the condition has now received more attention (WHO, 1987)

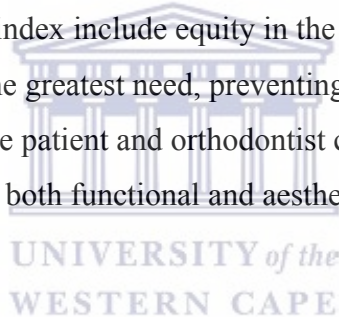
While considered non-life threatening, malocclusion may change the way the orofacial components function and alter dentofacial aesthetics to the extent of affecting an individual's quality of life causing social and functional limitations (Hagg, 2006). Therefore, arresting and correcting the malocclusions early, prevents progression to their full form and as such remove factors that would otherwise interfere with the regular development of the dental arches (Tausche *et al.*, 2004).

Majority of patients seek orthodontic treatment primarily to improve their aesthetics (Laothong and Cheng, 2017). Anterior teeth malalignment is the most common

presenting complaint (Marques *et al.*, 2009). Orthodontic treatment is seen to positively affect their appearance and self-esteem (Laothong and Cheng, 2017). However the need for orthodontic treatment is dependent on how the patient perceives their condition and how much function and aesthetics is affected (Samsonyanová and Broukal, 2014, Taghavi Bayat *et al.*, 2017).

## 2.1. Assessing Orthodontic treatment need

In assessing orthodontic treatment need, it is best to use an index that is standardized. An index comprises a set of numerical values describing the relative status of a population on a graduated scale with definite upper and lower limits, which is designed to permit comparison with other populations classified by the same criteria and methods (Russell, 1956, Gupta and Shrestha, 2015). The benefits of an Orthodontic treatment needs index include equity in the distribution of treatment with priority given to those with the greatest need, preventing unnecessary treatment, and providing a basis on which the patient and orthodontist can constructively discuss the treatment that should provide both functional and aesthetic benefits (Birkeland *et al.*, 1996).

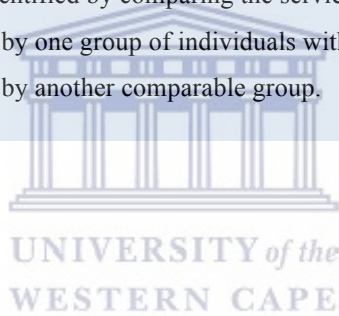


The concept of needs assessment is at the very core of orthodontic services (Moshkelgosha *et al.*, 2015). Self-perceived and Normative need does not always lead to the utilization of service any more than the availability and utilization infers a need (Adeyemi *et al.*, 2008). People will seek treatment depending on their level of exposure, preference, past experiences, referring dentist and dental health infrastructure (Marques *et al.*, 2009). Bradshaw (1972) described four basic types of need:

- Normative need
- Felt need
- Expressed need/Demanded need
- Comparative need

Table 1: Types of Need

Type of need	Definition	Examples
Normative need	Need that is defined by experts. Normative needs are not absolute and there may be different standards laid down by different experts.	Vaccination
Felt need	Need perceived by an individual. Felt needs are limited by individual perceptions and knowledge of services.	Having a headache
Expressed need (Demanded need)	Felt needs turned into action. Help seeking.	Dental visit for toothache
Comparative need	Needs identified by comparing the services received by one group of individuals with those received by another comparable group.	Need for a school if neighboring town has one



2.2. Objective (Normative) VS Orthodontic (Felt) treatment need.

Traditionally, the common model of oral health needs assessment depends almost entirely on dental or orthodontic professionals opinions (Sheiham, 2005, Asgari *et al.*, 2013b). Normative need assessment refers to the impairments and diseases which an expert, administrator or scientist defines as need (Essenz, 2010, Asgari *et al.*, 2013b). However, as a major shortcoming, wider concepts of general health which consider the incorporation of functional, psychological and social well-being in patient care are not accounted for usually in the Normative approach (Asgari *et al.*, 2013a).

Psychosocial factors like how a person feels about their appearance drives the demand for Orthodontic treatment (de Oliveira and Sheiham, 2004). Rather than a disease, it has been shown in most patients that malocclusion is a deviation from a documented



average therefore making psychological and social factors integral to the distinction between acceptable and unacceptable occlusion (Tsakos, 2008).

Of significant importance in orthodontics are subjective perceptions. This is the distinction between what is considered acceptable or unacceptable in occlusion can be variably influenced by personal aesthetic standards and a host of societal norms (O'Brien *et al.*, 2006). Therefore, a patients' opinion on their dental appearance should be considered during the assessment of the need and outcome of orthodontic treatment. In a UK study, a group of 11-12 year olds who perceived their dental aesthetics to be poor or those who had been teased were more likely to seek out dental treatment, hence the need to study the self-perceived need for treatment (Mandall *et al.*, 2005).

It is critical that the clinician and patient are in mutual agreement as far as the severity of the presenting condition or complaint is. This is essential for successful aesthetic treatment to occur. In this way, the patient's understanding is guaranteed, communication between clinicians and patient improves, thereby positively affecting compliance levels from these patients (Siddiqui *et al.*, 2014).

Considerable differences exist between how a patient perceives their dental appearance and orthodontic treatment needs and how the clinician perceives the same (Siddiqui *et al.*, 2014). A Brazilian study showed that a high percentage of dentists found that a group of adolescents who reported to have orthodontic treatment need did not have effects on their quality of life. Additionally, about one-fourth of the adolescents who were found to have oral impacts were not considered to have normative treatment need (de Oliveira and Sheiham, 2004).

It has been shown in a number of studies that patients overestimate their pretreatment conditions more than clinicians (Hamdan, 2004, Hassan, 2006). Although a study in Saudi Arabia (Albarakati, 2007) found no significant difference between the opinions of the patient and the orthodontist, a study conducted in Turkey showed that an orthodontist might over-estimate the severity of conditions to a greater extent (11.5%) than patients (6.7%) (Dogan *et al.*, 2010). In a study among both adolescents and young adults, only 50–65% of those normatively assessed by an orthodontist, as in need of orthodontic treatment actually perceived such a need (Koochek *et al.*, 2001).

There is a disparity between orthodontic needs assessed by a dental practitioner and the self-perceived need for orthodontic treatment (O'Brien *et al.*, 2006). When orthodontic needs assessment is done normatively, children whose malocclusion affects their quality of life are sometimes denied treatment or, paradoxically, some of those whose malocclusion does not affect their quality of life are treated (de Oliveira and Sheiham, 2004). Therefore, in the measurement of orthodontic need, the appropriate tool should not only use a normative measure but include the determination self-perceived need (Tsakos, 2008). Integration of the objective clinical measures with the patient subjective indicators makes a comprehensive system of assessing orthodontic treatment need (Asgari *et al.*, 2013b).

### *2.3. Factors influencing the need for orthodontic treatment*

In the quest for Orthodontic treatment, several factors influence the reasons that people seek orthodontic treatment and how they perceive their need for orthodontic treatment. Self-esteem, peer group norms, previous orthodontic treatment, gender, age, and socio-economic background, are some of the factors that have been seen to affect an individual's perception of dental appearance, malocclusion and the readiness to receive and comply with orthodontic treatment (Abu Alhaija *et al.*, 2005, Mandall *et al.*, 2001, Jenkins, 1984)

The relationship between children's self-esteem and the way they perceive their dental appearance or malocclusion cannot be isolated from the psychosocial effects (Mandall *et al.*, 2001). Children who are teased and bullied at school may perceive their dental appearance as very displeasing and this in turn affects their uptake of orthodontic treatment (Shaw, 1981, DiBiase and Sandler, 2001, Hamdan, 2004)

Subjective orthodontic treatment need was shown to be influenced by the psychological impact of malocclusion and self-perception as evident by the results of a forward stepwise logistic analysis (Xiao-Ting *et al.*, 2010). In this study, it was demonstrated that 59.9% of foreign habitants and 73.9% of Chinese natives considered that malocclusion would affect psychological development.

In recent times, the acceptance of aesthetics and its psychosocial impact as an important orthodontic treatment benefit has been growing (Cunningham and Hunt,

2001). The psychological and behavioral patterns of an individual are sometimes unfavorably influenced by their facial and dental attractiveness which are also affected by malocclusions and their resultant impaired craniomandibular function (Linder-Aronson *et al.*, 2002).

Previous orthodontic experience could also be a factor influencing perception of Orthodontic treatment need (Kerosuo, 2000, Birkeland *et al.*, 2000). It is seen that dental age, gender, and urban/rural areas of living affect perception of orthodontic treatment need as well as satisfaction with dental appearance. Older, female, and urban populations have been shown to have a greater awareness of their dentitions as well as concerns over attractiveness (Pietila and Pietila, 1996, Peres *et al.*, 2008, Abu Alhajja *et al.*, 2005).

In earlier years, a study by Shaw (1981) on children regarding their feelings about dental appearance, found that females were more dissatisfied with their dental appearance compared to males. In a Finnish study (Tuominen *et al.*, 1994), it was found that men were more often satisfied with their dentition than women, as did Xiao-ting (Xiao-Ting *et al.*, 2010) in both Chinese natives and foreign inhabitants. In more recent studies (Grzywacz, 2003, Al-Zubair *et al.*, 2015), it was demonstrated that there was a higher perception of orthodontic treatment need in females than males consistent with Shaw (Shaw, 1981). An investigation into the knowledge concerning orthodontic treatment in the Beijing area found a gender disparity that suggested that the percentage of women with teeth concerns was higher than men (Du, 2008). It is also supported by another study, which showed that females have a higher demand and need for subjective orthodontic treatment (Hagg, 2001).

Some studies have found a lack in significance between the two genders (Padaris *et al.*, 2009). Nevertheless, others found that gender did not play a significant role at all in perception of orthodontic need and treatment uptake (Aikins *et al.*, 2012, Spalj *et al.*, 2010). The normative need for orthodontic treatment, on the contrary, was shown to be higher in men than in women (Padaris *et al.*, 2009, Aikins *et al.*, 2012).

The way one perceives their body image differs with age. Adolescents and younger adults are more conscious and have higher expectations than children though they may be unwilling to undergo treatment (Bos *et al.*, 2003). By age 12, a child's dentition consists of permanent teeth and most or all the primary teeth have been shed

and it is usually at this age that orthodontic treatment is initiated (Kok *et al.*, 2004, Birkeland *et al.*, 1996). Similarly, by this age, the child has reached the stage in which they develop new tools for abstract and deductive thinking (Wadsworth, 1996, Mandall *et al.*, 2000). Additionally, this further emphasizes this age group as an attractive target for research in dentistry particularly orthodontics because of their body image and self-perception (Sharma 2014).

Socioeconomic status and general dental treatment have been demonstrated to be correlated. Adults in high socioeconomic groups have more teeth preserved and have more dentistry performed compared to people in lower socioeconomic groups (Park *et al.*, 2016). Salzmann stated that the resultant aesthetics value is a primary motivating factor in the demand for orthodontic treatment and further indicated a possible link between an individuals' line of work and their need to improve their aesthetics (Salzmann, 1967). Ranked professionals were found to have the highest need for good dental appearance (Park *et al.*, 2016). The implication here is that middle class people who are likely to have higher occupational motivation may in turn have a higher affinity for orthodontic treatment. It has also been shown that an individuals' socioeconomic status affects their need for orthodontic treatment (Lindegard *et al.*, 1971). Families of a lower socioeconomic status expressed a greater need for orthodontic treatment (Badran *et al.*, 2014).

