Centre for International Health
Institute of Clinical Dentistry
University of Bergen

Oral disease and Oral health related quality of life in pregnancy and early childhood: Surveys from urban and rural areas of Uganda

Margaret Nekesa Wandera

Dedication

This Thesis is dedicated to the memory of my beloved parents Regina Nanfuka Wandera and

Michael O M Wandera.

Table of contents

Acknowledgements

ACRONYMS

ANC	Antenatal care
CAL	Clinical attachment level
CI	Confidence interval
CPI /CPITN	Community Periodontal Index of treatment needs
dmft	Decayed, missing and filled teeth due to caries in primary dentition
DMFT	Decayed, missing and filled teeth due to caries in secondary dentition
ECC	Early childhood caries
GDP	Gross Domestic product
MCH	Mother and Child health
OHI-S	Oral Hygiene Index Simplified
OHRQoL	Oral health related quality of life
OIDP	Oral impacts on Daily performance
OR	Odds ratio
PROMISE-EBF	Promoting infant health and nutrition in sub-Saharan Africa: Safety and efficacy of exclusive breastfeeding promotion in the era of HIV.
SES	Socio-economic status
HAZ	height-for-age z-scores
WHZ	weight-for-height z-scores
WAZ	weight-for-age z-scores
WHO	World Health Organization

List of papers

Paper I

Wandera M, Engebretsen IMS, Okullo I, Tumwine JK, Åstrøm AN for the PROMISE-EBF Study Group. **Socio-demographic factors related to periodontal status and tooth loss of pregnant women in Mbale district, Uganda.** BMC Oral Health 2009, **9**:18.

Paper II

Wandera M, Engebretsen IMS, Rwenyonyi CM, Tumwine JK, Åstrøm AN and the PROMISE-EBF Study Group. **Periodontal status, tooth loss and self-reported periodontal problems effects on oral impacts on daily performances, OIDP, in pregnant women in Uganda: a cross-sectional study.** Health Quality of life Outcomes, 2009: **7**: 89

Paper III

Wandera M, Kayondo J, Engebretsen IM, Okullo I, Astrøm AN. **Factors associated with caregivers' perception of child's health- and oral health status: a study of 6-36-month-olds in Uganda**. Int J Paediatr Dent. 2009 Jul; 19(4):251-62. Epub 2009 Mar 23.

1. INTRODUCTION

1.1 Focus of the present thesis

The thesis presented is based on two separate surveys. Survey I is focusing on pregnant women at about 7 months gestational age resident in urban and rural areas of Mbale district, Eastern Uganda. Survey II is focusing on 6-36 months old children and their caregivers attending Mother and Child Health Care facilities, MCH, in Kampala district, Uganda. Survey I concerns the prevalence, socio-demographic distribution and psycho-social impacts of periodontal disease and tooth loss in pregnant women, whereas Survey II assesses the degree to which socio-demographic, clinical- and psychosocial factors associate with caregivers' overall evaluation of the oral health- and general health status of their 6-36 months old children.

Specifically the present thesis considers;

1) Prevalence and severity of periodontal status and tooth loss in pregnant women and the association of these measures of oral health with socio-demographics, gestational age, dental care utilization and oral hygiene behavior

2) Prevalence of oral impacts on daily performances, OIDP, in pregnant women and the relationship of oral impacts with periodontal status, tooth loss and self-reported oral symptoms suggestive of periodontal disease.

3) Factors associated with caregiver's overall evaluation of the oral health- and general health status of their 6-36 months old children.

Survey I is justified by the fact that little is known about the occurrence, distribution and determinants of periodontal disease and tooth loss in pregnant women emanating from sub-Saharan Africa that can be used to plan public health policies to improve maternal oral and general health. Survey II of this thesis is justified by the fact that the impact of oral diseases

on the oral quality of life in pre-school children and their families has not been thoroughly investigated neither in the context of developed- nor in the context of developing countries. This is notably as oral disease among children is widespread (Casamassimo et al., 2009). In socio-economically developing countries a trend towards increase in children's dental caries prevalence has been observed. This has been attributed to changes from a traditional- to a more Western-style diet, including commercialized sugar products (Kiwanuka et al., 2004, Miura et al., 1997, Sgan-Cohen and Mann, 2007).

1.2 Conceptual models

The three papers constituting the present thesis might generally be viewed from a life-course perspective (Ben-Shlomo and Kuh, 2002). This approach to conceptualization of chronic disease aetiology has increasingly been recognized to be applicable to wider notions of health and well being. A life course approach might be defined as the study of long-term effects on health- and oral health of physical and social exposures during gestation, childhood, adolescence, young adulthood and later adult life (Osler, 2006). Thus, biological markers, such as maternal oral health during pregnancy might affect offspring's' birth weight which again is critical for the development of health- and oral health aspects in childhood, adolescence and adult life. Recent studies have shown that apart from its increased frequency during pregnancy, periodontal disease constitutes an independent risk factor for preterm birth (Wimmer and Pihlstrom, 2008, Dasanayake et al., 2008). About 18% of preterm low weight births have been attributed to periodontal diseases during pregnancy (Boggess and Edelstein, 2006). Low birth weight infant delivery is a major health problem in low income countries (WHO/UNICEF, 2004). Furthermore, low birth weight is associated with high morbidity and mortality rates (McCormick, 1985, WHO/UNICEF, 2004). Within a life course perspective poor maternal oral health status during pregnancy as assessed in Paper I might affect mothers'

quality of life and well being, assessed in Paper II and subsequently oral health and well being of their infant children assessed in Paper III through biological markers at birth, such as low birth weight.

Conceptual models illustrating causal relationships among various domains of oral health outcomes have been presented by Locker (1988), Gilbert et al (1998), Johnson and Wolinsky (1993), and Wilson and Cleary (1995). The model by Wilson and Cleary (1995) was employed to guide the selection of variables and the statistical analyses of Paper II and Paper III. According to this model (Fig 1) health outcomes are classified into five main levels; biological and physiological variables, symptom status, functional status, general health perceptions and overall quality of life or subjective well-being. Accordingly, studies of self-rated oral health status need to address the following main concepts: oral disease and disorder, oral health related symptoms and functional disadvantages. Specifically, this conceptual model hypothesizes a progression from distal determinants such as oral diseases to more intermediate and proximal determinants such as pain, functional problems and oral disadvantages. Distal determinants (e.g. oral disorder) might influence oral health perceptions directly or indirectly through factors at the intermediate (symptom status) and proximal (functional disadvantage) levels of the hierarchy. Finally, proximal level determinants constitute the immediate direct influences on health and oral health perceptions.

The relationship between health/oral health and socioeconomic status, SES, is well established (Sabbah et al., 2007, Petersen et al., 2005, Locker, 2000). Several studies show a gradient of an improving health with improving SES. The SES indicators commonly used have been income, education and occupation. However, different indicators of social strata can be investigated as means to determine areas of intervention specific for health (Adler and

3

Ostrove, 1999). The actual mechanism through which SES relates to health outcomes is being debated (Adler et al., 1993). Adler et al. (1993) have described a conceptual model suggesting that socio-economic position affects general health/oral health through health care, psycho-social factors and health related behaviors (Fig 2). Whereas the arrows in the model are in one direction, there is a possibility that there are interactions between different aspects which can be identified through research and thus refine the model. Once other SES differentials are identified, recommendations for prevention and treatment that are effective across the social strata can then be designed (Adler et al., 1993). Adler's model was employed in Paper I to explore the relationship of parity, recognized as a measure of socio-economic position, dental care utilization, psycho-social factors and oral hygiene on tooth loss and periodontal disease in pregnant Ugandan women.

1.3 Periodontal disease globally

The most common form of periodontal disease has been defined as "an inflammatory process affecting one or more of the supporting tissues of teeth – the gingival tissue, the periodontal membrane and the alveolar bone" (Scherp, 1964). More recently the American Academy of Periodontology defined chronic periodontitis as "an infectious disease resulting in inflammation within the supporting tissues of teeth, progressive attachment and bone loss-characterized by pocket formation and or recession of gingiva" (AAP, 2001).

In early epidemiological studies, gingivitis and periodontitis were combined and considered a continuum (Lopez and Baelum, 2003). Studies of experimental gingivitis by Loe and coworkers demonstrated that accumulation of plaque led to gingivitis and that gingivitis was treated by plaque removal (Loe et al., 1965). This evidence suggested a plaque-gingivitis-periodontitis concept (Loe et al., 1965). Currently, the diagnosis of periodontal disease is

based on probing depth, clinical attachment level, CAL, the radiographic pattern and extent of alveolar bone loss, gingival inflammation measured as bleeding on probing or a combination of those measures (Page and Eke, 2007). In addition, consideration might be given to age, gingival recession, tooth mobility, medical and dental history, and signs and symptoms including pain and microbial deposits (Page and Eke, 2007). Although a standard case definition is a central requirement in epidemiological research, a plethora of case definitions has been used in population based studies without an accepted standard and with a wide range of signs and symptoms employed (Kinane and Bouchard, 2008).

The methods recommended by the World Health Organization, WHO, for recording of periodontal disease have varied from Rusell's periodontal index to the Community Periodontal Index of Treatment Need, CPITN/CPI (Page and Eke, 2007). The CPI was introduced by WHO to provide profiles of the periodontal status of populations and to enable countries to plan prevention programs (Benigeri et al., 2000). CPI data are also helpful in the surveillance of oral health at country level (Petersen and Ogawa, 2005). The CPITN/CPI has been utilized extensively in most countries around the world. Use of CPITN/CPI involves the scoring of 10 indicator teeth for the presence of pockets ≥6 mm (code 4), pockets 4-5mm (code 3), calculus (code 2), bleeding on probing (code 1) and healthy (code 0). The highest score is recorded for each tooth and subject (for further description, see Paper I). The use of CPI builds on the traditional view of the natural history of periodontal disease in terms of plaque accumulation leading to gingivitis, which in turn inevitably progress to periodontitis and ultimately causes tooth loss, unless this chain is broken at the first early step of plaque accumulation (Baelum et al., 2007). The CPI methodology has been heavily criticized and consequently attachment level measurements (clinical attachment level, CAL) have been included in the WHO survey methodology (Baelum et al., 2007). Epidemiological data in

terms of CPI represents the professional oral health care providers' normative assessment of dental health care need. This normative assessment does not take into account the pain and suffering of people, their perceived needs, expectations and wants (Baelum et al., 2007). Studies have indicated that CPI data leads to overestimation of treatment needs particularly among younger age groups (Kingman and Albandar, 2002). Nevertheless, this index has the advantages of being simple, having speed, reproducibility and international uniformity (Petersen and Ogawa, 2005).

