



**UNIVERSITY
OF TURKU**

AVAILABILITY, ATTITUDES AND COSTS OF SELECTED DENTAL SERVICES IN A LOW-INCOME COUNTRY

Kasusu Klint Nyamuryekung'e



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The originality of this thesis has been checked in accordance with the University of Turku quality assurance system using the Turnitin OriginalityCheck service.

ISBN 978-951-29-7674-4 (PRINT)
ISBN 978-951-29-7675-1 (PDF)
ISSN 0355-9483 (Print)
ISSN 2343-3213 (Online)

Grano Oy - Turku, Finland 2019

*To Adelyne, Killian and Katriel;
for staving off the procrastination temptress.*

ABSTRACT

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Availability, attitudes and costs of selected dental services in a low-income country

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Turun yliopiston julkaisu – Annales Universitatis Turkuensis, Turku, 2019

The aim of this study was to determine the availability of selected dental services, attitudes towards such services and economic factors associated with their utilization in a low-income country.

Data utilized for this study was collected in two phases. Phase I was a survey of all dental facilities in four selected regions in Tanzania. The survey was administered to officers-in-charge of dental facilities and other dental practitioners working within these facilities. Phase II was a series of cross-sectional studies conducted among outpatients attending four selected regional hospitals in Tanzania. Data was collected using self-administered questionnaires.

Dental materials and equipment were inconsistently available and only 3/28 studied dental facilities had all the seven investigated equipment fully functional and in use. The self-rated competency among dental practitioners ranged from 6.4 to 9.8 for all six procedures questioned, but equal scores between cadres were only for tooth extractions (9.7 vs. 9.1 respectively). Competencies for placing restorations were all rated lower by other cadres (p varied from $< .05$ to $< .001$). Most of the patients had a negative overall attitude (-1.99) towards tooth filling treatment although those with previous tooth filling experience had positive attitudes (1.00). The mean willingness-to-pay (WTP) values for tooth filling (7,398 and 7,726 Tshs for anterior and posterior teeth, respectively) were higher ($p < 0.001$) than for tooth extraction irrespective of tooth type (5,448 and 6,188 Tshs, respectively). Being 45+ years increased the likelihood to offer lower WTP values. More than half (55%) of the patients would experience significant financial impacts as a result of their utilization of dental services.

The findings clearly suggest that there are a multitude of factors that influence the observed dental treatment patterns being predominated by tooth extractions in Tanzania.

Keywords: Willingness-to-pay, costs, dental services, attitudes, Tanzania

TIIVISTELMÄ

Kasusu Klint Nyamuryekung'e

Valikoitujen hammashoitopalvelujen saatavuus, niihin liittyvät asenteet ja käytön kustannukset vähävaraisessa maassa

Turun yliopisto, Lääketieteellinen tiedekunta, Hammaslääketieteen laitos, Sosiaalihammaslääketieteen oppiaine, Kansallinen suun terveystieteiden tohtoriohjelma (FINDOS-Turku)

Turun yliopiston julkaisuja – Annales Universitatis Turkuensis, Turku, 2019

Tutkimus selvitti valikoitujen hammashoitopalveluiden saatavuutta sekä niihin liittyviä asenteita ja käyttöön liittyviä taloudellisia tekijöitä vähävaraisessa maassa.

Ensin tehtiin kyselytutkimus kaikissa hammashoitopalveluja tarjoavissa yksiköissä neljällä valitulla tansanialaisella hallintoalueella näiden yksiköiden johtajien ja hammashoitoa antavien työntekijöiden keskuudessa. Toiseksi toteutettiin sarja poikkileikkaustutkimuksia kyselyin näiden neljän hallintoalueen avohoitopotilaiden keskuudessa. Kyselyissä selvitettiin valikoitujen hammashoitopalvelujen kustannuksia, hammashoitomateriaalien ja -laitteiden saatavuutta, hammashoidon työntekijöiden kokemia valmiuksia, potilaiden asenteita ja maksuhalukkuutta paikkaushoittoon sekä potilaille hammashoidosta aiheutuviin kustannuksiin.