A study conducted among Peruvian school children showed that age, sex and socioeconomic status did not significantly affect the distribution of normative and self-perceived orthodontic treatment need (Bernabé and Flores-Mir, 2006). Similar results were found in an Indian study (Prabu, 2008) showing that socioeconomic status had no significant effect on the distribution of treatment need both normatively and subjectively.

A study conducted on more than 6000 14-year olds (Tickle *et al.*, 1999) showed normatively assessed need (IOTN score 4 and 5) to be more frequently present among deprived children and for lack of need to be more prevalent amongst affluent children. Similarly, a study in Jordanian adolescents found that there was greater normative as well as perceived treatment needs among low socio-economic groups compared to high position groups (Badran, 2010).

Socio-economic backgrounds influence orthodontic treatment need because the education, access, availability and affordability vary in different socio-economic groups, with the higher end usually more advantaged.

#### ***2.4 Index of Orthodontic Treatment Need (IOTN)***

The Index of Orthodontic Treatment Need (IOTN) is one of the most widely used occlusal indices in Europe and is gaining widespread use around the world (Hamdan *et al* 2013).

The IOTN is a clinical index used to assess orthodontic treatment need, proposed by Brook and Shaw in 1989 (Brook and Shaw, 1989). It assesses Orthodontic treatment need from an anatomic as well as aesthetic point of view (Brook and Shaw, 1989). It has been modified over the years to accommodate different needs according to different societies and changing times (Khasim, 2013).

The aim of the study by Brook and Shaw was to develop a valid and reproducible index of orthodontic treatment priority. After reviewing the available literature, it was felt that this could be best achieved by using two separate components to record firstly the dental health and functional indications for treatment, and secondly the aesthetic impairment caused by the malocclusion (Brook and Shaw, 1989).

A modification of the index used by the Swedish Dental Health Board (Linder-Aronson, 2007) was used to record the need for orthodontic treatment on dental health and functional grounds. This index was modified by defining five grades, with precise dividing lines between each grade. An illustrated 10-point scale was used to assess independently the aesthetic treatment need of the patients. This scale was constructed using dental photographs of 12-year-olds collected during a large multi-disciplinary survey. Six non-dental judges rated these photographs on a visual analogue scale, and at equal intervals along the judged range, representative photographs were chosen.

To test the index in use, two sample populations were defined; a group of patients referred for treatment, and a random sample of 11 -12-year-old schoolchildren. Both samples were examined using the index and satisfactory levels of intra- and inter-examiner agreement were obtained (Brook and Shaw, 1989).

The IOTN generally combines aesthetic components and dental health components:

- **Dental health components (DHC)**
- **Aesthetic components (AC)**

#### **2.4.1. Dental Health Component (DHC)**

It is based on the Swedish Medical Health Board index (Linder-Aronson, 2007) and is classified into 5 grades. Grade 1 being “no need for treatment, Grade 5 being “Treatment need’ while the grades in between denote varying degrees of malocclusion severity and treatment need.

Grade 1	No treatment
Grade 2	Minor anomaly, no treatment need
Grade 3	Borderline treatment need
Grade 4	Treatment need
Grade 5	Treatment need

This component is based on the evaluation of 5 occlusal traits with the acronym MOCDO

- **Missing teeth:** This includes aplasia, displaced and impacted teeth. Hypodontia requiring pre-restorative orthodontics or orthodontic space closure to obviate the need for prosthesis.
- **Overjets:** Includes reverse sagittal overjets. Increased overjet greater than 6mm. Reverse overjet greater than 3.5 mm with no masticatory or speech difficulties. Reverse overjet greater than 1 mm but less than 3.5 mm with recorded masticatory and speech difficulties.
- **Crossbite:** Anterior or posterior crossbites with greater than 2 mm

discrepancy between retruded contact position and intercuspal position.

- **Displacement:** Contact point displacements greater than 4 mm.
- **Overbites:** Including Lateral or anterior open bites greater than 4 mm.  
Deep overbite with gingival or palatal trauma.

Below is a figure describing the details of the Dental Health Component of the IOTN

Figure 1: The DHC of the IOTN (Brook and Shaw, 1989)

Grade	Characteristics
<b>5 (Very great)</b>	5.i Impeded eruption of teeth (with the exception of third molars) owing to crowding, displacement, the presence of supernumerary teeth, retained primary teeth and any pathological cause 5.h Extensive hypodontia with restorative implications (more than one tooth missing in any quadrant) requiring preresorative orthodontics 5.a Increased overjet >9 mm 5.m Reverse overjet >3.5 mm with reported masticatory and speech difficulties 5.p Defects of cleft lip and palate 5.s Submerged primary teeth
<b>4 (Great)</b>	4.h Less extensive hypodontia, requiring preresorative orthodontics or orthodontic space closure to obviate the need for a prosthesis 4.a Increased overjet >6 mm but ≤9 mm 4.b Reverse overjet >3.5 mm with no masticatory or speech difficulties 4.m Reverse overjet >1 mm but <3.5 mm, with recorded masticatory and speech difficulties 4.c Anterior or posterior crossbites with >2 mm discrepancy between retruded contact position and intercuspal position 4.l Posterior lingual crossbite with no functional occlusal contact in one or both buccal segments 4.d Severe displacements of teeth >4 mm 4.e Extreme lateral or anterior open bites >4 mm 4.f Increased and complete overbite with gingival or palatal trauma 4.t Partially erupted teeth, tipped and impacted against adjacent teeth 4.x Supplemental teeth
<b>3 (Moderate)</b>	3.a Increased overjet >3.5 mm but ≤6 mm with incompetent lips 3.b Reverse overjet >1 mm but ≤3.5 mm 3.c Anterior or posterior crossbites with >1 mm but ≤2 mm discrepancy between retruded contact position and intercuspal position 3.d Displacement of teeth >2 mm but ≤4 mm 3.e Lateral or anterior open bite >2 mm but ≤4 mm 3.f Increased and complete overbite without gingival or palatal trauma
<b>2 (Little)</b>	2.a Increased overjet >3.5 mm but ≤6 mm with competent lips 2.b Reverse overjet >0 mm but ≤1 mm 2.c Anterior or posterior crossbite with ≤1 mm discrepancy between retruded contact position and intercuspal position 2.d Displacement of teeth >1 mm but ≤2 mm 2.e Anterior or posterior open bite >1 mm but ≤2 mm 2.f Increased overbite ≥3.5 mm without gingival contact 2.g Prenormal or postnormal occlusions with no other anomalies; includes up to half a unit discrepancy
<b>1 (None)</b>	Extremely minor malocclusions including displacements <1 mm

## 2.4.2 Aesthetic Component (AC)

The Aesthetic Component consists of 10-grade standard reference photographs representing different grades of dental attractiveness. The rating is based on matching the dental appearance of patient with one of the photographs by the dentist and/or any other non-professional. Grade 1 represents the most attractive and grade 10, the least attractive.

This makes it a useful tool in determining perceived Orthodontic treatment need both objectively and subjectively.

The Aesthetic Component measures the decay in aesthetics and brings into account treatment on social-psychological grounds. It consists of a 10- point scale illustrated by a series of photographs that were rated for attractiveness by a panel of lay judges and were selected as being equidistantly spaced through the range of grades. The IOTN-AC provides assessment that is easily seen and can be measured, regarding the patient's perception of their presenting malocclusion and their treatment needs.

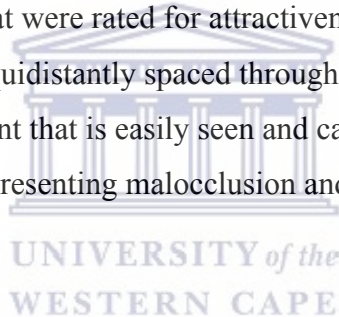




Figure 2: The AC of the IOTN (Brook and Shaw, 1989)



A rate is awarded for overall dental attractiveness and not necessarily the specific similarities to the photographs. The advantage of assessing using photographs is that there is no influence by oral hygiene, periodontal status and any tooth discoloration.

The final value reflects the treatment need on the grounds of aesthetic impairment and by implication of the social psychological need for orthodontic treatment (Avinash, 2015).

The need for treatment is therefore determined as follows:

Grades 1-2: No need for treatment

Grades 3-4: Slight need for treatment

Grades 5-7: Moderate need for treatment

Grades 8-10: Definite need for treatment

The DHC assessment can only be carried out by an expert because of the specific objective criteria assigned to it. However, the AC has the advantage of having both the expert and the layperson being able to individually assess the amount of orthodontic treatment needed (Khasim, 2013).

The patient's perception of their own malocclusion should be taken into account when determining orthodontic treatment and should not only be based on normative treatment need as judged by the professional (Mandall *et al.*, 2001).

### 2.5 Comparing the DHC and the AC of the IOTN.

The DHC of the IOTN basically measures the normative treatment need while the AC of the IOTN measures the subjective need by the examiner and by the patient. At times the two may not agree. The AC score of the patient and the examiner on the other hand sometimes are similar. The way a patient understands their aesthetic classification and/or orthodontic treatment need, may not always be as accurate to the patient as it is to a trained orthodontist. This discrepancy can be a concern when an orthodontist finds a certain condition to be severe, and a patient does not agree possibly limiting treatment uptake and compliance.

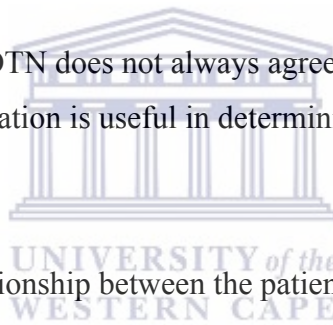
A study of assessment of orthodontic treatment need showed that patient self-perception and orthodontist perception of the presenting patients categorized most patients as having mild treatment need (Patient-determined IOTN-AC, 79.3% and Orthodontist-determined IOTN-AC, 62.8%) (Siddiqui *et al.*, 2014). This result was different from the normative treatment need, where the IOTN-DHC score placed most of the patients in the category of severe treatment need (47.1%). The study

highlighted the fact that both the orthodontist and patients were inclined to the perception of mild orthodontic treatment needs and rated the dentitions as more aesthetically pleasing than the normative treatment need would indicate, irrespective of the patient's age.

In a study on 11-year olds, (Birkeland *et al.*, 1996) it was found that in a sample size of 359 children with a mean age of 10.6 years, 53.2% had moderate to severe treatment need, as per the normative need, while self-perception was inclined towards mild treatment need, similar to the study in a Nepalese population (Sujita 2012).

The AC of IOTN (Brook and Shaw, 1989) recorded many children in the category of little need for orthodontic treatment that actually had a need for treatment on dental health grounds (IOTN/DHC) (Brook and Shaw, 1989) although their aesthetic impairment did not fall into the most severe grades (Brook and Shaw, 1989).

In general, the DHC of the IOTN does not always agree with the AC of IOTN even in the same patient. This information is useful in determining orthodontic treatment uptake as well as outcome.



Of interest as well is the relationship between the patient's perception of the dental attractiveness and the Orthodontist's perception, both scored by the AC of the IOTN. A study conducted on 5112 Malaysian children aimed to assess their treatment need using IOTN-AC scores determined by orthodontists, children, and their parents. The study did not consider the normative treatment need. It was found that while the orthodontist scored 22.8% of children in "Definite Treatment Need" (IOTN-AC 8–10), 5.8% of children and 4.8% of the parents had the same result. Hence the children and the parents perceived the children's treatment needs differently than did the orthodontists (Abdullah and Rock, 2002).