Less well defined diagnostic criteria for periodontal disease reduces the possibility of comparing prevalence and severity estimates across populations and within the same population across time (Page and Eke, 2007). Nevertheless, some broad epidemiological patterns of periodontal disease have been outlined in the literature. Thus, the prevalence of edentulism is found to be considerable higher, the mean number of remaining teeth lower and the level of oral hygiene substantially better in populations of high income countries as compared to populations of low- and middle income countries (Baelum et al., 2007). Despite the high prevalence of gingivitis reported in adolescent populations (Albandar 2002), the extent and severity of periodontal disease appear to increase with increasing age in populations across Established Market Economies, sub-Saharan Africa and China (Baelum et al., 2007). However, the affected teeth distribution in subjects is skewed, in that for instance 22% of subjects aged 20-29 yr old in China carry 75% of the total attachment loss burden (Baelum et al., 2007). A trend of declining prevalence and severity of periodontal disease from 1988 to 2000 has been demonstrated by the national surveys of periodontal disease conducted in the US population in all racial/ethnic groups, with a current prevalence rate of moderate to severe periodontitis ranging from 4-10% (Borrell et al., 2005). A similar trend has been observed among young adults in Scandinavia (Hugoson and Norderyd, 2008).

Information about periodontal health status globally that has been assessed by the CPITN is stored in the WHO Global Oral Health Bank (http://www.dent.niigata-u.ac.jp/prevent/perio/contents.html). According the WHO data, gingival bleeding is prevalent among adult populations in all regions of the world, whereas advanced periodontal disease with pockets of 6mm or more affects about 10-15% of adults worldwide. According to the report by Petersen and Ogawa (2005) periodontal disease contributes significantly to the global burden of oral diseases. Table 1 provides an overview of studies considering the periodontal condition of populations emanating from sub-Saharan Africa.

Chronic periodontal disease is considered a multi-factorial disease. The most important risk factors or risk indicators for periodontal disease have been listed in terms of; geographic region (Albandar, 2002), oral hygiene level, (Abdellatif and Burt, 1987, Axelsson and Lindhe, 1981, Corbet et al., 2002) smoking (Albandar 2002), diabetes mellitus, increasing age, male gender (Baelum et al., 2007, Albandar, 2002), race/ethnicity (Baelum et al., 1996, Albandar, 2002), and genetic factors. Moreover, the following risk factors have been listed; bacterial specificity, viruses, host response factors, socio-economic status, osteoporosis, psychological factors and local factors in terms of tooth morphology, form and location of tooth furcation, level and quality of dental restoration, dental calculus formation, dental caries lesions, trauma from occlusion, gingival form, contact between teeth and other local anatomic features (Albandar, 2002, Albandar and Rams, 2002).

1.4 Oral health related quality of life

Emerging consensus in the literature has identified oral health related quality of life (OHRQoL) as a multidimensional construct containing physical, social and psychological domains (Slade, 1997a). Over the years several socio-dental indicators have been developed,

ranging from single-item indicators to composite inventories or scoring systems, covering the aforementioned OHRQoL domains. The indices are requested to be simple to use, reliable, valid, precise, acceptable, and amenable to statistical analysis, correspond to decision making criteria and to be supported by a relevant theoretical model.

A remarkable increase in development and testing of OHRQoL measures, their use in health surveys, clinical trials and studies evaluating oral health service has been noted over the past two decades. A number of research tools are developed and modified that focus on subjective measures (which address perceptions, feelings and behaviors) to assess health, well-being and quality of life of adults as well as in children (Slade, 1997b). These instruments, or socio-dental indicators, developed to assess the functional, social and psychological outcomes of oral disorders, are similar in that they are theory based and based on self-report measures (Slade, 1997b, Buck and Newton, 2001). They vary, however, in terms of length, content, sub-scale structure, response format and methods of obtaining quality of life scores. As concluded in a review by Slade et al. (1998), no single instrument can be regarded as a gold standard set of questions. Table 2 and 3 provide an overview of oral quality of life instruments for use in adults and children and reference to studies that have applied those instruments.

The OHRQoL indicators are to a varying extent based on the conceptual framework derived from the World Health Organization's (WHO) International Classification of Impairment, Disabilities and Handicaps (ICIDH) which has been amended for dentistry by Locker (WHO, 1980, Locker, 1988). The ICIDH provides a basis for the empirical exploration of the links between different dimensions or levels of consequence variables and consists of the following key concepts: impairments, functional limitations, pain and discomfort and disability and

handicap. Impairments refer to the immediate biophysical outcomes of disease, commonly assessed by clinical indicators. Functional limitations at the second level are concerned with functioning of body parts whereas pain and discomfort refer to the experiential aspects of oral conditions in terms of symptoms. In addition to dissatisfaction with dental appearance, they comprise the intermediate impacts, caused by oral health status. Any of the dimensions mentioned at the first and second level may lead to the third level of outcomes which refer to any difficulties in performing activities of daily living and to broader social disadvantages – named "ultimate impacts" and corresponding to the WHO and Locker's concept of disability and handicap (WHO, 1980, Locker, 1988) (Fig 3).

Figure 1 Wilson and Cleary Model (1995)
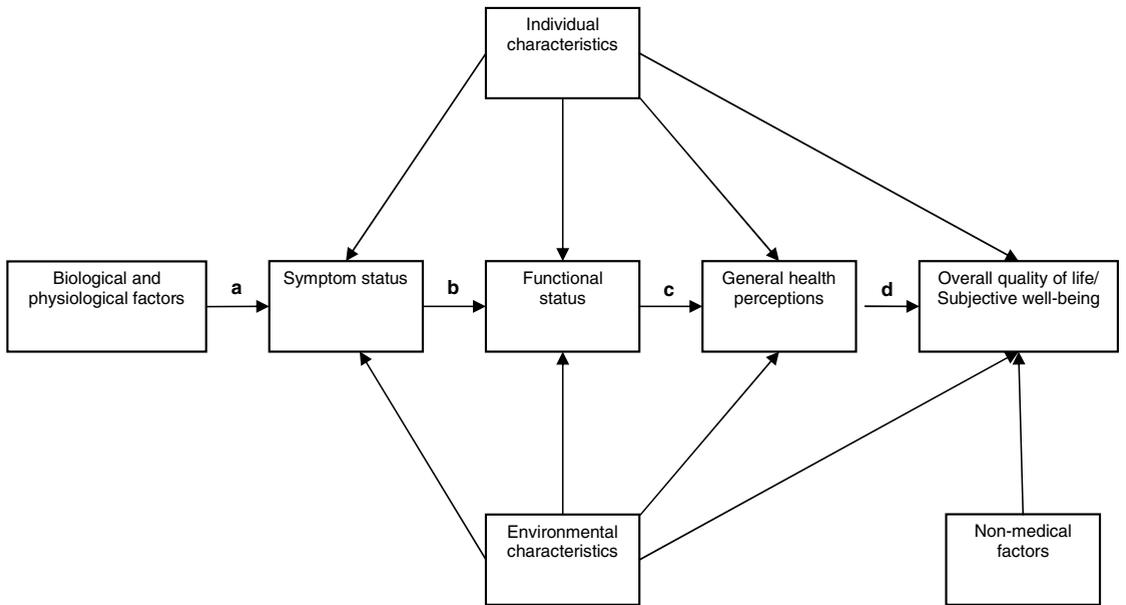
Figure 2 Simplified model of Pathways from socioeconomic status, SES, to Health (Adler and Ostrove, 1999).
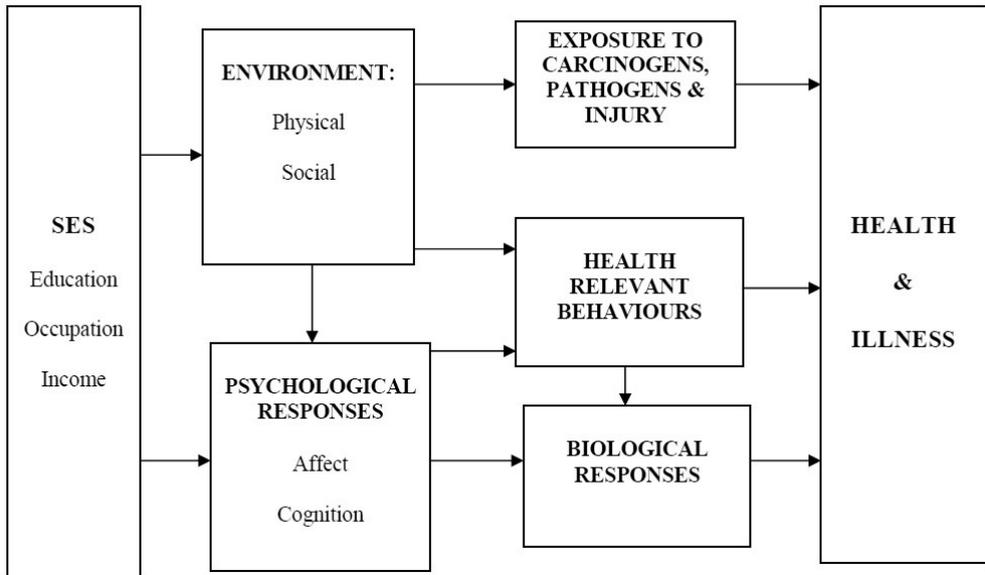
Figure 3 Theoretical framework of consequences of oral impacts
(Modified from WHO's International Classification of Impairment, Disabilities and
Handicaps) (WHO, 1980)

Level 1

Impairment

Level 2
Intermediate
Impacts

| Pain | Discomfort | Functional limitation | Dissatisfaction with appearance |

Level 3
Ultimate
Impacts

Impacts on daily performance

Physical   Psychological   Social
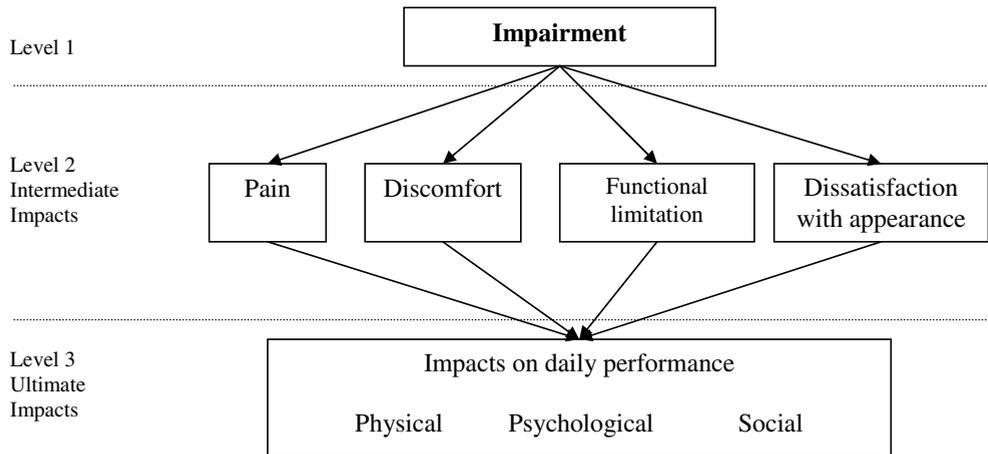
Table 1 A Summary of studies of periodontal disease in sub-Saharan African populations, 1995-2008.