Materiaaleja ja laitteita oli vaihtelevasti saatavilla. Vain kolmessa tutkitusta 28 hoitolasta kaikki seitsemän tutkimuksessa tarkasteltua laitetta olivat käytössä ja toimintakunnossa. Hammaslääkärin kokemat valmiudet toimenpiteisiin vaihtelivat (6,4–9,8) ja olivat saman tasoisia muiden ammattiryhmien kanssa vain poistoissa (9,7 vs. 9,1). Paikkausvalmiudet olivat alempia muilla ammattiryhmillä ($p < 0,05$ – $< 0,001$). Useimmilla potilailla oli negatiivinen kokonaisasenne (-1,99) paikkaushoittoon. Heillä, joilla oli aiempaa kokemusta paikkaushoidosta, oli positiivinen asenne (1,00). Paikkaushoidon maksuhalukkuuden keskiarvot olivat huomattavasti korkeammat (7398 Tansanian shillinkiä (Tshs) etualueella ja 7726 Tshs taka-alueella) kuin hammaspoistojen maksuhalukkuuden (5448 Tshs etualueella ja 6188 Tshs taka-alueella, $p < 0,001$). Hammashoitopalvelujen käyttö aiheutti yli puolelle (55 %) tutkituista potilaista merkittäviä taloudellisia vaikutuksia.

Tulokset osoittavat selvästi, että Tansaniassa monet tekijät vaikuttavat hammashoitopalvelujen tuotantoon, jota hallitsevat hampaiden poistot.

Avainsanat: Maksuhalukkuus, kustannukset, hammashoitopalvelut, asenteet, Tansania

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ABBREVIATIONS

ANOVA	Analysis of variances
CHE	Catastrophic health expenditures
CI	Confidence intervals
CVM	Contingent valuation methods
DRC	Daily resources for consumption
GDP	Gross domestic product
LMIC	Low-mid income countries
SFI	Significant financial impacts
Tshs	Tanzanian Shillings
US\$	United States dollars
WHO	World Health Organization
WTP	Willingness-to-pay

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following articles, which are referred to in the text by the Roman numerals I-IV.

Paper I: Nyamuryekung'e KK, Lahti SM, Tuominen RJ. The relative patient costs and availability of dental services, materials and equipment in public oral care facilities in Tanzania. *BMC Oral Health*. 2015 Dec;15(1):74.

Paper II: Nyamuryekung'e KK, Lahti SM, Tuominen RJ. Attitudes towards tooth fillings in Tanzanian adults and its association with previous filling experience. *BMC Oral Health*. 2018 Dec;18(1):12.

Paper III: Nyamuryekung'e KK, Lahti SM, Tuominen RJ. Patients' willingness to pay for dental services in a population with limited restorative services. *Community Dental Health*. 2018 Aug;35(3):167-172

Paper IV: Nyamuryekung'e KK, Lahti SM, Tuominen RJ. Costs of accessing dental services and its financial impacts to patients in a population with limited oral health care services. In press *Community Dental Health*. 2018

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1 INTRODUCTION

Low-mid income countries (LMIC) are so-called as a reflection of their limited financial resources as measured by their gross domestic products (GDP). The vast majority of countries classified as “low-income” are found in sub-Saharan Africa (Fantom, and Serajuddin, 2016). These countries experience a high proportion of the global disease burden, but also have the lowest proportion of human resources for health. Furthermore, as an indirect consequence of the World Bank policy in the 1980s which advocated for introduction of user fees as a means of sustainable financing of the health systems in these countries, the vast majority rely overwhelmingly on out of pocket payments, cash payments at the point of health service, for financing their health systems (Whitehead *et al.*, 2001).

It has been shown that in settings where large proportions of the population are poor, a requirement of cash in lieu of access to healthcare may lead to accessibility issues. One can expect that the poor people particularly may face economic burden because of required out-of-pocket payments for health care services (Wagstaff *et al.*, 2018). Many people in LMIC only go to health facilities after a prolonged period of wait-and-see. Their first choices when seeking health care may be traditional healers and over the counter drugs from pharmacies. This is usually due to lack of, and uncertainty regarding the amount of money that would be required to obtain treatment for their health problem, coupled with low levels of understanding of their ailment and the corresponding care, which may result into poor attitudes towards available health care.