Results in a Saudi Arabian study (Siddiqui *et al.*, 2014) are in agreement with those of a study among Jordanian school children, which found that students between 13 and 17 years of age were more inclined to rate themselves as having no need of treatment (Abu Alhaija *et al.*, 2005). The self-perception for their treatment need groups was also statistically significant. A study on Nigerian school children also found that a

higher percentage of children perceived their malocclusions on the attractive end of the aesthetic scale (92%) while the orthodontist found 37.6% in moderate to definite treatment need (Kolawole *et al.*, 2008).

### 2.6 Advantages of the IOTN

The patient's perception of their own dentition should be considered in the determination of orthodontic treatment need and not only be based on normative treatment need as judged by the professional (Mandall *et al.*, 2001).

One of the main advantages of the IOTN is that it has the DHC, an objective assessment that is carried out by the professional as it has its own specific objective criteria. Then IOTN also has the AC which has the professional as well as the lay person or patient judging the level of orthodontic treatment need based on selection of the 10 intraoral photographs, giving it a subjective perspective. The AC of the IOTN, compared to all other indices has the distinct advantage of having the patient assess their own AC and therefore perceived need.

The IOTN as an index has proven to be reliable over time (Cooper *et al.*, 2000). In this study on the reliability of the IOTN, results suggested that the dental health component of IOTN was reliable over time between the ages of 11-19 years despite temporal changes in the separate occlusal traits that comprise the index. The aesthetic component of IOTN tended to show an improvement over time. Therefore, the IOTN is a reliable index over time when considering occlusal changes that are occurring during the 11-19-year age range. Intra-examiner and inter-examiner reliability has been shown to be high ( $>0.75$ ); (Ovsenik and Primožic, 2007, Sharma 2014)

A study of the evaluation of three indices found the IOTN to be the least time consuming compared to the Eismann index and the Eismann-Farcnik (EF) index, taking about 1-2 minutes per patient (Ovsenik and Primožic, 2007).

### 2.7 The modified IOTN

The original IOTN of Brook and Shaw though detailed in its structure, was found in epidemiological studies to be very complex and time-consuming (Burden *et al.*, 2001). Though it captures in detail the severity of malocclusion, it has the challenge of lengthy training periods and suffers reliability due to the complex detail in the

DHC (Burden *et al.*, 2001). These factors led to the formulation of a more practical modification of the IOTN by Burden under the British Association for the Study of Community Dentistry (BASCD) (Burden *et al.*, 2001).

The DHC of the modified IOTN according to Burden *et al* (2001) is a two-grade scale that only captures:

- Definite need for Treatment
- No need for Treatment

The modified DHC simplifies the identification of people in need of treatment and improves the reliability and validity of the index.

The acronym MOCDO is still maintained in the evaluation of occlusal traits but simplified such that any case with a DHC equal or greater than 4mm generally is graded as need for treatment:

- 1) Missing teeth: Congenitally absent, ectopic, impacted teeth with 4mm or less of space needed, unpalpable palatally ectopic canines. Hypodontia requiring pre-restorative Orthodontics.
- 2) Overjets: Increased Overjets and reverse overjets. Measurement is taken from the labial aspect of the most prominent incisor and a recording of need for treatment is taken if it exceeds 6mm and 4mm for the reverse overjet.
- 3) Crossbites: Any posterior or anterior crossbite with more than 2mm discrepancy between intercuspal and retruded contact points is recorded. In addition, any displacement on closure is recorded as need for treatment.
- 4) Displacement of contact points: Only applies to crowding between permanent teeth. Measure between the contact points of the two most crowded teeth. Need for treatment is allotted for a reading of 4mm or more.
- 5) Overbites: Deep overbites causing palatal or gingival traumatic injury and anterior or lateral open bites greater than 4mm all are recorded as need for treatment.

In the modified IOTN, The AC maintains the same ten-point scale but the recording is simplified in that:

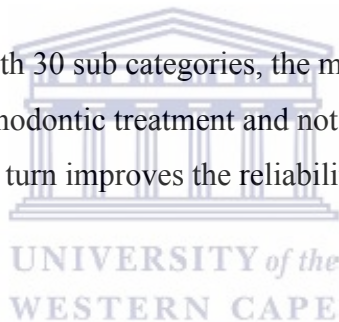
- Grades 1-7: No need for treatment
- Grades 8-10: Need for treatment.

Since its introduction, few epidemiological studies have used the modified IOTN with the index simplified to two categories:

- Definite Need for Treatment
- No Definite Need for Treatment.

The modified Index of orthodontic treatment is therefore mainly recommended in epidemiological studies because it utilizes only two grades. This means that patients' severity of malocclusion cannot be assessed and classified (Carlos Bellot- Arcis, 2012).

Instead of five-grade scale with 30 sub categories, the modified IOTN aims to simply identify people in need of orthodontic treatment and not necessarily the complexity of the occlusal anomaly. This in turn improves the reliability and validity of the index (Avinash, 2015).



The modified index of orthodontic treatment has been used in various studies across the world to assess Orthodontic treatment need. In a South African study Rampersadh (2015) using the modified IOTN, it was found that the normative need for orthodontic treatment was higher than the patient's self-perceived need (child rated AC), but then lower than the examiner's perceived need (examiner rated AC) (Rampersadh, 2015).

## **2.8 The Index of Complexity, Outcome and Need (ICON)**

The index of Complexity, Outcome and Need (ICON) is an occlusal index developed basing on the perception of 97 international orthodontists on 240 dental casts (Daniels and Richmond, 2000).

It incorporates an aesthetic score as well as a record of severity of malocclusion. This index is practical in its application, reliable and easy to use in the assessment of treatment need as well as treatment outcome.

In a study on comparison of Indices, it was shown that in the assessment of treatment need, the ICON is largely in agreement with the IOTN. The study further suggested that the ICON could be used in substitution for the IOTN with largely similar results (Lopez, 2017)



## Chapter 3: Aim and Objectives

AIM:

The aim of the study was to assess the general orthodontic treatment needs in a sample population the Namibian school children aged 12-15 years in a school in Khomas Region.

*The objectives were:*

- To determine the objective need for orthodontic treatment using the Dental Health Component (DHC) of the modified Index of Orthodontic Treatment need (IOTN) in a sample population of Namibian school children aged 12-15 years in Khomas Region.
- To determine the subjective need for orthodontic treatment using the Aesthetic Component (AC) of the modified index for Orthodontic Treatment Need (IOTN) in a sample population of Namibian school children aged 12-15 in Khomas Region.
- To determine the relationship between the normative (orthodontic) and subjective (felt) need by assessing the agreement of the Dental Health Component (DHC) of the modified IOTN with the Aesthetic Component (AC) of the modified IOTN.
- To find the associations between orthodontic treatment need and demographic and socioeconomic factors.



### **3.1 Value of contribution and Importance of research**

Considering the scarcity of baseline data on orthodontic treatment needs in Namibia, this study will go some way in highlighting an objective orthodontic treatment need problem if one exists as well as the perception of individuals on their aesthetics from any resulting malocclusion.



## Chapter 4: Research Design And Methodology

The study assessed Normative need and Felt need in a 12 -15-year age group.

Normative need will be expressed as the objective need for orthodontic treatment defined by the expert/examiner using a scientifically acceptable index while Felt need will be expressed as the self-perceived/ subjective need for orthodontic treatment by the child/ subject using the same index.

The Modified Index of Orthodontic Treatment need (IOTN) was the index of choice because using the dental health component (DHC), researchers can determine objectively the presence of malocclusion and orthodontic normative treatment need thereof. The aesthetic component (AC) of the IOTN can be used to determine both the subjective as well as the objective orthodontic treatment need of a person. A combination of these factors therefore made the modified IOTN comprehensively suited for this study.



### 4.1 Research Hypothesis

The hypotheses tested were:

- There is significant objective and perceived need for orthodontic treatment among school children in Khomas region Namibia.
- The Normative / Objective and Felt / Subjective need for Orthodontic treatment are always in agreement

### 4.2 Study design

The research was conducted as a cross sectional study. This study design was used because it can measure the prevalence of health outcomes or determinants of health,

or both, in a population at a point in time or over a short period. Another application of a cross sectional survey lies in assessing treatment need and planning health care.

For this study, the Modified Index of Orthodontic Treatment Need (IOTN) Index was used to capture the Orthodontic normative treatment need of the child examined. The Aesthetic Component of the IOTN (AC) was used to capture the subjective orthodontic treatment need, as it captures both the child's perceived treatment need as well as the examiner rated treatment need. Intra-oral examinations were carried out for the use of the Aesthetic component and the Dental Health component of the IOTN.

This study also included two questionnaires per family: One to the child being examined as it was useful in capturing the demographics and in determining their self-assessed need for Orthodontic treatment and one to the child's guardian which captured the socio-economic status of the child (Appendix 9 and 8 respectively). These two questionnaires also helped to study the factors that influence the need for orthodontic treatment.



#### *4.3 Sampling technique*

Sampling is the process of selecting a number of individuals for a study in such a way that they represent a larger group from which they are selected. A sample is a smaller, but hopefully representative collection of units from a population used to determine truths about that population (Field, 2005).

The Region of Khomas was chosen for this study as it represents a diverse group of children and has the largest population of all regions in Namibia. According to the 2011 census, there are 342,141 people out of the total population of 2,113,077, making it 16%. Therefore, a representative sample could present a diverse view and understanding of malocclusion and perceived orthodontic treatment need and it also has a diverse socio-economic grouping.

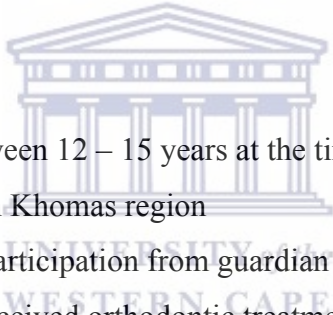
After choosing the target area, the second cluster that was selected was the school.

Using a list of schools in the area obtained from the Department of Education's

EMIS, (Education Management Information System) a school was selected based on the ethnic diversity primarily found in this school. Since the study is targeting 12-15 year olds, the appropriate grade chosen as the tertiary sampling unit were Grades 7-10. These grades represent upper primary and lower secondary pupils. According to the EMIS (Education Management Information System) report, Ministry of Education, Namibia, there are 14 schools in the Khomas region that offer combined primary and secondary education, therefore the school to visit was selected from these (Ministry of Education, 2012). As the tertiary cluster, all children in those grades 6-9 were invited to participate; however, at this stage, convenience sampling was used to select individuals to participate in the study.

#### *4.4 Subject Selection*

Convenience sampling at the chosen school was used in selecting the subjects, with which the following applied:

- 
- All children aged between 12 – 15 years at the time of the study
  - Resident and school in Khomas region
  - Written consent and participation from guardian
  - Those that have not received orthodontic treatment.

The reason for selecting this age group lies in the fact that by 12 years, most if not all primary teeth have been shed and the dentition is basically permanent and so making it an appropriate age for assessing orthodontic treatment need and usually initiating of orthodontic treatment. Also by this age, a child has the ability to think in abstract terms and make deductible conclusions and therefore will be able to participate well in the AC of the IOTN.

#### *4.5 Sample population and size:*

The population should be representative in terms of many factors influencing need for Orthodontic treatment such as age, gender, ethnicity and socio-economic status. The sample population was taken from the guardians and school children, grades 7-10 from a school in the Khomas region. There was a total enrollment of 174 children from grade 7 -10.

#### *4.6 Variables*

In this study, the variables measured included both dependent and independent variables.

Dependent Variables:

- The percentage of children with a definite need for orthodontic treatment according to the DHC of the modified index of orthodontic treatment need.
- The percentage of children with a definite need for orthodontic treatment according to the AC of the modified index of orthodontic treatment need.