Author/yr	Country	N	Age (yr)	Recording	Prevalence
Ngatia et al. (2008)	Kenya	289	≥45	WHO basic methods	85.6% Calculus
					82.5% Gingival recession
					77.4% Bleeding gums
Fanas et al. (2008)	Libya	2015	7-16	Periodontal pockets	4.9% periodontal pocketing
Mumghamba et al. (2006)	Tanzania	302	14-44	Gingival Bleeding	100% gingival bleeding
				PPD	33% gum bleeding during tooth brushing
				Self-report	99% calculus
					27%, PPD 4-5 mm
					3% PPD 6+ mm
Agbelusi and Jebodo (2006)	Nigeria	1600	12	CPITN	72.7% needed periodontal treatment
Muwazi et al. (2005)	Uganda	693; 396	12 yr; 35-44	Gingival bleeding	BOP- 53.9%; 46.5%
				Calculus	Calculus - 56%; 79.3%
Taiwo et al. (2004)	Nigeria	690	≥65	CPITN	94.8% had some form of periodontal disease
				Mobility	
Varenne et al. (2004)	Burkina Faso	1914	4 index ages	WHO basic methods	CPI=3 in 13% of 18yr to 36% of 35-44yr.
Wandera and Twa twa (2003)	Uganda	685	5-22	WHO basic methods	59% healthy periodontium
Kikwilu and Mandai (2001)	Tanzania	1297	8-15	WHO basic methods	75% healthy periodontium
Adegbembo et al. (2000)	Gambia	1235	8-80	WHO basic methods	<12% healthy periodontium

Author/yr	Country	N	Age (yr)	Recording	Prevalence
Petersen and Kaka (1999)	Niger	1473	4 index ages	CPITN	CPI= 2 in 99% of 18 yr and 87% of 35-44
Frencken et al. (1999)	Zimbabwe	3709	15-19; 35-44	CPITN	Bleeding -21%; 9% Calculus – 47%; 60% 4-5mm pocket – 8%; 19% >6mm pocket – 0.4%; 4%
Gugushe (1998)	South Africa	3763	20-64	CPITN	5% healthy periodontium
Lembariti et al. (1997)	Tanzania	164	30-44	Probing depth	16% Periodontitis (ppd$\geq$6mm)
Mumghamba et al. (1996)	Tanzania	839	3-88	BOP Calculus Periodontal pockets	7.4% healthy periodontium
Adegbembo and El Nadeef (1995)	Nigeria	4631	15-65	WHO basic methods	All subjects needed one form of periodontal treatment.
Baelum et al. (1995)	Kenya	1131	15-65	CPITN Periodontal Attachment	Only 3 individuals CPI score = 0
Mumghamba et al. (1995)	Tanzania	1746	3-84	BOP Periodontal pockets Gingival recession	79% gingivitis 0.5% PPD >6mm 13% recession >4mm

BOP Bleeding on probing
CPI /CPITN Community Periodontal Index of treatment needs
PPD periodontal pocket depth

Table 2 Oral Health Related Quality of Life instruments for use in adults, their abbreviations, number of items contained, original reference and publications.

Instrument	Abbreviation	Number of items	Original Reference
Oral Health Impact Profile	OHIP-49	49	Slade & Spencer, (1994)
Oral Health Impact Profile OHIP-14	OHIP-14	14	Slade, (1997a)
UK Oral Health Related Quality of Life Measure	OHQoL-UK	16	McGrath & Bedi, (2001)
Oral Impacts on Daily Performance	OIDP	9 (8)	Adulyanon & Sheiham, (1997)
Geriatric (General) Oral Health Assessment Index	GOHAI	12	Atchison & Dolan, (1990)
Orthognatic Quality of Life Questionnaire	OQoLQ	22	Cunningham et al., (2000)
Oral Health Impact Profile (OHIP-EDENT)	OHIP-20	20	Allen & Locker, (2002)

Table 3 Oral Health Related Quality of Life instruments used in children, their abbreviations, number of items contained and original reference

Instrument	Abbreviation	Number of items	Original Reference
Early Childhood Oral Health Impact Scale	ECOHIS	13	Pahel et al. (2007)
Child Oral Health Impact Profile	COHIP for children 8-15 yrs	34	Broder and Wilson-Genderson (2007)
Surgical Orthodontic Outcome Questionnaire	SOOQ	15/33	Locker et al. (2007)
Child Oral Health related Quality of Life	COHRQoL for 8-10 yr olds	25	Humphris et al. (2005)
Child-Oral Impact on Daily Performance	Child-OIDP	8	Gherunpong et al. (2004)
Parental/caregiver perceptions	P-CPQ	31	Jokovic et al. (2003)
Family Impact Scale (Family Impact of child oral and oro-facial conditions)	-	14	Locker et al. (2002)
Child Perceptions Questionnaire	CPQ $_{11-14}$	37	Jokovic et al. (2002)

2. AIMS

This study examined the prevalence, severity, socio-demographic distribution and associated factors of periodontal disease and tooth loss in pregnant Ugandan women at about 7 months of gestational age. Considering the importance of perceived oral health and oral impacts for the planning of dental care in pregnancy, this study further estimated the prevalence of oral impacts and the relationship between oral impacts and a range of clinical- and subjective oral health indicators. Finally, this study assessed the psychometric properties of an oral health related quality of life scale developed for children and their family and assessed the prevalence and clinical and non-clinical correlates of oral impacts in 6-36 months old children as reported by caregivers. Such information is pivotal for the planning and implementation of maternal and child oral health care programs in Uganda.

2.1 Specific aims

Paper I - The present study aimed to examine periodontal status and tooth loss in pregnant Ugandan women and assessed the relationship with parity, socio-economic factors, gestational age, dental care utilization and oral hygiene behavior. Following the propositions of Adler's model (Adler et al., 1993), it was assumed that socio-demographic position and parity (shown to be closely related to socio-economic status) affected tooth loss and periodontal problems in pregnant women. Socio-demographic position and parity may act independently of, or through (i.e. mediated by) dental care utilization, psycho-social factors and oral hygiene behavior.

Paper II - Focusing on pregnant women at about 7 months gestational age, this study aimed to estimate the prevalence of OIDP, and examine the relationship of oral impacts with periodontal status, tooth loss and self-reported symptoms suggestive of periodontal disease.

Finally, this study examined whether or not tooth loss impacted on reported problems chewing common Ugandan foods and assessed the relationship of self-reported chewing problems with OIDP.

Paper III- Focusing on Ugandan infants aged 6-36 months and their caregivers, and guided by the conceptual framework of Wilson and Cleary (1995), the purpose of this study was to examine the degree to which clinical and psycho-social factors relating to child oral health were associated with caregivers' overall evaluation of child oral health and general health status.

3. MATERIAL AND METHODS

3.1 Study area

This thesis is based on two separate surveys, Survey I and Survey II conducted in the two Ugandan districts of Mbale and Kampala, respectively (Fig 4). At the time of study, Uganda was divided administratively into 80 districts. Each district is further subdivided into sub-districts, counties and sub-counties. Districts are named after their administrative and commercial town.

Uganda is a landlocked country located on the Eastern part of the African continent. Uganda has a population of approximately 31.3 million with an annual growth rate of 3.2%. The current Gross Domestic Product (GDP) per capita is estimated $1,100 [July 2008 estimate] (CIA, 2009) (www.cia.gov/library/publications/the-world-factbook/geos/ug.html)

The total health expenditure per capita was estimated at 7.2% of the GDP. The total fertility rate of Uganda is 7.1 per woman. Antenatal coverage (at least 4 visits) is 47% and only 42.7% of deliveries are by skilled health personnel. Thirteen percent of the Ugandan population are urban dwellers and there exists a disparity with regard to percentage deliveries by skilled health personnel of 37.7% and 80.7% in rural and urban areas, respectively (WHO, 2009b). (http://www.who.int/whosis/data/Search.jsp) The Ministry of Health in Uganda requires all children aged 0-5 years to attend Mother Child Health Clinics for immunization and growth monitoring. The current Immunization coverage is reportedly to be over 80% for all childhood vaccines (WHO, 2009a).

(http://www.who.int/vaccines/globalsummary/immunization/timeseries/tscoveragebcg.htm)

The official languages in Uganda are English and Swahili, while other Niger-Congo (Bantu) and Nilo-Saharan languages are spoken. Uganda literacy rate is 66.8%.

Mbale district is located 190 km northeast of Kampala. The population is estimated to be 721,242 (2002 census) of whom 92% are rural residents. The district is divided administratively into the sub-counties of Bubulo, Budadiri, Bulambuli, Bunghoko, Manjiya and the town centre, Mbale Municipality. Kampala, the capital city of Uganda, covers an area of 197 km^2 and has a population of 1.2 million of whom 18% are under 5 years. Kampala has an overall literacy rate of 88.4% (www.cia.gov/library/publications/the-world-factbook/geos/ug.html). Kampala is administratively divided into 5 divisions, two of which, Nakawa (42.5 km^2) and Makindye (40.6 km^2), constituted the study areas. In 2008, Nakawa had a total population of 300,000, including 80,000 females aged 15-49. The corresponding figures for Makindye were 380,000 and 100,000.

3.2 Survey I

3.2.1 Selection procedures and study profile (Table 4 and Fig 5)

The material of Survey I which applies to Paper I and II (Table 4) was collected as a sub-study of a multi-centre cluster-randomized behavior intervention trial PROMISE-EBF: exclusive breastfeeding promotion in sub-Saharan Africa, in Mbale district, Eastern Uganda between January 2006 and August 2008. The sample size of the oral health sub-study was estimated to be 800 pregnant women, assuming a prevalence of tooth loss (i.e. at least one tooth lost) of 50%, a precision of 0.05 and a design effect of 2. PROMISE-EBF included several outcomes, the size of the sample was calculated separately for each of them and the largest sample size acquired was adopted. Participating women were members of PROMISE-EBF (Id NCT00397150 at http://clinicaltrials.gov) conducted in four sub-Saharan African countries; Uganda, Burkina Faso, Zambia and South Africa. In each country, 24-34 clusters were randomized with 12-17 intervention- and 12-17 control clusters and with > 800 mother/infant pairs included per country. The units for randomization were clusters made up

of 1-2 villages with an average of 1000 inhabitants (35 infants per year given a birth rate of 3.5%) (PROMISE-EBF-final scientific report, 2009). Recruitment of pregnant women into the study was made through a system with one designated recruiter in each cluster. The eligibility criteria were; pregnant women at about 7 months gestational age residing in- and intending to continue to live in the study areas and who consented to study participation. A woman could also be included if she had given birth and the baby was less than 1 week old. A total of 886 pregnant women were eligible to participate from whom information became available for 877 women (participation rate 98.9 %; mean age 25.6 sd 6.4) who participated in the PROMISE-EBF recruitment interview and the oral health interview. Seven hundred and thirteen women (mean age 25.5 sd 6.6) underwent a clinical oral examination at their own homes (Fig 6). The reason for not participating in the clinical examination was difficulties to locate women, withdrawal of consent and death.

3.2.2 Ethical clearance

Ethical clearance for the PROMISE-EBF study was obtained in each participating country including Norway (Appendix 1). Informed consent was obtained before enrollment into the study. A woman was approached by the recruiter to arrange a meeting with the study team. At this meeting the data collector explained to the woman and ensured that she understood the purpose and procedures of the study. The woman was informed that participation was voluntary, and that they could leave the study at any time without any consequences. A written copy of the information was left with the woman after obtaining consent. The woman either signed or gave a thumbprint when she consented. All signed forms were filed and kept at the study office. All subjects undergoing clinical examination who presented with pain as a consequence of acute oral conditions were referred for treatment as soon as possible.