Even if the patients in these countries do overcome these formidable financial hurdles and manage to attend health facilities, they are not guaranteed of the best care. Low-level health facilities within LMIC may experience frequent medication and equipment stock-outs, are understaffed and lack the necessary investigative tools. The most prevalent dental ailments, dental caries and periodontal diseases, are not frequently associated with mortality. Thus, in many cases, and as a consequence of need of maximization of limited resources, policy-makers may overlook oral health; despite their strong interconnectedness to general health and significant contribution to quality of life.

Due to these factors, tooth extractions in LMIC constitute the vast majority of dental care instituted to the served populations, despite significant resources invested in the training of oral health care professionals and establishment of dental care facilities.

Consequently, patients may not reap the full benefits conferred by oral health practitioners, and one could describe these dental care facilities as graveyards of teeth (Petersen and Bourgeois, 2005; Kandelman *et al.*, 2012).

2 REVIEW OF LITERATURE

2.1 Oral health systems

2.1.1 Oral health systems in low-mid income countries: an overview

An oral health system consists of all organizations, people and actions primarily tasked with promotion, restoration or maintenance of oral health. To function optimally, it requires human resource, finances, information, supplies, transport, communication networks and overall stewardship (WHO, 2007). General health systems contain within it also the framework for provision of dental care services within the served populations. An appropriate oral health care system is expected to focus on disease control, prevention and health promotion to maintain health and function of the mouth and adjacent structures (Kandelman *et al.*, 2012). Low-mid income countries (LMIC) have the largest burden of diseases worldwide and the least amount of resources required for their health systems in order to fulfil and address their health challenges (Boutayeb, 2006).

Large proportions of illnesses in LMIC are either avoidable or treatable with available medications and interventions. Thus, the overwhelming disease burden is considered primarily as a consequence of poverty: poor nutrition, sanitation and hygiene, indoor air pollution and lack of health education (Stevens, 2004). About 90% of the deaths and disability arising due to diseases that may be linked with poverty occur in rural areas of Sub Saharan Africa (Bhutta *et al.*, 2014). A systematic review on the global impact of oral diseases reveals that the burden has been increasing in the last 25 years. The number of people with untreated oral conditions has risen from 2.5 billion in 1990 to 3.5 billion in 2015. A greater than 100% increase in disease burden due to oral conditions has been observed in four regions in Africa and three regions in South America between 1990 and 2015. Total tooth loss was the leading cause of disability adjusted life-years associated with oral conditions in 19 of the 21 studied regions (Kassebaum *et al.*, 2017).

Poor oral health has been identified worldwide as a significant public health problem (Petersen and Bourgeois, 2005; Marcenes *et al.*, 2013). Despite the impact of oral diseases in terms of pain and suffering, impairment of function, and reduced quality of life of individuals and communities, oral diseases still do not constitute a priority for health authorities of many low-income African countries (Abid *et al.*, 2015). Furthermore, oral disease and illness remain widely-encompassing problems affecting different strata of populations along socio-economic lines, leading to widening inequity in oral health status both within and across countries (Petersen and Kwan, 2011). There is an unequal distribution of oral diseases with

the most disadvantaged populations affected the most. More than 90% of dental caries in LMIC remains untreated and the poorest have the largest proportion of this unmet treatment need (Williams *et al.*, 2015). In many LMIC, oral pain and discomfort is common, and dental visits are predominantly symptomatic (Okunseri *et al.*, 2004; Varenne *et al.*, 2006; Kikwilu *et al.*, 2008b). Oral health services are typically provided in relatively well-established hospitals where there is less importance given to preventive and restorative care, compared to health centres, dispensaries and clinics (Achembong *et al.*, 2012; Ogunbodede *et al.*, 2015). Additionally, management of existing services and resources has been described as inadequate. In many LMIC, under the considerable burden of infectious diseases, health care financing programs do not give sufficient priority to oral health (Kandelman *et al.*, 2012).