Independent Variables:

Age, gender and socioeconomic status were measured to evaluate to what extent these influence the need for orthodontic treatment.

#### *4.7 Calibration of the examiner*

The examiner was trained and calibrated in the use of the IOTN before data collection began. This was in order to create an acceptable level of reliability. The examiner was calibrated against two independent competent examiners using 20 study models. The result of the kappa statistic was 0.9061 which is very good agreement between all the examiners. Intra-examiner reliability and reproducibility tests were carried out during the examinations to make sure the data remains reliable.

#### *4.8 Infection Control*

All mirrors and probes were disposed of after single use. Disposable gloves, masks and glasses were used during examinations. Stainless steel orthodontic rulers were cold sterilized and autoclaved before re-use.



#### *4.9 Exclusion criteria*

Any child for whom guardian consent was not attained was excluded.

Any child who declined to participate on the day of data collection was excluded.

Any child who was currently undergoing or had received orthodontic treatment was excluded from the study.

Any child who did not fit the age group was excluded.

#### *4.10 Ethics Statement*

All aspects of the proposed study were designed in accordance to the UWC research ethics policy. Ethical approval was obtained from the UWC health research ethics committee (Appendix 2).

Prior to data collection, the selected school Principal was being contacted for approval and consent (Appendix 3, 4 and 5).

The proposed participants and the guardians were also approached. They were provided with information sheets (Appendix 3) and then asked for informed consent for both the questionnaires and the clinical examinations. Participants were advised that they could withdraw at any stage of the project without consequence. The researcher undertook to protect the identity and the nature of the participant's contribution. To ensure anonymity, the survey was anonymous and did not contain information that may personally identify the participants. To ensure confidentiality, all the hard data was securely locked away in a filing cabinet and soft copies kept using password-protected computer files. If we write a report or article about this research project, the identity of the participants will be protected. All children who needed Orthodontic treatment were referred to Katutura State Hospital for further management or referral. Furthermore, all aspects of this project were compliant to the guidelines set forth by the Helsinki Declaration for biomedical research involving human subjects.

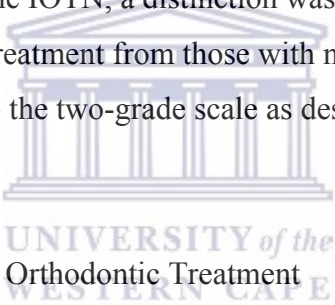
#### *4.11 Research Instruments and procedure*

The modified Index of Orthodontic need was the index of choice in fulfilling the objectives of this research study.

#### 4.11.1 The DHC of the modified IOTN

The Dental Health Component was used to determine the normative (orthodontic) need for orthodontic treatment as well as to record the presence of malocclusion. The child was asked to sit or to stand in front of the examiner and with the use of natural light the examiner carried out an intra-oral examination of the dentition. A pair of gloves per child as well as a mask over the examiner's nose was used as an infection control strategy and a disposable wooden spatula used to retract the cheek. No radiographs, study models or previous records were used. The oral examination took about 2 minutes per child.

Using the modified DHC of the IOTN, a distinction was made between those individuals with a definitive treatment from those with no definitive treatment need. The criteria were according to the two-grade scale as described by Burden *et al* (2001): -

- 
- 0; No definite need for Orthodontic Treatment
  - 1; Definite need for Orthodontic Treatment

Therefore, each child was examined and according to the scale, if even one of the conditions described in the DHC of the modified IOTN was found, a 1 was allotted and no further conditions were sought. Conditions sought for during the examination and recording of the modified DHC fall under the acronym MOCDO for missing teeth, overjets, crossbites, displacement of contact points and overbites.

An easy to sterilize orthodontic ruler with a 4mm and 6mm mark was used to take these measurements.



#### 4.11.2 The Modified AC of the IOTN

The 10 point scaled illustration by a series of photographs rated for attractiveness by a panel of lay judges was used as the tool to determine the felt need.

The child was seated in front of the examiner in natural light and asked to bite on their back teeth and smile for the assessment by the examiner. The examiner then studied the smile and an examiner-rated grade was picked from the 10-point scale and recorded. A rating was allocated for overall dental attractiveness rather than specific similarities to the photographs. This exercise took 1-2 minutes per child. Grades 1-7 on the scale denote a 'no need for treatment' while grades 8-10 on the scale denote a need for treatment. Therefore, the examiner rated need for treatment was determined depending on the grade chosen from the scale. The main aim was to differentiate those graded 8-10 from those graded 1-7. In an effort to eliminate bias, a random series of photographs were presented to the children in place of the standard AC pictograph.

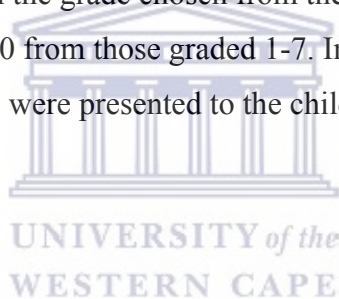


Figure 3: AC of the Modified IOTN (Re-ordered)



#### **4.11.3 Student's questionnaire**

Each child was asked to fill in a questionnaire; the questions were few and limited to capturing demographics, self-assessed grading according to the AC of IOTN and an opinion on the need for treatment. In the questionnaire, the child was also asked to pick a grade on the scale that they feel best represents their own dental attractiveness.

The photographs from the original AC Panel were re-ordered and mixed up and not presented as from best to worst to avoid bias. This was recorded as the self-assessed/ subjective need or no need for treatment depending on the grade picked (Appendix 8).

#### **4.11.4 Guardian's questionnaire**

It was of great importance to have each guardian give us some information regarding the socio-economic status. A question on education level, location of dental services, receipt of social grants, household amenities and employment status was included. This helped to relate the need for treatment to the socio-economic status of an individual (Appendix 7).

#### *4.12 Data Collection and Analysis*

Data collected from the examinations and quantitative information from the questionnaires was entered and tabulated in an Excel spreadsheet on the days of collection.

The database created using Microsoft Excel was statistically analyzed and presented, as a percentage of the representative sample population with normative/objective

orthodontic treatment need as well as the percentage of the sample population with Felt/subjective orthodontic treatment needs.

The relationship between the examiner- rated AC and the child rated AC was analyzed. The relationship of AC compared to the DHC in the determination of the orthodontic treatment need and various other factors which affected the need for orthodontic treatment were also analyzed.

#### **4.12.1 Statistical Analysis**

Difference in groups for continuous data were evaluated using a t-test to determine if the data was normally distributed. Differences in categorical data were evaluated using Chi square test. Data analysis was performed using STATA software version 15. A statistical  $p$  value was set at 0.05 to denote statistical significance.



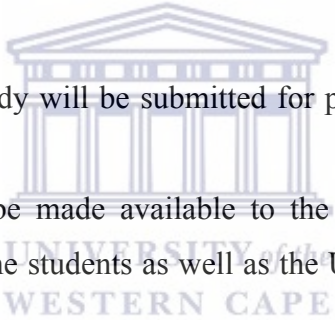
## CHAPTER 5: Data dissemination plan

Disseminating research findings to those who will use the information in practice is a noble practice for any researcher. Sharing of data encourages connection and collaboration between researchers, which can result in important new findings within the field.

### *Materials to be disseminated:*

This thesis will be made available in both hard and soft copies. Hard copies will be in form of hard cover books while the soft copies will be on either CD ROM or USB disks.

### **Plan:**

- 
- The results of this study will be submitted for publication in a peer-reviewed journal.
  - The study will also be made available to the University of Western Cape library for access to the students as well as the University of Namibia, Dental School library.
  - A copy of this study will be made available to the Oral health department of the Ministry of Health and Social Services, Namibia.

## CHAPTER 6: Results

In this Chapter, the data collected and analyzed will be presented with regard to the aim and objectives of the study.

### *6.1 Demographic Information*

#### **6.1.1 Gender**

There were 174 children in grade 7- 10 that were invited to participate in the study, 105 children and their guardians gave their informed consent. Three participants were excluded because two were currently receiving orthodontic treatment and the other participant was not eligible due to their age. Of the 102 participants, 65 (63.7%) were female, making up the majority, while 37 (36.2%) were male.

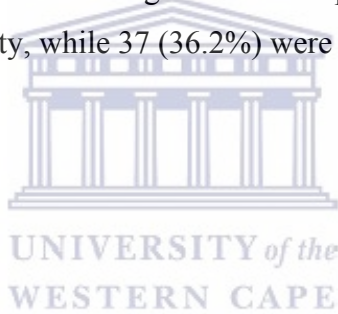


Table 2: Demographic information of the sample

	<b>Total n (%)</b>
<b>Gender</b>	
Female	65 (63.7)
Male	37 (36.2)
<b>Age</b>	
12	9 (8.8)
13	27 (26.5)
14	40 (39.2)
15	26
<b>Frequency of visits</b>	
0 x annually	60 (58.8)
1-2 x annually	36 (35.3)
More than 2 times annually	6 (5.9)
<b>Education level</b>	
Grade 12	6 (5.9)
Certificate	15 (14.7)
Diploma	45 (44.1)
Undergraduate Degree	34 (33.3)
Postgraduate Degree	2 (1.9)

### 6.1.2 Age

The majority (39.2%) of the study population consisted of fourteen year olds. Twelve, thirteen and fifteen-year old participants constituted 26.5%, 25.5% and 8.8% of the study population, respectively.

### 6.1.3 Frequency of dental visits

More than 58% of the sample population do not visit the dentist at least once per year, while only 5.9% visited the dentist more than twice per year.

## 6.2 Socio-economic information

### 6.2.1 Employment status

94% of the guardians who returned the questionnaire were employed and only 6% were not employed.

### 6.2.2 Social grant

More than 87% of the guardians did not receive any form of social grant while 12.8% received some form of social grant.



### 6.2.3 Education level

All of the participating guardians had some basic education. The majority, 44.1% were diploma holders while only 1.9%, were in possession of Postgraduate degree. Undergraduate degrees, certificate holders and Grade 12 holders made up 33.3%, 14.7% and 5.9% of the sample respectively.

Table 3: Education level

EDUCATION LEVEL	FREQUENCY (%)
Diploma	44.1
Postgraduate	1.9
Undergraduate	33.3
Certificate	14.7
Grade 12	5.9



## 6.2.4 Household amenities

Questions 3-5 in the guardians' questionnaire were designed to capture the socio-economic status using some basic indicators of wealth.

All the participants were shown to have electricity and piped water in their homes. 59.8% of the guardians owned cars, 28.4% hired a taxi (rented a car) to take their children to school while 11.7% of the children walk to school.

As far as housing is concerned, 47% lived in their own home, 39.2% rented a home and 13.7% lived with family.

Table 4: Household Amenities

<i>Amenities</i>	<i>Total n (%)</i>
<i>Electricity</i>	102 (100)
<i>Piped water</i>	102 (100)
<i>Home</i>	
<i>Own</i>	48 (47)
<i>Rent</i>	40(39.2)
<i>Lives with family</i>	14(13.7)
<i>Transport</i>	
<i>Own car</i>	61(59.8)
<i>Hire a taxi</i>	29(28.4)
<i>Walks to school</i>	12(11.7)

### 6.3 Dental Health Assessment

#### 6.3.1 Dental Health Component (DHC), ERAC and CRAC

Of the 102 participants, 59% presented a definite need for orthodontic treatment (DHC). More than 17% of the 102 participants found that they had a need for orthodontic treatment (CRAC). 31.4% were found to have need for orthodontic treatment according to the AC grade chosen by the examiner (ERAC). (See Table 4)

Table 5: Need for treatment according to the Dental Health Component (DHC), Examiner and Child Aesthetic Component ERAC/CRAC

	DHC n (%)	ERAC n (%)	CRAC n (%)
<b>Definite need</b>	61 (59.8)	32 (31.4)	18 (17.7)
<b>No need</b>	41 (40.2)	70 (68.6)	84 (82.4)
<b>Total</b>	102	102	102



#### 6.3.2 Association between Examiner-rated AC and Child rated AC

According to the Aesthetic Component of the modified IOTN, the biggest percentage of the children rated themselves as aesthetically pleasing needing no orthodontic treatment.