3.2.3 Interviews with pregnant women in household settings

A total of 6 interviews and one oral examination were scheduled for each participant; a recruitment interview for the PROMISE-EBF and an oral health interview at 7 months gestational age, followed by interviews at 3-, 6-, 12-, and 24 weeks post partum. Seven trained research assistants conducted face to face interviews in the participants' homes. All questionnaires were translated to the local language Lumasaaba, commonly spoken in Mbale. Data collection was done using handheld computers with the software EpiHandy (www.epihandy.com). Data collected on handheld computers were synchronized daily with a server. The PROMISE-EBF study recruitment interview included the socio-demographic questions and lasted approximately 30 minutes (Appendix 2). The oral health interview lasted 5 - 8 minutes and included questions about perceived oral health status, oral impacts on daily performances, OIDP, oral health knowledge and oral health related behaviors including dental visiting habits (Appendix 3).

3.2.4 Oral clinical examination of pregnant women in household settings

Mothers underwent a full mouth oral examination in their homes performed by a trained, calibrated dentist (M.W). The oral examination was done using a headlight torch as an artificial source of light with a dental mirror and CPI periodontal probe. Periodontal status was assessed using the Community Periodontal Index -CPI (WHO, 1997) while oral hygiene was assessed using Oral Hygiene Index Simplified, OHI-S (Greene and Vermillion, 1964). The two–digit (FDI) system of tooth nomenclature was used to indicate specific teeth. The mothers were also assessed for presence/absence of natural teeth (Appendix 4).

3.3 Survey II

3.3.1 Selection procedures and study profile (Table 4)

A cross-sectional Mother and Child Health Clinic (MCH)-based study was conducted in Kampala district during June-October 2007. One non-governmental (Kibuli) and one governmental (Naguru) MCH care facility were purposely selected in Makindye and Nakawa, respectively. Both facilities have large catchment areas and include community outreach clinics for the provision of child immunization. The inclusion criteria were caregivers with children aged 6-36 months attending the Kibuli and Naguru clinics for immunization and/or growth monitoring. Caregiver-child pairs who presented at the clinics for treatment of any illness were excluded. All caregiver-child pairs who attended the clinics during the study period and satisfied the inclusion criteria predefined for the study were eligible for participation. Out of 831 eligible caregivers approached, 816 agreed to participate (response rate 98.1%). This matched the required sample size of 800 mother/caregiver-child pairs pre-calculated on the basis of a 30% prevalence of ECC and a standard error of 3% among 3yr old children. Another 5% was added to the sample size to account for children who had to be excluded from the analysis for being the second eligible child of the same mother/caregiver. Data were collected through oral clinical examinations, anthropometric measurements and structured interviews with the caregivers.

3.3.2 Ethical issues

The study ethical clearance was given by the Uganda National Council of Science and Technology (Appendix 5). Permission to carry out the study in Kampala was granted by the administrative authorities. All caregivers received a copy of information regarding the study which had been read to them in advance. Caregivers' consented to participate in study by signing or thumbprint on prepared consent forms. All children undergoing clinical

examination who presented with pain as a consequence of acute oral conditions were referred for treatment as soon as possible.

3.3.3 Caregivers Interview

A structured interview schedule was constructed in English and translated into Luganda (the main local language of the central region) by trained research assistants. Health professionals reviewed the structured interview for semantic and conceptual equivalence. Sensitivity to culture and selection of appropriate words were considered. Face to face interviews were conducted by research assistants with the caregivers in a private room at the MCH unit. The questions were on socio-demographics, common childhood illness and children's oral quality of life as perceived by the caregivers.

3.3.4 Clinical oral examination and anthropometric status

The oral clinical examination was carried out by one trained and calibrated dentist (Josephine Kayondo) while a trained assistant recorded the observations (Fig 6). Caries of erupted teeth in the primary dentition was examined visually under field conditions using natural light and a mouth mirror. Lesions were recorded as present when a carious cavity was apparent on visual inspection. Data were collected on the tooth level and caries was recorded on fully and partially erupted teeth in terms of decayed, missing and filled teeth due to caries (dmft), using the World Health Organization (WHO) recommendations for oral health surveys (WHO, 1997).

Before the children were examined clinically, their weight and recumbent length were taken in accordance with World Health Organization recommendations (WHO, 2007). Standardized 25 kg portable Salter Spring scales measuring to the nearest 0.1 kg were used to determine

weight. Recumbent length was measured to the nearest 0.1 cm with specially designed length boards. Using the WHO Child Growth Standards (WHO, 2007) (WHO Anthro 2005 software), anthropometric indices were constructed on the basis of weight, length, age and sex (WHO, 2007). Wasting was defined as weight-for-height z-scores (WHZ) < -2 SD, stunting as height-for-age z-scores (HAZ) < -2 SD and underweight as weight-for-age z-scores (WAZ) < -2 SD (WHO, 2007).

3.4 Characteristics of the data and statistical analysis

Data analyses were carried out using SPSS (version 15.0). Table 5 summarises the main statistical methods used in Survey I and Survey II. The significance level was set at 0.05

Table 4 Survey I and Survey II constituting the basis of the three papers in the thesis

Paper	Focus	Sample description
I	**Survey I** Periodontal status and tooth loss in pregnant women	All women of approximately[*] 7 months gestation recruited into the PROMISE-EBF study from 24 clusters (18 rural/ 6 urban) in Mbale district were eligible for participation in the oral sub study
II	Oral impacts on Daily performance (OIDP) of pregnant women	Year: 2006 - 2008 (n=877)
III	**Survey II** Caretakers perception of child's health and oral health	Purposive sampling of caregivers of 6-36 month old children attending MCH clinics at Naguru (n = 275) and Kibuli hospital (n = 541) in Kampala Year: 2007

---

[*] Pregnant women recruited into study were identified by a local leader 'belly spotting' so actual gestation age were given by women.

Table 5 Statistical tests and methods used in Papers I-III

Statistical test/methods used	Paper I	Paper II	Paper III
Chi square	+	+	+
Logistic regression	+	+	+
Cronbach's alpha	-	+	+
Cohen's Kappa	+	+	+
Principal component Analysis, PCA	+	+	+

Figure 4 Map of Uganda showing administrative divisions and Districts of Mbale and Kampala.

Figure 5 Profile of participation in Survey I

PROMISE-EBF 24 Clusters
Total number of eligible women
886 (100%)

Women who consented to
participate in interviews
877 (98.9%)

Women who did not get
clinical exam; inaccessible
or denied consent
173 (19.5%)

Women who underwent
Clinical Exam
713 (80.5%)

Test re-test participants of
clinical exam
50 (5.6%)
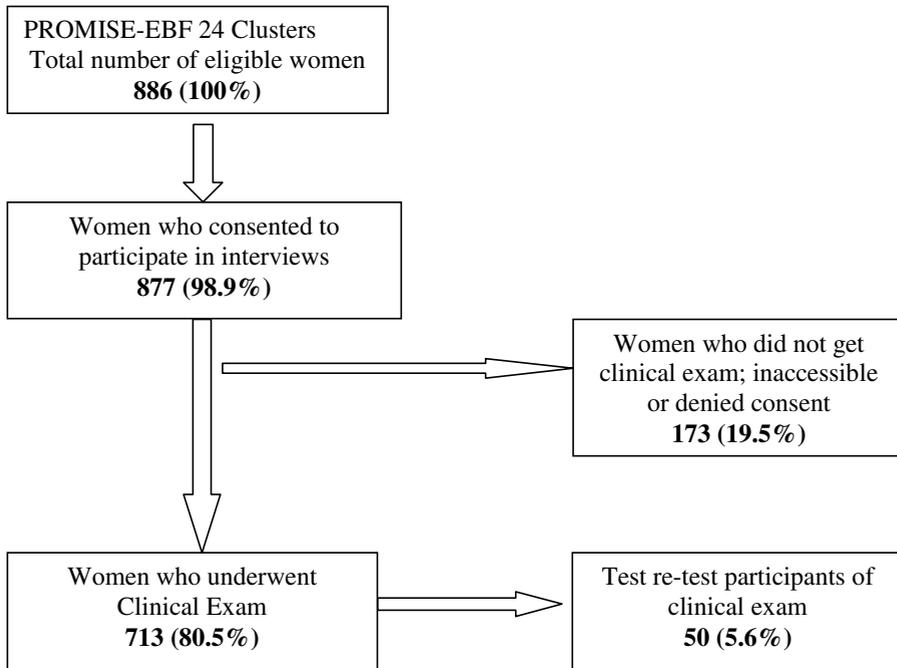
Figure 6 Data collection in survey I and II
a) and c) Clinical Examination of pregnant woman at their homes.
b) Research assistant conducting interview with handheld computer
d) Clinical examination of child at MCH clinic.

Figure 7 Members of PROMISE-EBF Study team (Mbale site)

4. RESULTS

4.1 PAPER I: **Socio-demographic factors related to periodontal status and tooth loss of pregnant women in Mbale district, Uganda**

The prevalence of tooth loss for any reason was 35.7%. The prevalence of periodontal disease according to CPI score was 0.6% who presented with shallow pockets (4-5mm), while 3.3% and 63.4% displayed bleeding and calculus, respectively. A total of 32.7% were without any sign of periodontal disease. Binary logistic regression analyses revealed that older women, women from larger households and those presenting with microbial plaque were respectively, 3.4, 1.4 and 2.5 times more likely, to have CPI score >0 whereas women who used bed nets were less likely (OR = 0.6) to have CPI score>0. Rural (OR= 0.9), nulliparous (OR=0.4) and women who never visited a dentist (OR=0.04) were less likely, whereas women from larger households (OR=1.5) were more likely to have lost at least one tooth.

4.2 PAPER II: **Periodontal status, tooth loss and self-reported periodontal problems effects on oral impacts on daily performances, OIDP, in pregnant women in Uganda: a cross-sectional study.**

Seven of the original 8 OIDP items were translated into the local language of Lumasaaba. Cronbach's alpha was 0.85 and 0.80 in urban and rural areas, respectively. The prevalence of oral impacts was 25% in the urban and 30% in the rural area. Corresponding estimates for CPI>0 were 63% and 68%. Adjusted ORs (95% CI) for having any oral impact were 1.1 (0.7-1.7), 1.9 (1.2-3.1), 1.7 (1.1-2.7) and 2.0 (0.9-4.4) if having respectively, CPI>0, at least one tooth lost, tooth loss in molars and tooth loss in molar-and anterior regions. The Adjusted ORs (95% CI) for any oral impact if reporting periodontal problems ranged from 2.7(1.8-4.2), (bad breath) through 8.6 (5.6-12.9), (chewing problem) to 22.3(13.3-35.9), (toothache).