2.1.2 Patient factors in utilization of oral health services

The Andersen's behavioural model for utilization of health services is one of the most frequently used frameworks for analysis of factors associated with patient utilization of health-care services (Andersen *et al.*, 1983). The context through which utilization occurs is an important factor in enabling or discouraging the intended health behaviour. Additionally, the environment and provider-related factors play a determining role in influencing healthcare utilization (Phillips *et al.*, 1998). However, modification of health-related behaviours remains a complex and time-consuming task. Usually, such attempts have mild effects in public health settings, with most of the behaviour-modification theories applied in public health situations emphasizing individuals' motivation and abilities. The role of context and social factors in shaping such behaviours is often overlooked in the applied interventions (Davis *et al.*, 2015). This is despite the social environment having been identified as the major determinant towards enabling behaviours and behavioural change in health (Watt *et al.*, 2015).

Attitude can be defined as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour" (Eagly and Chaiken, 1993). Conscious and non-conscious attitudes both play a role towards effecting behaviours, as long as the environmental and other external factors allow for it (Ajzen, 1996). Oral health attitudes can therefore be defined as those factors determining individual's translation, motivations and behaviours towards maintaining their oral health (Albarracín *et al.*, 2005). Favourable oral attitudes have been shown to increase the number of preventive and restorative dental visits and to decrease the prevalence of dental symptoms (Riley *et al.*, 2006). Education may increase awareness of cause-effect relationship between certain behaviours and health outcomes. Therefore, its provision is one of the ways through which behaviours may be altered (Khanagar *et al.*, 2014). According to Hubley (2006), education is one of the least resource intensive means to bring behavioural change and there is ample evidence that it works even in resource-constrained environments. Some of the behaviours which have been shown to

negatively affect health include smoking, excessive consumption of alcohol, inadequate physical activities and poor hygiene (Sheiham and Watt, 2000).

Patient satisfaction is a key determinant of future utilization of oral health services (Ntabayeet *et al.*, 1998). It is surmised that satisfaction may help in reinforcing the positive outlook associated with service given (Homburget *et al.*, 2005). Inter-personal interaction with the dental care practitioner has been identified as one of the key factors towards establishment of satisfaction with dental care amongst adolescents and adults in rural and urban areas of low-income countries (Ntabaye *et al.*, 1998; Okullo *et al.*, 2004). On the other hand, the practitioner-related factors including treatment choices, preferences for patients and demographic characteristics have also been shown to influence dental patients' treatment patterns and subsequent satisfaction (Brennan and Spencer, 2005).

According to Wallace and McEntee (2012), there may be instances whereby there is a poor-fit between the provided dental services and public health needs of low-income individuals. The need for provision of fees-for-service may be problematic for these individuals due to their continual sensitivity to the amount of expenditure required in obtaining whatever kind of care they are prescribed by the dental practitioners.

Published studies of dental patient satisfaction and attitudes in LMIC are scarce; however, amongst dental patients in Tanzania, more than three-quarters reported satisfaction with the dental care received (Mwela and Kikwilu, 2013). Treatment time, cost of treatment and waiting times were considered by the patients as the least satisfying aspects of their received care. Worth noting is the finding that patients receiving restorative care were generally less satisfied compared to those receiving oral-surgical treatment. Furthermore, dental attitudes have been shown to be better in urban rather than in rural residents in Tanzania and Burkina Faso (Varenneet *et al.*, 2004; Kikwilu *et al.*, 2008a). It has been suggested that people living in rural areas are likely to be poorer, be older, be health illiterate, have more caries, have fewer teeth, and have less money to spend on dental care than persons living in urban areas (Ettinger, 2007).