Similarly, the examiner rated 70 (68.6%) of the participants as aesthetically pleasing with no need for orthodontic treatment.

Only 31.4% of the participants were perceived by the examiner as having a definite need for treatment, while 12 (37.5%) children rated themselves as having a definite

need for orthodontic treatment. And of the 70 (68.6%) who do not need treatment according to the examiner, 64 (91.4%) of the children were in agreement.

A chi-square test for association was conducted between CRAC and ERAC. All expected cell frequencies were greater than five. There was a statistically significant association between CRAC and ERAC,  $\chi^2(1) = 12.65, p < 0.001$ . This indicated a moderately strong association between DHC and ERAC, Cramer's V = 0.3521.

Table 6: Examiner-related AC versus Child-related AC

		ERAC		<i>p</i> -value
		No need	Need	
CRAC	No need	64	20	< 0.001 <sup>a</sup>
	Need	6	12	
	Total	70	32	

<sup>a</sup> chi-square test



### 6.3.3 Association between DHC and Examiner rated AC

Based on the DHC of the modified IOTN, 59.8% of the participants were shown to have a definite need for orthodontic treatment. This is the objective assessment of need based on the modified DHC of the IOTN. Aesthetically, the examiner recorded 31% in need of treatment according to the AC of the IOTN.

Of the 32 children who were shown to be in need of orthodontic treatment by the ERAC, 30 (93.7%) were in agreement according to the objective DHC.

A chi-square test for association was conducted between DHC and ERAC. All expected cell frequencies were greater than five. There was a statistically significant association between DHC and ERAC,  $\chi^2(1) = 22.35, p < 0.001$ . There was a moderately strong association between DHC and ERAC, Cramer's V = 0.468.



Table 7: DHC versus ERAC

		ERAC		<i>p</i> -value
		No need	Need	
DHC	No need	39	2	< 0.001 <sup>a</sup>
	Need	31	30	
	Total	70	32	


<sup>a</sup>chi-square test

### 6.3.4 Association between DHC and Child-rated AC

Of the 18 participants shown to have a definite objective need for orthodontic treatment by their own assessment according to the CRAC of the IOTN, 16 (88.8%) children were in agreement according to the modified DHC assessment. 39 (46.4%) participants who did not show need according to DHC, also did not perceive need for treatment aesthetically.

A chi-square test of independence was conducted between DHC and CRAC. All expected cell frequencies were greater than five. There was a statistically significant association between DHC and CRAC,  $\chi^2(1) = 7.692$ ,  $p = 0.006$ . The association was moderately strong, Cramer's  $V = 0.2746$ .

Table 8: DHC versus CRAC



		CRAC		<i>p</i> -value
		No need	Need	
DHC	No need	39	2	< 0.006 <sup>a</sup>
	Need	45	16	
	Total	84	18	

<sup>a</sup>chi-square test

## 6.4 Factors affecting Orthodontic treatment need

### 6.4.1 Age

#### *Association between Age and DHC*

The highest number of children (39.2%) who participated were 14 year olds and this age group had the highest number of children in definite need for treatment objectively. A chi-square test of independence was conducted between Age and DHC and it was determined that there was not a statistically significant association between Age and DHC.

#### *Association between Age and CRAC*

The majority of the children did not perceive need for orthodontic treatment for their own dentition, including 34(85%) of the 40 14-year olds who also represent the highest number of children in any age group. Fishers' Exact test was conducted between CRAC and Age. All expected cell frequencies were not greater than five. There was not a statistically significant association between Age and CRAC,  $p = 0.846$ . The association was small, Cramer's  $V = 0.0935$ .

Table 9: DHC and CRAC versus Age

DHC	AGE n (%)				p-value
	12	13	14	15	
Need	7 (77.7)	17 (62.9)	24 (60)	13 (50)	0.5 <sup>a</sup>
No need	2 (22.2)	10 (37)	16 (40)	13 (50)	
Total	9	27	40	26	
<b>CRAC</b>					
Need	1 (11.1)	6 (22.2)	6 (15)	5 (19.2)	0.85 <sup>b</sup>
No need	8 (88.8)	21 (77.7)	34 (85)	21 (80.7)	
Total	9	27	40	26	

## 6.4.2 Gender

### *Association between DHC and Gender*

Although 39 (60%) of the 65 females and 22 (59.4%) of the 37 males were identified as having definite need for treatment, there was not a statistically significant association between DHC and Gender. A chi-square test of independence was conducted between DHC and Gender. All expected cell frequencies were greater than five. The association was small, Cramer's  $V = -0.0053$ .

### *Association between CRAC and Gender*

A chi-square test of independence was conducted between Gender and CRAC. All expected cell frequencies were greater than five. There was no statistically significant association between Gender and CRAC,  $\chi^2(1) = 0.6311$ ,  $p = 0.427$ . The association was small, Cramer's  $V = 0$ .

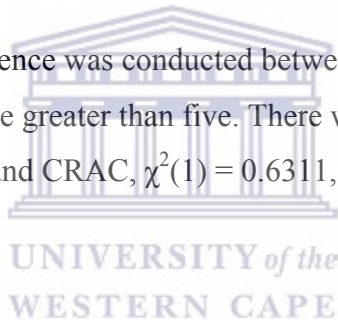


Table 10: DHC and CRAC versus Gender

DHC	GENDER n (%)		p-value
	Female	Male	
Need	39 (60)	22 (59.4)	<b>0.96<sup>a</sup></b>
No need	26 (40)	15 (40.5)	
Total	65	37	
<b>CRAC</b>			
Need	10 (15.3)	8 (21.6)	<b>0.427<sup>a</sup></b>
No need	55 (84.6)	29 (78.4)	
Total	<b>65</b>	<b>37</b>	

<sup>a</sup> chi-square test

### 6.4.3 Dental Visits

#### *Association between DHC and Dental Visits*

It was found that the children who visited the dentist more than twice a year had a very low need for treatment according to the DHC of the modified IOTN. Those that visited the dentist once or none at all showed a greater need for treatment. A Fisher's Exact test was conducted between DHC and visits. There was no statistically significant association between DHC and visits,  $p = 0.553$ . There was mild effect size, Cramer's  $V = 0.1925$ .

#### *Association between CRAC and Dental Visits*

The children who visited the dentist more than 2 times per year were shown to perceive their need for treatment as lower than those who visited the dentist less or not at all.

A Fisher's Exact test was conducted between Visits and CRAC. There was no statistically significant association between Visits and CRAC,  $p = 0.979$ . There was a small effect size, Cramer's  $V = 0.078$ .

Table 11: DHC and CRAC and Dental Visits

DHC	VISITS n (%)					p-value
	0	1	2	3	4	
Need	35 (58.3)	12 (66.6)	11(61.1)	1 (25)	2 (100)	0.553 <sup>a</sup>
No Need	25 (41.6)	6 (33.3)	7 (38.8)	3 (75)	0 (0)	
Total	60	18	18	4	2	
<b>CRAC</b>						
Need	11 (18.3)	3 (16.6)	3 (16.6)	1 (25)	0 (0)	0.979 <sup>a</sup>
No Need	49 (81.6)	15 (18.3)	15 (83.3)	3 (75)	2 (100)	
Total	60	18	18	4	2	

<sup>a</sup> Fisher's Exact test



#### 6.4.4 Socio-Economic factors

##### *Employment*

##### DHC and Employment

57.2% of the children whose parents are employed were shown to have a definite need for treatment according to the DHC while 42.7% showed no need. A Fisher's Exact test was conducted between DHC and employment. There was no statistically significant association between DHC and employment,  $p = 0.079$ . There was mild negative effect size, Cramer's  $V = -0.205$ .

Table 12: DHC versus Employment

DHC	Employment n(%)		Total	<i>p</i>
	No	Yes		
No Need	0 (0)	41 (42.7)	41	<i>0.079</i> <sup>a</sup>
Need	6 (100)	55 (57.2)	61	
Total	6	96	102	

<sup>a</sup> Fisher's Exact test

##### CRAC and Employment

82.3% of the children whose parents were employed did not perceive need for treatment for their own dentition while only 17.7% thought they needed treatment. A Fisher's exact test was conducted between Employment and CRAC. There was no statistically significant association between Employment and CRAC,  $p = 0.715$ . There was no effect size, Cramer's  $V = 0.0064$ .

Table 13: CRAC versus Employment

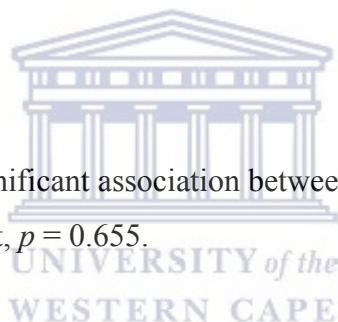
CRAC	Employment n (%)			p-value
	No	Yes	Total	
No need	5 (83.3)	79 (82.3)	84	0.715*
Need	1 (16.6)	17 (17.7)	18	
Total	6	96	102	

\*Fisher's Exact test

## Education

### DHC and Education

There was no statistically significant association between Education and DHC as assessed by Fisher's exact test,  $p = 0.655$ .



### CRAC and Education

73.3% of children of whose parents hold certificate level education did not perceive a need for orthodontic treatment as well as 88.9% of children of diploma holders and 76.4% of degree holders. In this community where all of the parents had some form of education, the children's perception of their need for treatment aesthetically was low. A Fisher's Exact test was conducted between Education and CRAC. There was no statistically significant association between Education and CRAC,  $p = 0.184$ .

Table 14: CRAC versus Education

CRAC	EDUC n (%)						p- value
	CERT	DEGREE	DIPLOMA	GD12	PGDip	Total	
No need	11 (73.3)	26 (76.4)	40 (88.9)	6 (100)	1 (50%)	84	<i>0.184*</i>
Need	4 (26.6)	8 (23.6)	5 (11.1)	0 (0)	1 (50)	18	
Total	15	34	45	6	2	102	

Fishers' Exact Test

### **Grant**

#### *DHC and being a Grant recipient*

Ten (77%) of the 13 children whose parents receive a grant were found to have need for orthodontic treatment while only 3 (25.7%) of the children whose parents do not receive a grant were found to have a need for treatment. A chi-square test of independence was conducted between DHC and Grant. All expected cell frequencies were greater than five. However, there was no statistically significant association between DHC and Grant,  $\chi^2(1) = 1.8164$ ,  $p = 0.178$ . The association was small, Cramer's V = 0.133.

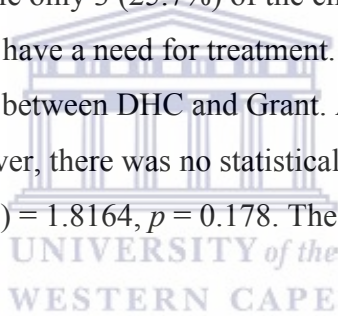


Table 15: DHC versus being a Grant recipient

DHC	GRANT n (%)			p- value
	No	Yes	Total	
No need	38 (74.5)	3 (23)	41	<i>0.178</i>
Need	51 (25.5)	10 (77)	61	
Total	89	13	102	

*CRAC and being a Grant recipient*

Of the 89 guardians' who did not receive grant 74 (83.1%) of their children did not perceive a need for treatment and only 16.9% thought they need treatment. On the other hand, 23.1% of the 13 who receive a grant perceive a treatment need.