4.3 PAPER III: **Factors associated with caregivers' perception of child's health- and oral health status: a study of 6-36-month- olds in Uganda**

Poor child oral health was reported by 40.2% and 17.5% of caregivers who reported their children's health as, respectively, poor and good. Having the least family wealth OR= 1.9 (95% CI 1.1-3.3) and reporting distressed family activities OR= 2.3 (95% CI 1.5-3.2) were associated with higher odds of reporting poor child oral health, whereas being a rural resident OR=0.5 (95% CI 0.2-0.7) and reporting no symptoms during tooth eruption OR= 0.3 (95% CI 0.2-0.7) were associated with lower odds of reporting poor child oral health. Perception of poor child oral health OR=2.8 (95% CI 1.9-4.2) and having the least family wealth OR= 1.7 (95% CI 1.1-2.9) were associated with higher odds of reporting poor child health status, whereas no stunting was associated with lower odds OR=0.5 (95% CI 0.3-0.7).

5. DISCUSSION

This section considers important methodological issues and discusses the main findings of the papers constituting the present thesis. The results are discussed in detail in the individual papers.

5.1 Methodological considerations

The present thesis utilized data collected in two cross-sectional sample surveys that included structured interview schedules and clinical oral examinations. Sample surveys were utilized firstly, to provide estimates of clinical- and subjective oral health characteristics of the two study populations; 6-36 months old children in Kampala and pregnant women resident in Mbale districts of Uganda. Secondly, sample surveys were utilized to test statistical hypotheses regarding correlates of clinical- and perceived oral health status in the two study populations investigated. One of the main advantages of employing the sample survey method is that it yields information on many variables of a large number of people at a relatively low cost (Moser and Kalton, 1971). Limitations of the sample survey approach are discussed below and also in detail in the individual papers of the thesis.

5.1.1 Reliability

A test is considered reliable when repeated measurements, made under constant conditions, will give the same result (Moser and Kalton, 1971). In measuring of an attribute, reliability is concerned with the degree of consistency or accuracy (Polit and Hungler, 1991). Measurement error plays a key role in reliability; thus a reliable instrument minimizes the error component and maximizes a true component of a score. In this study, several measures were taken to ensure data quality. They included training of research assistants who were fluent in the local language prior to study, pilot studies and repeated checks during the data

entry process. Furthermore, with regard to clinical examinations, all measurements were carried out by one investigator in each survey. Reproducibility assessed by duplicate clinical examinations of 50 pregnant women in Mbale gave kappa values of 0.91 for missing teeth and kappa values ranging from 0.48 to 0.85 for CPI scores of index teeth (Paper I and II). Due to ethical and logistical reasons, re-interviews could not be carried out with pregnant women in Mbale. Duplicate interviews and oral clinical examinations of 50 randomly selected child-caregiver pairs in Kampala provided kappa statistics of 1.0 for children's prevalence of dental caries and number of teeth erupted, whereas kappa values ranged from 0.24-0.91 for children's oral health as perceived by caregivers (Paper III).

For internal consistency reliability estimation, a single test is administered on one occasion and the items are tested for homogeneity (Streiner and Norman, 2003). That is, all the items should be tapping different aspects of the same attribute (Streiner and Norman, 2003). Thus, the more homogenous items the higher the correlation (Cronbach's alpha). Therefore, the more reliable the measure, indicating that they measure the same underlying concept. In Paper II, the 7 OIDP items gave Cronbach's alpha of 0.85 and 0.80 among pregnant women in urban and rural areas of Mbale. In Paper III, the early child oral impact score and the family impact score adapted from the ECOHIS (Pahel et al., 2007) and Locker's Family Impact Scale (Locker et al., 2002) gave Cronbach's alpha of 0.8 and 0.9, respectively. The values of internal consistency obtained in this thesis indicate exemplary internal consistency according to McDowell and Newell (1996).

5.1.2 Validity

There are two aspects of validity: internal validity which deals with the question of whether a true measure is obtained for the subjects under study; and external validity which relates to whether the findings can be generalized to a wider population (Moser and Kalton, 1971).

5.1.2.1 Internal validity

Acceptable reliability estimates obtained from the instruments utilized in this study does not necessarily ensure their validity. The most accurate ways of obtaining correct diagnoses for decayed teeth, tooth loss and periodontal status would have required x-ray units, adequate lighting, etc. and women's dental history to obtain reasons for tooth loss. The clinical examinations were conducted under field conditions according to the recommendations by WHO (1997) and might have introduced bias by misclassification. In addition, subjective oral health indicators were assessed using self-report methods, which are prone to recall- and social desirability bias. In this study, validity was justified by the associations between pregnant women's OIDP scores and clinical- and self-reported oral health – all relationships observed to be in the expected direction (Paper II) and by the positive associations obtained between children's dental caries and Child Oral Impact / Family Impact score (Paper III). Furthermore, as construct validity is dependant on theory, the observed associations harmonizing the propositions of Wilson's and Cleary's model (1995) (Paper II& III) and the Adler model (Paper I) is as much a test of theory as of the validity of the measurements.

Assessment of the validity of the results of the present thesis involves a consideration of alternative explanations of the associations observed in terms of chance, bias and confounding. Since the size of the study populations investigated in this study was relatively large, even very small and clinically less meaningful differences could be deemed unlikely to be caused

by chance. This problem could have been solved by use of confidence intervals. On the other hand, most statistically significant relationships identified in the three papers were of substantial magnitude, thus showing beyond doubt that they could not have reached statistical significance due to a large sample size alone. Evaluating the role of bias as an alternative explanation of an observed relationship is another necessary step in interpreting the study results. The role of selection bias in Survey I is considered in detail in Paper I. A recall period of six months utilized for the OIDP scale among pregnant women has proved successful in a number of studies of adult populations, indicating fewer problems with recall bias. Paper II describes in detail the validity of the modified OIDP inventory utilized among pregnant women in Mbale. Unlike bias, confounding is a consequence of the complex relationship between various independent variables and outcomes. In the present thesis, confounding was considered and controlled by stratified analyses, multiple variable analyses, thus comparing unadjusted and adjusted findings and moreover by age standardization when comparing urban and rural findings of periodontal disease and tooth loss (Paper I).

5.1.2.2. External validity

Convenient sampling method was utilized in Paper I and II, constituting a sub-study under the PROMISE-EBF study that recruited pregnant women for subsequent randomization into a randomized controlled trial. Mbale district and 24 clusters (18 rural and 6 urban) within Mbale were selected based on accessibility (the road standard, probability to use car in the rainy season, access to water, church, school etc) criteria without random selection. All pregnant women in the selected 24 clusters in Mbale were eligible for study. Due to the convenience sampling design it is difficult to assert the representativeness of the study participants with respect to the population of pregnant women in Mbale district or in Uganda, generally. However, the urban-rural trend with regard to indicators of socio-economic status

observed among pregnant women from Mbale is comparable to those found in the general population of Uganda (See Paper I, Table 1). Thus, Urban Ugandans tend to have higher education and to be wealthier than their rural counterparts. There are reportedly increasing poverty levels as one moves from city centers to rural areas (UBOS, 2007) (www.geocities.com/literracyaiduganda/demographics.html). Moreover, the main aim of the oral health interview and clinical examination presented in Paper I and Paper II was to identify correlates of periodontal disease and tooth loss and to examine the pathways of association of socio-demographics, parity and health related variables with the oral health outcomes of interest. As such the external validity was deemed to be of less importance in the oral sub study as in the main PROMISE-EBF study. For a detailed discussion of the representativeness of the study population of caregiver-children pairs in Kampala, see Paper III.

5.1.2.3 Cross cultural adaptation

Most measures of health related quality of life are developed in English language and are intended for use in English speaking countries (Guillemin et al., 1993). It is therefore important to develop measures specifically designed for use in other non-English speaking populations, like caregivers of young children and pregnant women in Uganda, since cultural groups differ in disease expression and in use of various health care systems (Guillemin et al., 1993). However, this would be costly both in terms of time and money, hence translation and adaptation of health related quality of life measure (Child Impact score /family impact score and the OIDP-inventory) into local Ugandan languages was mandatory (Paper II and III). In this study guidelines for cross cultural adaptation (Paper II and III) were adhered to in order to preserve sensibility of the quality of life measure inventories (Guillemin et al., 1993).

5.2 Discussion of major findings

5.2.1 Prevalence of oral disease and OHRQoL

As shown in Paper I, there were no cases of severe periodontal disease in terms of pockets of more than 6mm (CPI code 4). Only 1.7% and 0.2% of the women investigated had shallow pockets of 4-5mm (CPI code 3) in urban and rural areas, respectively. The prevalence of bleeding (CPI code 1) was low for both urban and rural women (4.4%, 2.8%), whereas that of calculus deposits (CPI code 2) was high (56.9% in urban and 65.3% in rural). The figures presented in Paper I are not easily comparable, as relatively few studies of periodontal disease have been conducted in the Ugandan population generally and in pregnant women, specifically. Muwazi et al. (2005) investigated prevailing oral conditions in the general Ugandan population and reported high prevalence's of calculus deposits amounting to 56% in 12- yr- olds and 79.3% in 35-44- yr- olds. A study of post partum women in Tanzania reported prevalence of calculus and periodontal pockets amounting to 99% and 30%, respectively (Mumghamba et al., 2006). Studies of the general sub-Saharan African populations have continued to report high prevalence of calculus (Ngatia et al., 2008, Varenne et al., 2004) and low prevalence of periodontal pockets (Mumghamba et al., 1996, Frencken et al., 1999, Mumghamba et al., 1995). A possible reason for the low severity of periodontal disease observed in sub-Saharan African populations may be related to genetic factors and host risk factors (Albandar, 2002, Johnson, 1989). In contrast, studies conducted among ante partum and postpartum women in other parts of the world have observed higher prevalence of periodontal disease. Though, direct comparison of the present prevalence estimates with those found elsewhere may be of limited value due to the variations in scoring between investigators. It is notable that a prevalence as high as 31% shallow pockets of 4-5 mm, was observed in pregnant Japanese women (Miyazaki et al., 1991). Another study among a group

of UK women of various ethnicity assessed immediately after delivery by Davenport et al. (2002) reports an even higher prevalence of 44% shallow pockets.

The mean number of teeth lost amounting to 0.7 is considerably lower than the 2 teeth lost per individual reported among pregnant women of similar age in Tanzania (Scheutz et al., 2002). The reported common causes of tooth loss are extraction, trauma or spontaneously due to advanced disease (Baelum et al., 1997, Kida et al., 2006). There is a scarcity of studies of tooth loss in the Ugandan population. Available information on tooth loss is from studies of dental caries and the missing component of the DMFT index employed (Okullo et al., 2003, Muwazi et al., 2005). Some information about tooth loss emanates from studies on traditional practices that involve tooth mutilations (Bataringaya et al., 2005) including subjects of younger age compared to the pregnant women participating in Survey I (Kiwanuka et al., 2004, Okullo et al., 2003, Nalweyiso et al., 2004, Robinson et al., 2005). In the neighboring countries of Tanzania and Kenya, studies of tooth loss have been conducted in different age groups providing evidence of higher prevalence of tooth loss than that observed among pregnant Ugandan women (Kida et al., 2006). Dental caries continues to be the most dominant cause for tooth loss both in industrialized and developing countries even though periodontal disease may be an important predictor (Manji et al., 1988, Copeland et al., 2004, Baelum et al., 1997).