2.1.3 Oral health services and utilization in Tanzania

Dental caries is the foremost reason of dental attendance in oral facilities in Uganda, Kenya, Sudan and others (Okulloet *et al.*, 2004; Sanya, 2004; Petersen and Bourgeois, 2005; Khalifa and Allen, 2012). Despite the strong association between tooth retention and oral health-related quality of life, restorative care has made very little impact on oral health care delivery in many LMIC (Tan *et al.*, 2016). In Tanzania, tooth extractions due to dental caries account for over 90% of all forms of dental treatment, and restorative work for less than 5% (Mandari

and Matee, 2006). This pattern of dental care being predominantly tooth extractions is replicated in several LMIC in Africa including Tanzania, Kenya, Sudan and Nigeria (Mosha and Scheutz, 1993; Okunseriet *et al.*, 2004; Sanya, 2004; Khalifa and Allen, 2012). The reasons for such skewed treatment profile have been stated to be many, including limited practical training and practice in restorative care, scarcity of resources and absence of any kind of advocacy (Mandari and Matee, 2006; Petersen and Bourgeois, 2005).

Dental materials and equipment availability are necessary for delivery of comprehensive dental care (Ferracane *et al.*, 2013). There is compelling evidence indicating that many of the dental facilities in LMIC have insufficient materials, equipment and staff to successfully carry out restorative services when indicated (Kikwilu *et al.*, 2009a; Kandelman *et al.*, 2012; Williams *et al.*, 2015). Furthermore, there are insufficient financial resources available within the oral health care systems of many LMIC to facilitate provision of required restorative care (Yee and Sheiham, 2002; Kandelman *et al.*, 2012).

In the last decades, there have been noted improvements in education, human development and health status of LMIC populations (Rosling *et al.*, 2018). However, there remained large disparities across and within countries. There were clear discrepancies between the advantaged and the disadvantaged groups (Boutayeb and Helmert, 2011). Furthermore, there was a lack of importance given to oral health and its relationship with general health and well-being was not given the attention it deserves (Artnik, 2007). This has implications for the type of services provided, priority of funding, program sustainability and population age groups to be served (Petersen and Bourgeois, 2005). In developing countries, data on oral diseases and availability of oral services are scarce because of either limited economic resources or the absence of trained investigators. Additionally, the decision makers, administrators and politicians may lack the understanding required to make informed decisions on dental care issues (Kandelman *et al.*, 2012).

A nationally-representative survey in Tanzania by Kikwilu and co-workers (2008b) revealed that 59% of the respondents had suffered from oral pain and/or discomfort within the twelve months that preceded the study, but only 26.5% of these had sought treatment from oral health care facilities. The reasons for not seeking emergency care were primarily due to lack of money to pay for treatment (27.9%) and self-medication (17.6%). Another study showed that large proportion (80%) of Tanzanian dental patients who had toothache had experienced five or more toothache episodes before they sought dental care. Reasons for such delays were use of traditional medicine (43.8%) and financial constraints (25.0%) (Kusekwa and Kikwilu, 2011).

Nevertheless, dental practitioners in Tanzania reported largely positive attitudes towards restorative care (Kikwilu *et al.*, 2009b). Their intent to engage in provision of restorative care

was shown to be strongly influenced by social pressure through usage of a self-administered questionnaire based on the Theory of planned behaviour (Godin and Kok, 1996). Additionally, patient preferences and socioeconomic factors play major roles in determining the utilization of dental services (Wallace and MacEntee, 2012). The use of traditional healers and self-medication remain one of the first care seeking methods in developing countries (Suraratdechaet *et al.*, 2005; Kusekwa and Kikwilu, 2011).

2.2 Economic valuation of health services

2.2.1 Willingness-to-pay (WTP): methodological aspects

The contingent valuation method (CVM) is a survey-based, hypothetical and direct method to determine monetary valuations for effects of health interventions (Klose, 1999). It is based upon cost-benefit analysis technique and the principle that individual consumers are the relevant sources for making such monetary valuations (Drummond *et al.*, 2005). CVM involves constructing a hypothetical market for a commodity and asking individuals directly the maximum amount they are “willing-to-pay” (WTP) to have the commodity in question or the minimum amount they would be ‘willing-to-accept’ in compensation to be deprived of it (Smith, 2003). Hence in contingent valuation studies consumers are asked to consider what they would be willing to sacrifice in terms of other commodities, for the explained benefits if they were available in the marketplace (Brien and Gafni, 1996). Therefore, WTP studies are one of the ways through which contingency valuation surveys can be conducted.