A chi-square test of independence was conducted between CRAC and Grant. All expected cell frequencies were greater than five. There was no statistically significant association between CRAC and Grant,  $p = 0.302$ . The association was small, Cramer's  $V = 0.054$ .

Table 16: CRAC versus Grant

CRAC	Grant n (%)			p- value
	Yes	No	TOTAL	
No need	10 (76.9)	74 (83.1)	84	0.302*
Need	3 (23.1)	15 (16.9)	18	
TOTAL	13	89	102	

\*Fisher's Exact test

## CHAPTER 7: Discussion

### *Introduction*

This chapter will discuss the results that have been presented and analyzed in the previous chapter while tying them in with the Aim and objectives presented in Chapter 3

### *7.1 Demographic information*

The participants of the study were drawn from a school of middle socio-economic background. The sample is a general overview of potential users of orthodontic services in an urban area. It is not a representative sample of the whole Namibian population of this age group.

Children and their guardians from Grades 7-10 were invited to participate in the study. 105 responded, however 3 were excluded for reasons such as undergoing going orthodontic treatment and failure to fit within the age bracket. Therefore, the final sample size was 102 participants.

#### **7.1.1 Age**

Age has been shown to be a factor in the need and demand for orthodontic treatment with the adolescents and younger adults having a greater affinity for orthodontic treatment and the older showing less need as far as perception is concerned (Bos *et al.*, 2003).

In this study however, since all of the participants were adolescents, there was no statistical significance between the individual age groups and the need for orthodontic treatment both objectively and statistically.

### **7.1.2 Gender**

Earlier studies have shown females to be more particular with regards to dentition. As they value dental appearance highly, females tend to be more critical in their self-evaluations and are usually not satisfied with dentition arrangements (Pietila and Pietila, 1996, Otuyemi and Jones, 1995, Holmes, 1992).

In contrast, are findings by Otuyemi (1995) who concluded that males were more likely to seek orthodontic treatment than females. In other studies, the males were shown to have a greater need normatively than females (Padisar *et al.*, 2009, Aikins *et al.*, 2012).

In this study, there were no statistically significance differences between the gender and the need for orthodontic treatment both objectively and subjectively. These results are similar to those reported in other studies done in South Africa, Kenya and Tanzania (Rampersadh, 2015, Mugonzibwa *et al.*, 2004, Mwangombe, 2016).



### **7.1.3 Frequency of dental visits**

In this study, there was a statistically significant association between the number of times a child visits the dentist annually and the need for orthodontic treatment both objectively and subjectively. It was shown that those who visited the dentist more than twice a year had a very low need for orthodontic treatment objectively while those that visited the dentist once a year or less frequently showed greater need for treatment.

Similarly, there was a low perception for orthodontic treatment need among the children who visited the dentist more frequently. This could indicate that those who

visit the dentist frequently have a higher chance of having their dental problems sorted out earlier and so prevent malocclusion and the resultant aesthetic disfigurement, which would later require orthodontic treatment. This was evident in a study done in China (Zhou, 2016) where regarding the visiting frequency, the children who visited the dentists regularly had a significantly lower rate of malocclusion than those who never had routine dental/oral examinations.

## 7.2 Socio-economic status

Education, employment, culture and social status influence the way people perceive their need for any form of dental treatment particularly orthodontic treatment in this case (Badran *et al.*, 2014, Park *et al.*, 2016)

It was shown that all of the participants came from homes with electricity and piped water. Almost 60% of the guardians owned cars, 28.4% hired a taxi (rented a car) to take their children to school while 11.7% of the children walked to school. As far as housing was concerned, 47% lived in their own home, 39.2% rented a home and 13.7% lived with family. It was also observed that 87% of the guardians did not receive any form of social grant.

From this we can conclude that this was a select group of participants whose socio-economic status is rated medium to high.

It was shown that the majority of the children whose parents were employed rated their dental appearance high and therefore did not perceive a need for treatment, while more children of employed parents were seen to need orthodontic treatment objectively.

It was also evident that all the parents had some form of education with the majority being diploma holders. There was no statistically significant association between the objective need as measured by the DHC and the employment status of the guardians, but it was evident that most of the children perceived their aesthetics as pleasing. 73% of children of certificate level guardians, 88,8% of children of diploma level guardians and 76% of children of degree level guardians did not perceive need for treatment.

Considering that this sample group was of middle to high socioeconomic status, these observations were similar to a study done by Badran *et al* (2014) who demonstrated that families of lower socioeconomic status expressed a greater need for orthodontic treatment. However, the high normative need in this group of employed guardians was contrary to studies by Tickle *et al* (1999) who showed that normatively assessed need is frequently present and high amongst children from less affluent groups. This reason for this discrepancy could be a lack of awareness about malocclusion and orthodontics despite their socio-economic status. A similar conclusion of lack of awareness was drawn from an Indian study where the normative need for orthodontic treatment was high despite the high socioeconomic status (Sudha, 2014).

### 7.3 Objective need.

This is also known as the normative need. This is the need for treatment defined by an expert. In this research project, it is the need for orthodontic treatment as defined by examiner who is a dentist. This was determined by the Dental Health Component (DHC) of the IOTN. Results showed that the majority (59.8%) of the sample population needed orthodontic treatment according to the DHC. This result is similar to that of a study done in Tanzania by Mugonzibwa *et al* (2004) where according to the DHC, 30% of the sample did not need orthodontic treatment while 70% needed treatment ranging from slight to definite need. In Senegal, one such study (Ngom *et al.*, 2007) showed that 42.6% of the sample population showed a definite need for orthodontic treatment according to the DHC. In South Africa, the definite need for orthodontic treatment was shown to be 41.2% according to the modified DHC (Rampersadh, 2015).

Outside Africa, a study on 12-17 year olds in the USA (Martin *et al.*, 2008), using the original IOTN, 80.6% of the sample population showed need for orthodontic treatment ranging from mild to severe. Similarly, in a study in France (Souames *et al.*, 2006) showed that there was a 50.1% definite need for treatment with the DHC of the IOTN.



Other studies have shown a comparatively low need for orthodontic treatment with the DHC being 29% of a sample population in Kenya (Ng'ang'a *et al.*, 1997) and 35.3% in Tanzania (Rwakatema *et al.*, 2007).

The high need for treatment in this study according to the Modified DHC of 59.8% could be explained as a cumulative need ranging from slight through borderline to severe. The modified DHC assesses the children for missing teeth, overjets, crossbites, displacement of contact points and overbites to a certain specified degree that determines whether or not there is a definite need for orthodontic treatment. A grade 1 is allotted for definite need and 0 is allotted where there is no need. Therefore, each child was examined and according to the scale, if even one of the conditions described in the DHC of the modified IOTN was found, a 1 was allotted and no further conditions were sought. Therefore, the modified DHC does not grade the severity of the need, but only if there is a need or not.



#### 7.4 Subjective need

This is the type of need based or influenced by personal feelings. In this case, it is the need determined by the Aesthetic Component of the IOTN.

The Child-rated Aesthetic Component (CRAC) was defined as the subjective need as defined by the participant/child while the Examiner rated Aesthetic Component (ERAC) was the subjective need as defined by the examiner. In both cases, this was done by comparing the child's dentition when they smile, with the 10 photographs of the Aesthetic Component of the IOTN and then choosing the one that closely matched the child's dentition.

The Child-rated Aesthetic Component (CRAC) showed that 82.4%, the majority of the children did not perceive a need for orthodontic treatment while only 17.7% were seen to perceive need for orthodontic treatment. Similarly, the Examiner-rated AC

showed that only 31.4% of the children needed treatment, with the majority of 68.8% showed no need for orthodontic treatment.

The findings in this study are consistent with those of Siddiqui *et al* (2014) who concluded that the patient and orthodontist tend to perceive patient malocclusions as more aesthetically pleasing. In a study on South African children (Rampersadh, 2015), 81.7% of the children graded themselves aesthetically pleasing with only 6.9% showing a definite need for orthodontic treatment. Similarly, the Examiner rated AC showed that 25.2% were in definite need for treatment while 56.2% fell into the "no to slight need for treatment" category. In a Nigerian study, 65 % were found to have no need for treatment according to the AC of the IOTN (Kolawole *et al.*, 2008).

#### *7.5. Examiner-rated Aesthetic Component (ERAC) compared to Child- rated Aesthetic Component (CRAC)*

The examiner rated 68.6% of the children as aesthetically pleasing, needing no treatment and the majority, 81.4% of the children rated themselves aesthetically pleasing as well. A statistically significant association was demonstrated between CRAC and ERAC.

In general, both the children and the examiner categorized most children as having no need for treatment even though the children still rated their dentitions as more aesthetically pleasing than the expert did. This finding is similar to that in a study done in Malaysia (Abdullah and Rock, 2002), where of the 5112 children seen, 22.8% scored definite need for treatment by the ERAC and 5.8% by CRAC, meaning the majority was rated aesthetically pleasing. These results are also in agreement with those reported by a study on Nigerian school children, which showed that 92 % of the children did not need treatment while the orthodontist found those that do not need treatment to be 62.4% (Kolawole *et al.*, 2008).

In as much as both the ERAC and CRAC tend to rate the subjects aesthetically pleasing, the children still perceive their aesthetics more pleasing than the expert do. In a study on Jordanian adolescents, it was shown that both the patient and orthodontist perception of the presenting patients categorized most patients as having mild orthodontic treatment need. The Patient-determined IOTN-AC of 79.3% was

categorized as mild as was the Orthodontist-determined IOTN-AC of 62.8% (Siddiqui *et al.*, 2014).

#### *7.6 Examiner rated Aesthetic Component (ERAC) compared to Dental Health Component (DHC)*

According to the modified DHC, 59.8% of the participants were shown to have an orthodontic treatment need, while only 31.4% were shown to have need according to the ERAC. However, 93.7% of those who were shown to have need according to the ERAC were in agreement with the needs assessment of the DHC. There was a statistically significant association between DHC and ERAC.

The ERAC and the DHC are both assessments carried out by the examiner/expert, but differ in that the ERAC is the examiners perception of aesthetics while the DHC is the examiner's clinical evaluation. In this study, it was shown that the examiner perceived a lower need for treatment (31.4%) compared to what was clinically observed as definite need of 59.8%. The results are similar to those of the Jordanian study (Siddiqui *et al.*, 2014) which also found the examiner's perception of need to be mild (62.8%) compared to the DHC assessment of 41.7% which placed most of the participants in definite need for orthodontic treatment.

These results could be attributed to the fact that the Aesthetic Component pictograph only shows a portion of the dentition and some aspects like posterior crowding, posterior crossbites or missing teeth may not be captured but yet be seen during assessment by the DHC. In addition to the examiner's societal bias could affect the aesthetic perception of the child, if the majority of the society have similar dental formulae aesthetically therefore denoting a no need for treatment especially that the pictograph does not exhaustively cover all seen dental formulae.