Paper II examined the impacts of oral condition on pregnant women's daily life activities using a modified 7 item OIDP inventory. The prevalence of OIDP of 25% and 30% observed among urban and rural women, respectively were lower than that estimated in young Ugandan and Tanzanian adults of comparable ages from the general populations (Masalu and Astrom, 2003, Astrom and Okullo, 2003). On the other hand, it is similar to the OIDP prevalence of

33% found in a study of pregnant women in Brazil (de Oliveira and Nadanovsky, 2006). Oral impacts were reported most frequently by women who experienced chewing problems and toothache. This finding agrees with a study of pregnant women in South India where the highest impact on quality of life were observed among women who reported painful mouth and difficulty eating (Acharya et al., 2009).

The findings presented in Paper III indicate a substantial burden from oral diseases in Ugandan children 6-36 months old, 18.1% children had tooth decay, thus supporting findings reported previously among pre- and primary school children in East Africa (Kiwanuka et al., 2004). The reported prevalence of ECC in sub-Saharan pre-school children (50%-60% early childhood caries) have been found to be comparatively higher than those found in industrialized populations (Nalweyiso et al., 2004, Kiwanuka et al., 2004). This study supports the evidence that poor dental health besides immediate impact on child's health and growth has further impacts which should be identified and addressed. This is especially important in populations where access to dental care is limited (Gussy et al., 2008).

5.2.2 Socio-economic correlates of oral disease and oral health related quality of life
This study investigated socio-economic disparities in periodontal status, tooth loss and OHRQoL among pregnant women, as well as in the health and oral health status of 6-36 months old children as reported by their caregivers. As shown in Paper I, older women and those of lower socio-economic status (in terms of larger households and parity) were more likely than their counterparts to present with signs of periodontal disease and tooth loss. The pattern of positive correlation between periodontal disease and age has been observed previously in Uganda (Albandar et al., 2002, Muwazi et al., 2005) and in studies conducted elsewhere (Borrell et al., 2005, Taani et al., 2003, Petersen and Ogawa, 2005). The age

distribution of periodontal disease is the basis on which WHO indicator ages were recommended for use in country surveys (Petersen and Ogawa, 2005). Tooth loss is known to be influenced by non dental factors such as socioeconomic-, behavioral- and attitudinal factors observed in the population (Kida et al., 2006, Baelum et al., 2007, Baelum et al., 1997). As presented in Paper I, women of higher parity presented with higher tooth loss than their lower parity counterparts. This may confirm the hypothesis that parity is positively related to number of missing teeth in young pregnant low-income country women. This hypothesis has persisted as a belief in many cultures, however, it is yet to be proven in studies neither in developed nor low-income countries (Russell et al., 2008). Parity related tooth loss could be interpreted as accumulated tissue destruction across time rather than an intrinsic parity related abnormality. In fact, previous studies have shown that both pregnancy and maternity alter dental visiting-and treatment patterns in women (Timothe et al., 2005).

In Paper III, caregivers who lived mostly in urban areas and those of poor family household wealth were more likely than their counterparts in the opposite groups to perceive poor child oral health status. Moreover, poor family wealth and stunting were the strongest predictors of caregivers' response to children's overall health status. In that paper stunting (height for age) was used as a proxy measure for child health inequality at the individual level since it is evident that the distribution of healthy children's height is never affected by ethnicity or race by the first five years of life. Wamani et al. (2006) in a study of Western Ugandan infants confirmed the relationship between SES and stunting. Similarly, Engebretsen et al. (2008) in a study from the same catchment area Mbale, Eastern Uganda, thus, advocating the use of stunting as an indicator or proxy of socio-economic status.

Few studies have examined socio-economic disparities in health- and oral health status and in related behaviors in pregnancy and early childhood in sub-Saharan Africa, where access to oral health care services at the local community level is at best very limited. Moreover, whether social inequality in oral health related behaviors account for the social gradient commonly seen in clinical and subjective oral health outcomes has not been examined focusing adults and children in non-occidental socio-cultural contexts. This is notable, since the oral health policy of many sub-Saharan African countries gives priority to children as target groups for oral health care services and since such studies might have important policy- and oral health program implications. In accordance with the propositions of Adler's model (1993), the study presented in Paper I revealed that the effect of parity on the prevalence of periodontal disease in pregnant women might have been mediated by other socio-demographic variables, psycho-social- and oral hygiene related factors.

Sub-Saharan Africa has the poorest overall health indicators in the world (WHOSIS, Schellenberg et al., 2003). Markers of socio-economic stratification in terms of international classifications of occupational status and income are not easily applied in sub-Saharan Africa, thus modifications have been proposed (Schellenberg et al., 2003). Various measures have been used to describe socio-economic disparity in health and oral health (Adler and Ostrove, 1999). The SES may be assessed as a single variable, a collection of variables and/or a computed variable. For instance Frencken et al. (1999) in a Zimbabwean National survey describe SES using location where lower SES were individuals who lived in rural suburbs while higher SES were those who lived in the urban suburbs. In the present study, a combination of socio-economic status indicators were applied in terms of place of residence, educational level, household wealth index, size of household, parity, owning land and use of bed nets. The family wealth index was computed using principal components analysis, a

method described in detail by Filmer and Pritchet (2001) suitable in the absence of information on income and expenditure. The asset index is a good proxy for long run economic status and tends to be reliable for use in populations where the ownership of assets between poor and rich is marked. This wealth measure is based on a weighted sum of self-reported household assets and the more conventional measure of parental education. The wealth index showed good discriminate power against caregivers' perceptions of health and oral health status of their children as well as against number of lost teeth in pregnant women. In addition, this study used a surrogate area based social indicator of place of residence, as suggested by Locker (2000). Area-based measures of socio-economic position reflect the socio-economic context in which people live rather than their personal wealth. Place of residence was used as a supplement to individual wealth data to add exploratory power to the models of oral health inequalities both in Survey I and Survey II. The mechanisms by which SES influences oral health to cause differences in counterparts are posed to be- levels of knowledge with regard to maintaining good oral hygiene, access to care, and affordability of services (Frencken et al., 1999, Taani et al., 2003, Copeland et al., 2004).

5.2.3 Clinical- and non- clinical correlates of OHRQoL

In Paper II, this study demonstrated a strong association between tooth loss and OHRQoL as measured by OIDP in pregnancy. This is consistent with other studies where clinical conditions have significant relationship with OHRQoL measures (Tsakos et al., 2006). On the other hand, there was no association with periodontal disease (CPI>0). This finding is also consistent with previous reports in the literature. The literature is unambiguous with respect to the relationship between normative measures of oral health and OHRQoL. Though few studies are focused on periodontal health and its impact on quality of life, there are studies of

individuals with severe periodontal disease that confirm a relationship (Needleman et al., 2004, Ng and Leung, 2006).

Reported oral health symptoms discriminated statistically significantly OHRQoL even when controlled for confounding, as shown in Papers II and III. This finding supports the use of OHRQoL measures together with objective clinical measures in oral health assessment (Ng and Leung, 2006). There are lifestyle and behavior factors that may influence the occurrence oral disease, and thereby OHRQoL (Cohen and Jago, 1976). These include tobacco use and oral hygiene among others. In Paper II, the number of women who ever smoked was too small to be entered into the statistical analyses. In general, the findings of the present study confirm the propositions derived from Wilson and Cleary (1995). Thus, Oral health indicators belonging to various levels of the conceptual hierarchy of the model of Wilson and Cleary (1995) influenced OHRQoL and should be studied further.

5.3 Conclusion

- Considerable proportions of pregnant women suffered some sign of periodontal disease (CPI>0) and any tooth loss. In spite of relatively high prevalence of oral disease observed in this study, only about one third of the pregnant women investigated reported any impact on daily performances.

- This study identified increasing age, low socio- economic status, and poor dental hygiene as the main risk indicators for periodontal disease, whereas low socio-economic status, urban residence, multi-parity and dental attendance emerged as the main risk indicators for any tooth loss.

- This study identified any sign of periodontal disease and tooth loss as risk indicators of increased oral impacts on daily performances. Oral problems, such as toothache,

problems with chewing and bad breath impacted negatively on women's oral health related quality of life.

- Forty percent of caregivers evaluated child oral health as poor if child's general health status was poor. If child general health status was good, a total of 17 % of the caregivers recognized child oral health as poor. Predictors of poor child oral health status were low socio-economic status and distressed family activities. No experience of symptoms during tooth eruption and child identified as not being stunted decreased the likelihood of caregivers reporting poor child oral health and general health status.

5.4 Recommendations

The findings of the present study point to a need to improve access to oral health care and oral health education for pregnant women, 6-36 months old children and their caregivers in Ugandan population. Survey I findings support the proposal of including an oral health education component for maternity care providers. It is possible that women are more acceptable to health information during pregnancy (Boggess, 2008), therefore information with regard to oral health on the benefits, safety, misconceptions could be initiated at the Antenatal care clinics. ANC may provide opportune time for positive oral health messages that enhance women and their children's oral health. Furthermore, since teeth begin to form *in utero, continue to develop post* natal and starts eruption at the age of 6 months, the importance of good health for mother during pregnancy and child in early years cannot be overemphasized. The central role of women for children's health and oral health – as promoters, caregivers and role models, should be utilized in oral health promotion programs (Thorpe, 2006). Oral health promotion messages can be designed for MCH clinics. MCH- and ANC clinics are accessed by all strata of society with an added advantage of communicating health promotion messages not only to women, but also other caregivers such as fathers and

other caregivers that might present children at the clinics. The option of integrating oral health promotion into existing health programs in low-income countries like Uganda, is potentially cost effective and might increase sustainability (Thorpe, 2006, Muhirwe, 2006).

Socio-economic disparities in oral health status and OHRQoL should be addressed by making services and information more accessible to all population strata through community based health and oral health programs. Oral health professionals should consider providing oral health information in the rural areas in particular, as this is where the majority of the Uganda population currently resides (UBOS, 2007). The current distribution of oral health services in Uganda is about 80% in the urban areas (Muhirwe, 2006). It is the responsibility of oral health professionals to advocate policy that will lead to resource mobilization that might improve access to appropriate oral health care for all.

6. REFERENCES

ABDELLATIF, H. M. & BURT, B. A. (1987) An epidemiological investigation into the relative importance of age and oral hygiene status as determinants of periodontitis. *J Dent Res,* 66**,** 13-8.

ADEGBEMBO, A. O., ADEYINKA, A., DANFILLO, I. S., MAFENI, J. O., GEORGE, M. O., AIHVEBA, N., THORPE, S. J. & ENWONWU, C. O. (2000) National pathfinder survey of periodontal status and treatment needs in The Gambia. *SADJ,* 55**,** 151-7.

ADEGBEMBO, A. O. & EL-NADEEF, M. A. (1995) National survey of periodontal status and treatment need among Nigerians. *Int Dent J,* 45**,** 197-203.

ADLER, N. E., BOYCE, W. T., CHESNEY, M. A., FOLKMAN, S. & SYME, S. L. (1993) Socioeconomic inequalities in health. No easy solution. *JAMA,* 269**,** 3140-5.

ADLER, N. E. & OSTROVE, J. M. (1999) Socioeconomic status and health: what we know and what we don't. *Ann N Y Acad Sci,* 896**,** 3-15.

ADULYANON, A. & SHEIHAM, A. (Eds.) (1997) *Oral Impacts on Daily perfomances,* Chapel Hill
University of North Carolina

AGBELUSI, G. A. & JEBODA, S. O. (2006) Oral health status of 12-year-old Nigerian children. *West Afr J Med,* 25**,** 195-8.

ALBANDAR, J. M. (2002) Global risk factors and risk indicators for periodontal diseases. *Periodontol 2000,* 29**,** 177-206.

ALBANDAR, J. M., MURANGA, M. B. & RAMS, T. E. (2002) Prevalence of aggressive periodontitis in school attendees in Uganda. *J Clin Periodontol,* 29**,** 823-31.

ALBANDAR, J. M. & RAMS, T. E. (2002) Global epidemiology of periodontal diseases: an overview. *Periodontol 2000,* 29**,** 7-10.

ALLEN, F. & LOCKER, D. (2002) A modified short version of the oral health impact profile for assessing health-related quality of life in edentulous adults. *Int J Prosthodont,* 15**,** 446-50.

ASTROM, A. N. & OKULLO, I. (2003) Validity and reliability of the Oral Impacts on Daily Performance (OIDP) frequency scale: a cross-sectional study of adolescents in Uganda. *BMC Oral Health,* 3**,** 5.

ATCHISON, K. A. & DOLAN, T. A. (1990) Development of the Geriatric Oral Health Assessment Index. *J Dent Educ,* 54**,** 680-7.

AXELSSON, P. & LINDHE, J. (1981) The significance of maintenance care in the treatment of periodontal disease. *J Clin Periodontol,* 8**,** 281-94.

BAELUM, V., CHEN, X., MANJI, F., LUAN, W. M. & FEJERSKOV, O. (1996) Profiles of destructive periodontal disease in different populations. *J Periodontal Res,* 31**,** 17-26.

BAELUM, V., LUAN, W. M., CHEN, X. & FEJERSKOV, O. (1997) Predictors of tooth loss over 10 years in adult and elderly Chinese. *Community Dent Oral Epidemiol,* 25**,** 204-10.

BAELUM, V., MANJI, F., WANZALA, P. & FEJERSKOV, O. (1995) Relationship between CPITN and periodontal attachment loss findings in an adult population. *J Clin Periodontol,* 22**,** 146-52.

BAELUM, V., VAN PALENSTEIN HELDERMAN, W., HUGOSON, A., YEE, R. & FEJERSKOV, O. (2007) A global perspective on changes in the burden of caries and periodontitis: implications for dentistry. *J Oral Rehabil,* 34**,** 872-906; discussion 940.

BATARINGAYA, A., FERGUSON, M. & LALLOO, R. (2005) The impact of ebinyo, a form of dental mutilation, on the malocclusion status in Uganda. *Community Dent Health,* 22**,** 146-50.

BEN-SHLOMO, Y. & KUH, D. (2002) A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. *Int J Epidemiol,* 31**,** 285-93.

BENIGERI, M., BRODEUR, J. M., PAYETTE, M., CHARBONNEAU, A. & ISMAIL, A. I. (2000) Community periodontal index of treatment needs and prevalence of periodontal conditions. *J Clin Periodontol,* 27**,** 308-12.

BOGGESS, K. A. (2008) Maternal oral health in pregnancy. *Obstet Gynecol,* 111**,** 976-86.

BOGGESS, K. A. & EDELSTEIN, B. L. (2006) Oral health in women during preconception and pregnancy: implications for birth outcomes and infant oral health. *Matern Child Health J,* 10**,** S169-74.

BORRELL, L. N., BURT, B. A. & TAYLOR, G. W. (2005) Prevalence and trends in periodontitis in the USA: the [corrected] NHANES, 1988 to 2000. *J Dent Res,* 84**,** 924-30.

BRODER, H. L. & WILSON-GENDERSON, M. (2007) Reliability and convergent and discriminant validity of the Child Oral Health Impact Profile (COHIP Child's version). *Community Dent Oral Epidemiol,* 35 Suppl 1**,** 20-31.

BUCK, D. & NEWTON, J. T. (2001) Non-clinical outcome measures in dentistry: publishing trends 1988-98. *Community Dent Oral Epidemiol,* 29**,** 2-8.

CASAMASSIMO, P. S., THIKKURISSY, S., EDELSTEIN, B. L. & MAIORINI, E. (2009) Beyond the dmft: the human and economic cost of early childhood caries. *J Am Dent Assoc,* 140**,** 650-7.

CIA (2009) The -world-factbook. Washington, D.C.

COHEN, L. K. & JAGO, J. D. (1976) Toward the formulation of sociodental indicators. *Int J Health Serv,* 6**,** 681-98.

COPELAND, L. B., KRALL, E. A., BROWN, L. J., GARCIA, R. I. & STRECKFUS, C. F. (2004) Predictors of tooth loss in two US adult populations. *J Public Health Dent,* 64**,** 31-7.

CORBET, E. F., ZEE, K. Y. & LO, E. C. (2002) Periodontal diseases in Asia and Oceania. *Periodontol 2000,* 29**,** 122-52.

CUNNINGHAM, S. J., GARRATT, A. M. & HUNT, N. P. (2000) Development of a condition-specific quality of life measure for patients with dentofacial deformity: I. Reliability of the instrument. *Community Dent Oral Epidemiol,* 28**,** 195-201.

DASANAYAKE, A. P., GENNARO, S., HENDRICKS-MUNOZ, K. D. & CHHUN, N. (2008) Maternal periodontal disease, pregnancy, and neonatal outcomes. *MCN Am J Matern Child Nurs,* 33**,** 45-9.

DAVENPORT, E. S., WILLIAMS, C. E., STERNE, J. A., MURAD, S., SIVAPATHASUNDRAM, V., CURTIS, M.A. (2002) Maternal periodontal disease and preterm low birth weight: case-control study. *J Dent Res,* 81**,** 313-8.

DE OLIVEIRA, B. H. & NADANOVSKY, P. (2006) The impact of oral pain on quality of life during pregnancy in low-income Brazilian women. *J Orofac Pain,* 20**,** 297-305.

ENGEBRETSEN, I. M., TYLLESKAR, T., WAMANI, H., KARAMAGI, C. & TUMWINE, J. K. (2008) Determinants of infant growth in Eastern Uganda: a community-based cross-sectional study. *BMC Public Health,* 8**,** 418.

FANAS, S. H., OMER, S. M., JABER, M. & THOMAS, S. (2008) The periodontal treatment needs of Libyan school children in Kufra and Tobruk. *J Int Acad Periodontol,* 10**,** 45-9.

FILMER, D. & PRITCHETT, L. (2001) Estimating wealth effects without expenditure data or tears: an application to educational enrollments in states of India. *Demography* 38.

FRENCKEN, J. E., SITHOLE, W. D., MWAENGA, R., HTOON, H. M. & SIMON, E. (1999) National oral health survey Zimbabwe 1995: periodontal conditions. *Int Dent J,* 49**,** 10-4.

GHERUNPONG, S., TSAKOS, G. & SHEIHAM, A. (2004) The prevalence and severity of oral impacts on daily performances in Thai primary school children. *Health Qual Life Outcomes,* 2**,** 57.

GILBERT, G. H., DUNCAN, R. P., HEFT, M. W., DOLAN, T. A. & VOGEL, W. B. (1998) Multidimensionality of oral health in dentate adults. *Med Care,* 36**,** 988-1001.

GREENE, J. C. & VERMILLION, J. R. (1964) The Simplified Oral Hygiene Index. *J Am Dent Assoc,* 68**,** 7-13.

GUGUSHE, T. S. (1998) The influence of socio-economic variables on the prevalence of periodontal disease in South Africa. *SADJ,* 53**,** 41-6.

GUILLEMIN, F., BOMBARDIER, C. & BEATON, D. (1993) Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. *J Clin Epidemiol,* 46**,** 1417-32.

GUSSY, M. G., WATERS, E. B., RIGGS, E. M., LO, S. K. & KILPATRICK, N. M. (2008) Parental knowledge, beliefs and behaviours for oral health of toddlers residing in rural Victoria. *Aust Dent J,* 53**,** 52-60.

HUGOSON, A. & NORDERYD, O. (2008) Has the prevalence of periodontitis changed during the last 30 years? *J Clin Periodontol,* 35**,** 338-45.

HUMPHRIS, G., FREEMAN, R., GIBSON, B., SIMPSON, K. & WHELTON, H. (2005) Oral health-related quality of life for 8-10-year-old children: an assessment of a new measure. *Community Dent Oral Epidemiol,* 33**,** 326-32.

JOHNSON, N. W. (1989) Detection of high-risk groups and individuals for periodontal diseases. *Int Dent J,* 39**,** 33-47.

JOHNSON, R. J. & WOLINSKY, F. D. (1993) The structure of health status among older adults: disease, disability, functional limitation, and perceived health. *J Health Soc Behav,* 34**,** 105-21.

JOKOVIC, A., LOCKER, D., STEPHENS, M., KENNY, D., TOMPSON, B. & GUYATT, G. (2002) Validity and reliability of a questionnaire for measuring child oral-health-related quality of life. *J Dent Res,* 81**,** 459-63.

JOKOVIC, A., LOCKER, D., STEPHENS, M., KENNY, D., TOMPSON, B. & GUYATT, G. (2003) Measuring parental perceptions of child oral health-related quality of life. *J Public Health Dent,* 63**,** 67-72.

KIDA, I. A., ASTROM, A. N., STRAND, G. V. & MASALU, J. R. (2006) Clinical and socio-behavioral correlates of tooth loss: a study of older adults in Tanzania. *BMC Oral Health,* 6**,** 5.

KIKWILU, E. N. & MANDARI, G. J. (2001) Dental caries and periodontal conditions among primary school children in Morogoro municipality, Tanzania. *East Afr Med J,* 78**,** 152-6.

KINANE, D. & BOUCHARD, P. (2008) Periodontal diseases and health: Consensus Report of the Sixth European Workshop on Periodontology. *J Clin Periodontol,* 35**,** 333-7.

KINGMAN, A. & ALBANDAR, J. M. (2002) Methodological aspects of epidemiological studies of periodontal diseases. *Periodontol 2000,* 29**,** 11-30.

KIWANUKA, S. N., ASTROM, A. N. & TROVIK, T. A. (2004) Dental caries experience and its relationship to social and behavioural factors among 3-5-year-old children in Uganda. *Int J Paediatr Dent,* 14**,** 336-46.

LEMBARITI, B. S., VAN'T HOF, M. A., PILOT, T. & VAN PALENSTEIN-HELDERMAN, W. H. (1997) Clinical parameters associated with periodontitis in untreated persons. *East Afr Med J,* 74**,** 427-30.

LOCKER, D. (1988) Measuring oral health: a conceptual framework. *Community Dent Health,* 5**,** 3-18.

LOCKER, D. (2000) Deprivation and oral health: a review. *Community Dent Oral Epidemiol,* 28**,** 161-9.

LOCKER, D., BERKA, E., JOKOVIC, A. & TOMPSON, B. (2007) Does self-weighting of items enhance the performance of an oral health-related quality of life questionnaire? *Community Dent Oral Epidemiol,* 35**,** 35-43.