### *7.7 Child-rated Aesthetic Component (CRAC) compared to Dental Health Component (DHC)*

The assessment of aesthetics by the child showed that 82.4% of the children rated themselves as aesthetically pleasing, needing no treatment while the examiner using the DHC showed a 41.2% rating of the children needing no orthodontic treatment. This result is similar to other studies done in the UK, Senegal and Malaysia (Kok *et al.*, 2004, Ngom *et al.*, 2007, Khasim, 2013), which demonstrated that the child aesthetic assessment was rated more pleasing than the examiner using the DHC. This is continually attributed to the fact that the layman usually assesses their dentition as more aesthetically pleasing than the dental professional who is more critical (Hamdan 2004).



## CHAPTER 8: Conclusion and Recommendations

The study was carried out in a school of middle to high socioeconomic status on children aged 12-15 years. The overall study sample size was 102. Of these, 61 (59.8%) were found to have a need for orthodontic need objectively while the subjective need was found to be 17.7% and 31.4% by the child and examiner respectively. From this we can conclude that there is a general need for orthodontic treatment despite the fact that the general perception by children and the examiner says otherwise. Therefore, there is a need for dialogue with regards to treatment need and expectations between the child, guardian and orthodontist before treatment starts to ensure that the child understands and good outcome is realized.

Also significant is the high need for orthodontic treatment objectively despite being in a middle to high socioeconomic status. It shows that there is a lack of awareness on malocclusions and as such the need for orthodontic treatment.

Based on the results of this study, a recommendation can be made that a large-scale survey on malocclusion prevalence and orthodontic treatment needs be carried out. Of significance would also be the creation of an awareness campaign on orthodontic treatment especially for those that have the need.

Considering the ERAC and CRAC were similar in their assessment with the greater percentage showing no need for treatment, it would be valuable to modify the index to include subjects with common African features, which may seem normal but are actually malocclusions.

## CHAPTER 9: Limitations

Limitations to the study were:

- Guardians who did not give consent to the children at all or in time therefore reducing the sample size
- With regards to the AC of the IOTN, the photographs were based on Caucasian 12-year olds and have been stated as being referenced to this group and not any other ethnic groups (Vig *et al*, 1999). Therefore, some occlusal profiles, which are endemic to African ethnicity, may not be regarded as malocclusions thereby affecting the subjective perceptions for orthodontic treatment in both the child and the examiner
- The study's results cannot be extrapolated to the rest of Namibia as it only examined one school



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## Appendices

### Appendix 1: Index of Orthodontic treatment Need ruler

0	3 i	4	5	5 Defect of CLP	3 O.B. with NO G + P trauma	Displacement open bite V         4 3 2 1
2	2 c			5 Non-eruption of teeth	3 Crossbite 1.2 mm discrepancy	
3		4		5 Extensive hypodontia	2 O.B. > _____	
4	ms - 5			4 Less extensive hypodontia	2 Dev. From full interdig	
				4 Crossbite >2 mm discrepancy	2 Crossbite < 1 mm discrepancy	
				4 Scissors bite	<b>IOTN Manchester (clinical)</b>	
				4 O.B. with G + P trauma		



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Appendix 2: Ethics Approval



OFFICE OF THE DIRECTOR: RESEARCH  
RESEARCH AND INNOVATION DIVISION

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08 June 2018

Dr C Serebe  
Faculty of Dentistry

**Ethics Reference Number:** BM18/3/19

**Project Title:** The orthodontic treatment needs in children aged 12-15 years in a school in Khomas region, Namibia.

**Approval Period:** 06 June 2018 – 06 June 2019

I hereby certify that the Biomedical Science Research Ethics Committee of the University of the Western Cape approved the scientific methodology and ethics of the above mentioned research project.

Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

**Please remember to submit a progress report in good time for annual renewal.**

The Committee must be informed of any serious adverse event and/or termination of the study.

A handwritten signature in blue ink, appearing to read 'Josias'.

*Ms Patricia Josias  
Research Ethics Committee Officer  
University of the Western Cape*

**PROVISIONAL REC NUMBER -130416-050**

### Appendix 3: Information Sheet



## FACULTY OF DENTISTRY

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[www.uwc.ac.za](http://www.uwc.ac.za)

### **PROJECT TITLE: THE ORTHODONTIC TREATMENT NEEDS IN CHILDREN AGED 12-15 YEARS IN A SCHOOL IN KHOMAS REGION, NAMIBIA**

#### **What is this study about?**

This is a research project being conducted by Dr. Catherine Serebe, at the University of the Western Cape. We are inviting you to participate in this research project because you fit the criteria of the research subject. The purpose of this research project is to attempt to reveal if malocclusion is a problem in this age group and therefore if there is need for orthodontic treatment both on an objective and a subjective point of view.

#### **What will I be asked to do if I agree to participate?**

You will be asked to complete questionnaires, one for the guardian and one for the student. The guardian's questionnaire will be taken home by the student for the guardian to fill and return the following day to the school. On the data collection day, each child will first fill their questionnaire with guidance if need be and then a short clinical examination of their mouth will be done by the examiner. This will be done at the school. The questionnaire should take about 5 minutes to complete while the examination should take about 2 minutes.

The research is voluntary and no treatment will be carried out during the study but if necessary, children in need of orthodontic treatment will be referred to Katutura State Hospital for further management or referral.

#### **Would my participation in this study be kept confidential?**

The researchers undertake to protect your identity and the nature of your contribution. To ensure your anonymity, the surveys are anonymous and will not contain information that may personally identify you.

To ensure your confidentiality, all the hard data will be securely locked away in a filing cabinet and soft copies kept using password-protected computer files.

If we write a report or article about this research project, your identity will be protected.

### **What are the risks of this research?**

All human interactions and talking about self or others carry some amount of risks. We will nevertheless minimize such risks and act promptly to assist you if you experience any discomfort, psychological or otherwise during the process of your participation in this study. Where necessary, an appropriate referral will be made to a suitable professional for further assistance or intervention.

### **What are the benefits of this research?**

The benefits to you may include an increased awareness of the general state of your occlusion however, this research is not designed to help you personally, but the results may help the investigator learn more about the need for orthodontic treatment in school going children aged 12-15 years. We hope that, in the future, other people might benefit from this study through improved understanding of malocclusion and orthodontic treatment needs among children.

### **Do I have to be in this research and may I stop participating at any time?**

Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.

### **What if I have questions?**

This research is being conducted by Dr. Catherine Serebe, Department of Orthodontics at the University of the Western Cape. If you have any questions about the research study itself, please contact Dr. Catherine Serebe at: [kserebe@yahoo.com](mailto:kserebe@yahoo.com) or 0856157928.

Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact:

Prof. Angela Harris  
Head of Department, Orthodontics  
University of the Western Cape  
Private Bag X1  
Bellville 7505  
[ampharris@uwc.ac.za](mailto:ampharris@uwc.ac.za)

Research Ethics Committee  
[research-ethics@uwc.ac.za](mailto:research-ethics@uwc.ac.za)  
0219592988/4111



*Appendix 4: Letter of Invitation for School Participation in the Research Project*



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TO: THE SCHOOL PRINCIPAL

.....

### LETTER OF INVITATION FOR SCHOOL PARTICIPATION IN THE RESEARCH PROJECT

My name is Dr. Catherine Serebe, Postgraduate student at the University of the Western Cape, Cape Town, South Africa. I am conducting a research on the Orthodontic treatment needs of children aged 12-15 years in Khomas region, Namibia under the supervision of Prof. Angela Harris, Head of Department, Faculty of Dentistry, University of the Western Cape.

I therefore invite your school to consider taking part in this research. This study has met the requirements of the Research Ethics Committee of the University of the Western Cape.

The study aims to:

- To determine the objective need for orthodontic treatment using the Dental Health Component of the modified Index of Orthodontic Treatment need (IOTN) in a sample population of Namibian school children aged 12-15 years in Khomas Region.
- To determine the subjective need for orthodontic treatment using the Aesthetic Component of the modified index for Orthodontic Treatment Need (IOTN) in a sample population of Namibian school children aged 12-15 in Khomas Region.
- To determine the relationship between the objective and subjective need by assessing the agreement of the Dental Health Component (DHC) of the modified IOTN with the Aesthetic Component (AC) of the modified IOTN.

The study is significant in a way that:

- It will provide baseline information on malocclusion and orthodontic need for treatment among children in Khomas region as a sample of the Namibian children population aged 12-15 years
- It will provide awareness about the participant's occlusion status
- It will give insight into the factors that influence children's perceived need for orthodontic treatment

### **Research plan and method**

Permission will be sought from the learners and their guardians prior to participation in the research. Only those who consent, and their parents' consent will participate.

Questionnaires for guardians will be given prior to examination day for the guardian to fill out and return. On Examination day, the learners will receive their questionnaires to fill out, a process that should take 5 minutes to complete with assistance on hand if needed. After that, each learner participating will have an oral examination that will take 2 minutes per learner.

All information collected will be treated with the strictest confidence and neither the school nor the individual learners will be identifiable in any reports that are written.

Participants may withdraw from the study at any point without penalty. The role of the school is voluntary and the School Principal may withdraw the school's participation at any time without penalty.

If the learner requires support as a result of their participation in the study, steps can be taken to accommodate this.

### **School involvement**

Once consent has been given to approach the learners to participate in the study, I will:

- Arrange with individual class teachers when to speak to the learners about the study
- Arrange to obtain informed consent and permission from the participants and their guardians
- Arrange time for data collection with class teachers

Attached for your information are copies of the participant's information and consent forms.

Thank you for taking time out to read this information.

Further information can be obtained from: [kserebe@yahoo.com](mailto:kserebe@yahoo.com)

If you agree for your school to participate in this study, please sign and return the attached school principal consent form.


Dr. CATHERINE SEREBE

.....  
RESEARCHER

PROF. ANGELA HARRIS

.....  
SUPERVISOR

Appendix 5: Principals' Consent Form

 **UNIVERSITY of the WESTERN CAPE**

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**SCHOOL PRINCIPAL CONSENT FORM**

**THE ORTHODONTIC TREATMENT NEEDS IN CHILDREN AGED 12-15 YEARS IN A SCHOOL IN KHOMAS REGION, NAMIBIA**

Name of school: AMAZING KIDS PRIVATE SCHOOLS & ACADEMY

I, Mrs. S.F. HARTUNG, give consent for you to approach learners aged 12-15 years to participate in the above mentioned study.

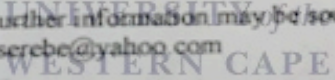
I have read the letter of invitation explaining the purpose of the research and I understand that:

- The role of the school is voluntary
- Only learners aged 12-15 years will be invited to participate and permission will be sought from the learners as well as their guardians.
- Only the learners and guardian who consent will participate in the study.
- All information obtained will be very confidential
- The study is anonymous and will not contain information that will personally identify the learner, guardian or the school.
- Participants can withdraw at any point with no penalty before data collection. This is because after the data is collected, there will be no way of tracing the data back to the individual.
- The report of the findings will be made available to my school and may be published.
- Further information may be sought from Dr. Catherine Serebe; 0856157928 or [kserebe@yahoo.com](mailto:kserebe@yahoo.com)

PRINCIPAL'S NAME: LORRAINE F. HARTUNG

PRINCIPAL'S SIGNATURE: [Signature]

DATE: JULY 2018

 **UNIVERSITY of the WESTERN CAPE**

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P.O. Box 2114  
Windhoek  
2018-09-25  
Tel: 304974  
Fax: 304975  
Email: [amazingkids@iway.na](mailto:amazingkids@iway.na)

FROM HOPE TO ACTION THROUGH KNOWLEDGE.