LOCKER, D., JOKOVIC, A., STEPHENS, M., KENNY, D., TOMPSON, B. & GUYATT, G. (2002) Family impact of child oral and oro-facial conditions. *Community Dent Oral Epidemiol,* 30**,** 438-48.

LOE, H., THEILADE, E. & JENSEN, S. B. (1965) Experimental Gingivitis in Man. *J Periodontol,* 36**,** 177-87.

LOPEZ, R. & BAELUM, V. (2003) Classifying periodontitis among adolescents: implications for epidemiological research. *Community Dent Oral Epidemiol,* 31**,** 136-43.

MANJI, F., BAELUM, V. & FEJERSKOV, O. (1988) Tooth mortality in an adult rural population in Kenya. *J Dent Res,* 67**,** 496-500.

MASALU, J. R. & ASTROM, A. N. (2003) Applicability of an abbreviated version of the oral impacts on daily performances (OIDP) scale for use among Tanzanian students. *Community Dent Oral Epidemiol,* 31**,** 7-14.

MCCORMICK, M. C. (1985) The contribution of low birth weight to infant mortality and childhood morbidity. *N Engl J Med,* 312**,** 82-90.

MCDOWELL, I. & NEWELL, C. (1996) *Measuring health : a guide to rating scales and questionnaires,* New York, Oxford University Press.

MCGRATH, C. & BEDI, R. (2001) An evaluation of a new measure of oral health related quality of life--OHQoL-UK(W). *Community Dent Health,* 18**,** 138-43.

MIURA, H., ARAKI, Y., HARAGUCHI, K., ARAI, Y. & UMENAI, T. (1997) Socioeconomic factors and dental caries in developing countries: a cross-national study. *Soc Sci Med,* 44**,** 269-72.

MIYAZAKI, H., YAMASHITA, Y., SHIRAHAMA, R., GOTO-KIMURA, K., SHIMADA, N., SOGAME, A. & TAKEHARA, T. (1991) Periodontal condition of pregnant women assessed by CPITN. *J Clin Periodontol,* 18**,** 751-4.

MOSER & KALTON (Eds.) (1971) *Survey Methods in Social Investigation,* Hampshire, Ashgate Publishing Limited.

MUHIRWE, L. B. (2006) Oral health in Uganda: the need for a change in focus. *Int Dent J,* 56**,** 3-6.

MUMGHAMBA, E. G., MANJI, K. P. & MICHAEL, J. (2006) Oral hygiene practices, periodontal conditions, dentition status and self-reported bad mouth breath among young mothers, Tanzania. *Int J Dent Hyg,* 4**,** 166-73.

MUMGHAMBA, E. G., MARKKANEN, H. A. & HONKALA, E. (1995) Risk factors for periodontal diseases in Ilala, Tanzania. *J Clin Periodontol,* 22**,** 347-54.

MUMGHAMBA, E. G., MARKKANEN, H. A. & HONKALA, E. (1996) Periodontal status and treatment needs in a rural area of Ukonga, Tanzania. *Int Dent J,* 46**,** 156-60.

MUWAZI, L. M., RWENYONYI, C. M., TIRWOMWE, F. J., SSALI, C., KASANGAKI, A., NKAMBA, M. E. & EKWARU, P. (2005) Prevalence of oral diseases/conditions in Uganda. *Afr Health Sci,* 5**,** 227-33.

NALWEYISO, N., BUSINGYE, J., WHITWORTH, J. & ROBINSON, P. G. (2004) Dental treatment needs of children in a rural subcounty of Uganda. *Int J Paediatr Dent,* 14**,** 27-33.

NEEDLEMAN, I., MCGRATH, C., FLOYD, P. & BIDDLE, A. (2004) Impact of oral health on the life quality of periodontal patients. *J Clin Periodontol,* 31**,** 454-7.

NG, S. K. & LEUNG, W. K. (2006) Oral health-related quality of life and periodontal status. *Community Dent Oral Epidemiol,* 34**,** 114-22.

NGATIA, E. M., GATHECE, L. W., MACIGO, F. G., MULLI, T. K., MUTARA, L. N. & WAGAIYU, E. G. (2008) Nutritional and oral health status of an elderly population in Nairobi. *East Afr Med J,* 85**,** 378-85.

OKULLO, I., ASTROM, A. N., HAUGEJORDEN, O. & RWENYONYI, C. M. (2003) Variation in caries experience and sugar intake among secondary school students in urban and rural Uganda. *Acta Odontol Scand,* 61**,** 197-202.

OSLER, M. (2006) The life course perspective: a challenge for public health research and prevention. *Eur J Public Health,* 16**,** 230.

PAGE, R. C. & EKE, P. I. (2007) Case definitions for use in population-based surveillance of periodontitis. *J Periodontol,* 78**,** 1387-99.

PAHEL, B. T., ROZIER, R. G. & SLADE, G. D. (2007) Parental perceptions of children's oral health: the Early Childhood Oral Health Impact Scale (ECOHIS). *Health Qual Life Outcomes,* 5**,** 6.

PETERSEN, P. E., BOURGEOIS, D., OGAWA, H., ESTUPINAN-DAY, S. & NDIAYE, C. (2005) The global burden of oral diseases and risks to oral health. *Bull World Health Organ,* 83**,** 661-9.

PETERSEN, P. E. & KAKA, M. (1999) Oral health status of children and adults in the Republic of Niger, Africa. *Int Dent J,* 49**,** 159-64.

PETERSEN, P. E. & OGAWA, H. (2005) Strengthening the prevention of periodontal disease: the WHO approach. *J Periodontol,* 76**,** 2187-93.

POLIT, D. F. & HUNGLER, B. P. (1991) *Nursing research : principles and methods,* Philadelphia, Lippincott.

ROBINSON, P. G., NALWEYISO, N., BUSINGYE, J. & WHITWORTH, J. (2005) Subjective impacts of dental caries and fluorosis in rural Ugandan children. *Community Dent Health,* 22**,** 231-6.

RUSSELL, S. L., ICKOVICS, J. R. & YAFFEE, R. A. (2008) Exploring potential pathways between parity and tooth loss among American women. *Am J Public Health,* 98**,** 1263-70.

SABBAH, W., TSAKOS, G., CHANDOLA, T., SHEIHAM, A. & WATT, R. G. (2007) Social gradients in oral and general health. *J Dent Res,* 86**,** 992-6.

SCHELLENBERG, J. A., VICTORA, C. G., MUSHI, A., DE SAVIGNY, D., SCHELLENBERG, D., MSHINDA, H. & BRYCE, J. (2003) Inequities among the very poor: health care for children in rural southern Tanzania. *Lancet,* 361**,** 561-6.

SCHERP, H. W. (1964) Current Concepts in Periodontal Disease Research: Epidemiological Contributions. *J Am Dent Assoc,* 68**,** 667-75.

SCHEUTZ, F., BAELUM, V., I.M., M. & MWANGOSI, I. (2002) Motherhood and dental disease. *Community Dent Health,* 19**,** 67 - 72.

SGAN-COHEN, H. D. & MANN, J. (2007) Health, oral health and poverty. *J Am Dent Assoc,* 138**,** 1437-42.

SLADE, G. D. (1997a) Derivation and validation of a short-form oral health impact profile. *Community Dent Oral Epidemiol,* 25**,** 284-90.

SLADE, G. D. (1997b) *Measuring oral health and quality of life : proceedings of a conference held June 13-14, at the University of North Carolina-Chapel Hill, North Carolina,* Chapel Hill, N.C., Department of Dental Ecology, School of Dentistry, University of North Carolina.

SLADE, G. D. & SPENCER, A. J. (1994) Development and evaluation of the Oral Health Impact Profile. *Community Dent Health,* 11**,** 3-11.

SLADE, G. D., STRAUSS, R. P., ATCHISON, K. A., KRESSIN, N. R., LOCKER, D. & REISINE, S. T. (1998) Conference summary: assessing oral health outcomes--measuring health status and quality of life. *Community Dent Health,* 15**,** 3-7.

STREINER, D. L. & NORMAN, G. R. (2003) *Health measurement scales : a practical guide to their development and use,* Oxford, Oxford University Press.

TAIWO, J. O., JEBODA, S. O., MOTAYO, T. O. & OBIECHINA, A. E. (2004) Periodontal health of the elderly people in South East local government area in Ibadan, Nigeria. *Afr J Med Med Sci,* 33**,** 285-91.

THORPE, S. (2006) Oral health issues in African Region: Current Situation and Future Perspectives. *Journal of Dental Education,* 70**,** 8-15.

TIMOTHE, P., EKE, P. I., PRESSON, S. M. & MALVITZ, D. M. (2005) Dental care use among pregnant women in the United States reported in 1999 and 2002. *Prev Chronic Dis,* 2**,** A10.

TSAKOS, G., STEELE, J. G., MARCENES, W., WALLS, A. W. & SHEIHAM, A. (2006) Clinical correlates of oral health-related quality of life: evidence from a national sample of British older people. *Eur J Oral Sci,* 114**,** 391-5.

TAANI, D. Q., HABASHNEH, R., HAMMAD, M. M. & BATIEHA, A. (2003) The periodontal status of pregnant women and its relationship with socio-demographic and clinical variables. *J Oral Rehabil,* 30**,** 440-5.

UBOS (2007) Uganda Demographic and Health Survey 2006. Claverton, Maryland., Uganda Bureau of Statistics (UBOS) and Macro International Inc.

VARENNE, B., PETERSEN, P. E. & OUATTARA, S. (2004) Oral health status of children and adults in urban and rural areas of Burkina Faso, Africa. *Int Dent J,* 54**,** 83-9.

WAMANI, H., ASTROM, A. N., PETERSON, S., TUMWINE, J. K. & TYLLESKAR, T. (2006) Predictors of poor anthropometric status among children under 2 years of age in rural Uganda. *Public Health Nutr,* 9**,** 320-6.

WANDERA, M. & TWA-TWA, J. (2003) Baseline survey of oral health of primary and secondary school pupils in Uganda. *Afr Health Sci,* 3**,** 19-22.

WHO (1980) *International classification of impairements disabilities and handicaps: a manual of classification,* Geneva, World Health Organization.

WHO (1997) *Oral Health Surveys. Basic Methods.,* Geneva.

WHO (2007) The WHO Child Growth Standards.

WHO (2009a) Immunization surveillance, assessment and monitoring

WHO (2009b) WHO Statistical Information Systems.

WHO/UNICEF (Ed.) (2004) *Low birthweight: country, regional and global estimates,* New York, United Nations Children's Fund and World Health Organization.

WHOSIS WHO Statistical Information System

WILSON, I. B. & CLEARY, P. D. (1995) Linking clinical variables with health-related quality of life. A conceptual model of patient outcomes. *JAMA,* 273**,** 59-65.

WIMMER, G. & PIHLSTROM, B. L. (2008) A critical assessment of adverse pregnancy outcome and periodontal disease. *J Clin Periodontol,* 35**,** 380-97.

AAP (2001) *Glossary of definitions for periodontal terms,* Chicago, The American Academy of Periodontology.