Appendix 6: Student's Assent form



UNIVERSITY of the  
WESTERN CAPE

**FACULTY OF DENTISTRY**

Private Bag X1 Tygerberg 7505  
TEL: +27 21 937 3106/3030  
FAX: +27 21 931 2287  
[www.uwc.ac.za](http://www.uwc.ac.za)

The study has been described to me in language that I understand. My questions about the study have been answered. I understand what my participation will involve and I agree to participate of my own choice and free will. I understand that my identity will not be disclosed to anyone. I understand that I may withdraw from the study at any time without giving a reason and without fear of negative consequences or loss of benefits

Participant's name:.....

Date:.....

Appendix 7: Parent/Guardian Permission Form



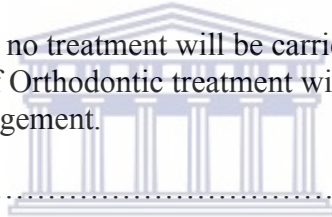
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WESTERN CAPE

## FACULTY OF DENTISTRY

Private Bag X1 Tygerberg 7505  
TEL: +27 21 937 3106/3030  
FAX: +27 21 931 2287  
[www.uwc.ac.za](http://www.uwc.ac.za)

We are inviting your child to participate in a research project about Orthodontic treatment needs among children aged 12-15 years. There are no foreseeable risks during the process of carrying out this study, however should any discomfort arise, we will be on hand to provide assistance.

The research is voluntary and no treatment will be carried out during the study but if necessary, children in need of Orthodontic treatment will be referred to the Orthodontist for further management.



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WESTERN CAPE

The study has been described to me in language that I understand. My questions about the study have been answered. I understand what my child's participation will involve and I agree for my child to participate of my own choice and free will. I understand that his/her identity will not be disclosed to anyone. I understand that he/she may withdraw from the study at any time without giving a reason and without fear of negative consequences or loss of benefits.

NAME: .....

SIGNATURE: .....

DATE: .....

Appendix 8: Guardian's questionnaire



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## FACULTY OF DENTISTRY

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[www.uwc.ac.za](http://www.uwc.ac.za)

This questionnaire is part of a research project being conducted by Dr. Catherine Serebe.

All the information given is confidential.

Do you give your consent to participate in this study?

YES  NO

.....  
Please tick the appropriate answer to the question

1) Are you currently employed?

Yes  NO

2) Do you receive a social grant?

YES  NO

3) Which of the following household amenities do you possess? Tick appropriate box.

ELECTRICITY	
CAR	
PIPED WATER INTO HOME	
PIPED WATER INTO YARD	

4) Please describe the home where you live:

	YES	NO
Owned/ bought by you		
Rented		
Live with family		
Live with friends		
Other		

5) Education:

What is the highest level of education completed in your household?

No formal education	
Below grade 10	
Grade 12 (Matric)	
Certificate	
Diploma	
Graduate degree	
Postgraduate degree	
Other (please specify)	



Thank you for your participation.

UNIVERSITY of the  
WESTERN CAPE

Research Participant's number.....

Dr. Catherine Serebe  
Researcher  
Dentist  
[kserebe@yahoo.com](mailto:kserebe@yahoo.com)  
+264856157928

Prof. Angela Harris  
Supervisor  
HOD Orthodontics  
University of the Western Cape  
[ampharris@uwc.ac.za](mailto:ampharris@uwc.ac.za)  
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Appendix 9: Student's Questionnaire



## FACULTY OF DENTISTRY

Private Bag X1 Tygerberg 7505  
 TEL: +27 21 937 3106/3030  
 FAX: +27 21 931 2287  
[www.uwc.ac.za](http://www.uwc.ac.za)

This questionnaire is part of a research project carried out by Dr. Catherine Serebe. All the information given here is confidential. Please Tick the appropriate box.

1) Do you want to be part of the study and undergo a check-up?

YES

NO

2) What is your gender?

MALE	 UNIVERSITY of the WESTERN CAPE
FEMALE	

3) How old are you?

12 years	
13 years	
14 years	
15 years	

4) How many times do you visit the dentist?

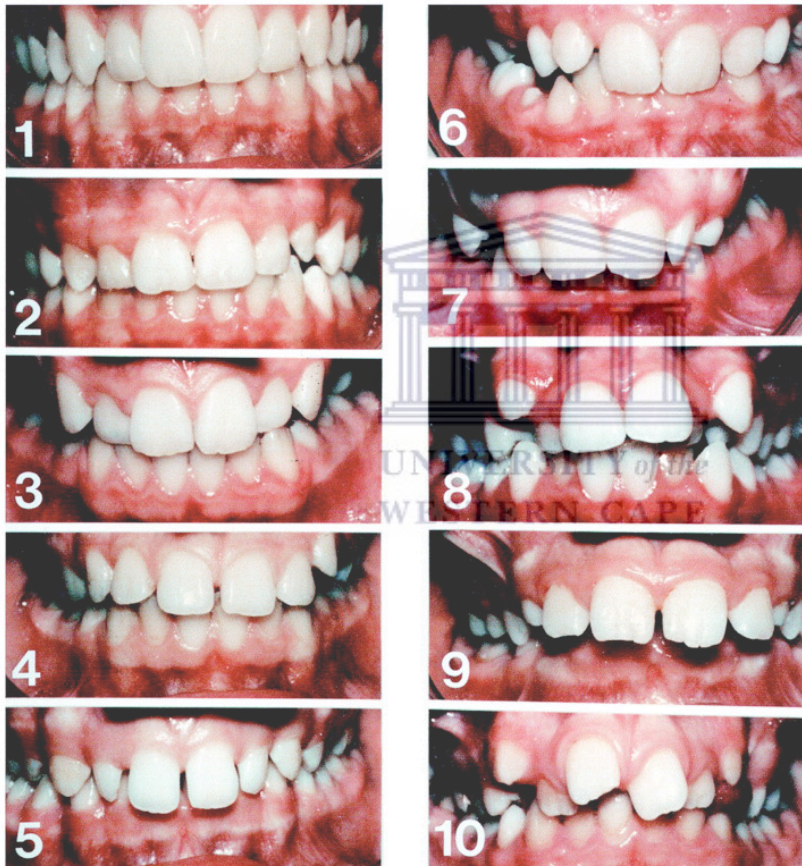
0 x /year	
1-2x/ year	
More than 2x /year	



5) Looking at the pictures below, choose by ticking, the picture(s) you think need to be fixed by braces.

1		6	
2		7	
3		8	
4		9	
5		10	

6) What picture do you think looks more like your teeth?



Thank you for your participation

To be completed by the Researcher:

Research participant number.....

Orthodontic Treatment need based on student rated AC.....

*Appendix 10: Data Collection Sheet for the modified DHC*

According to Burden et al (2001), if even one of the conditions described in the DHC of the modified IOTN is found, a 1; is allotted and no further conditions are sought. Conditions sought for during the examination and recording of the modified DHC fall under the acronym MOCDO:

Age:

Sex:

CONDITION	0	1
MISSING TEETH		
OVERJET		
CROSSBITE		
DISPLACEMENT OF CONTACT POINTS		
OVERBITES		



Thank you for your participation

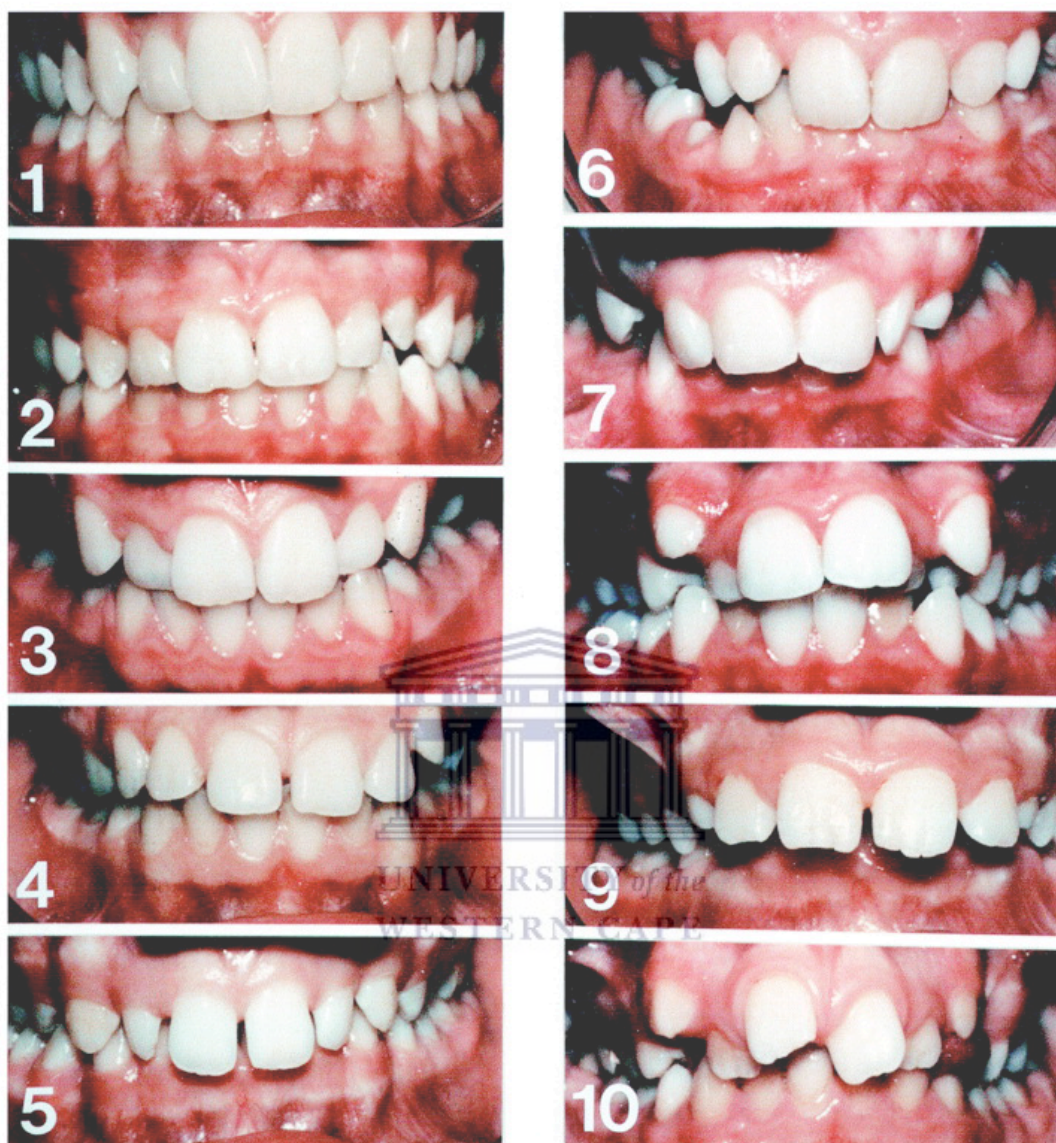
To be completed by the Researcher

Research Participant's Number.....  
 Orthodontic Need for Treatment based on the Modified IOTN,  
 DHC.....

.....  
 Dr. Catherine Serebe  
 Researcher  
 Dentist  
[kserebe@yahoo.com](mailto:kserebe@yahoo.com)  
 +264856157928

.....  
 Prof. Angela Harris  
 Supervisor  
 HoD Orthodontics  
 University of the Western Cape  
[ampharris@uwc.ac.za](mailto:ampharris@uwc.ac.za)  
 +27219373105

Appendix 11: Examiner Data collection sheet for the modified AC



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Thank you for your participation

To be completed by the Researcher

Research Participant's Number .....

Orthodontic Need for Treatment based on the Modified IOTN,  
AC.....

Dr. Catherine Serebe  
Researcher  
Dentist  
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Prof. Angela Harris  
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