There are multiple survey and questionnaire techniques which can be used in CVM to determine estimates of the willingness of individuals to pay for the service under consideration. These include bidding games, payment card method, discrete choice experiments, standard gamble and open-ended questions (Birch and Ismail, 2002). The “amounts” proposed by the respondents can therefore be highly dependent on the constructed, hypothetical scenarios presented to them (Smith, 2003). A well-detailed and realistic CVM scenario helps to inform the respondents on the commodity or health service to be valued and thus enables respondents to make better informed, and hopefully, more reliable and valid choices (Neumann *et al.*, 1994). The WTP elicitation scenario has to be made as realistically as possible, approximating the actual purchase context. The entire validity and usefulness of a WTP survey might hinge solely on the “believability” of the presented situation to the targeted respondents (Wertenbroch and Skiera, 2002).

Although several imperfections exist within the WTP methodology, it is frequently utilized within the research community. Furthermore, WTP studies can provide information to pol-

icy-makers on the intensity of individuals' preferences for particular health programmes (Drummond *et al.*, 2005). While health state utility scales are constrained by the same maximum value of 1 ('best imaginable health') for each individual, WTP scales do not have such a uniform upper limit. It is constrained by the respondent's budget, which will vary among income groups (Blumenschein *et al.*, 2008). Therefore, WTP is not an income-neutral preference scale. In theory, as long as WTP depends on ability to pay, those with a greater ability to pay will be able to express a greater WTP. This highlights a potential shortcoming of the WTP method, and the need to ensure that WTP values are considered and adjusted for income. Nevertheless, income sensitive WTP values have also been shown to be strength of the method in several cases too, depending on the chosen approach (Olsen and Smith, 2001).

According to Klose (1999), a number of biases have been identified in the process of elicitation of WTPs. The commonest one is a family of biases known as the "response effect bias". This bias is subdivided into "incentives to misrepresent responses", "implied values cues" and "scenario misspecifications". Incentives to misrepresent responses may occur when respondents state a WTP amount which differs from their true WTP amount because of strategic reasons, or as an attempt to comply with expectations of interviewers. If the subjects believe that their responses will be used to set long-term prices, they may undervalue their valuations. Likewise, if they end up believing that they may lead to an introduction of a desirable product, they may overstate their valuations. Implied value cues biases occur, when the contingent market scenario provides or is interpreted to provide information of a correct value. Scenario misspecification biases occur, when the scenario is not understood by respondents as intended. According to Nunes and Boatwright (2004), internal and external reference prices may affect consumer perceptions and consequently the price that consumers are willing to pay for a product or service. By serving as anchors, such "incidental" prices may inadvertently alter a consumer's willingness to pay for an item that he or she intends to buy. Previous and present prices of close substitutes may affect internal reference prices, or customers' expectation of a reasonable price level.

Despite the possibility of biases in the WTP method, it remains a valid tool in measuring the intensity and direction of preferences among available health alternatives. Provided that its limitations are considered during the study design and appropriate steps are taken to adequately mitigate them, it is an invaluable tool in assessment of individuals and communities' economic valuation of healthcare benefits.

2.2.2 WTP in health care context

The WTP method has proven successful in the assessment of severity of symptoms and functional difficulties associated with rheumatoid arthritis. It was successfully able to correlate the disease impact of the symptoms to the monetary valuation offered (Tuominen *et al.*, 2011). It has also been found to be a valid and reliable in the assessment of patients with hyperhidrosis. However, it was shown to be incapable of tracking changes in health states (Müller and Augustin, 2013). In a different study investigating the purchase of insecticide treated nets, WTP could accurately predict at 80% level those that had reported their hypothetical WTPs to the actual purchase of the nets being sold at the stated WTP price. Thus, WTP was demonstrated to accurately predict real-life purchasing behaviour (Onwujekwe *et al.*, 2001).

There have been several studies on health care conducted in Tanzania utilizing CVM. Patients desiring cataract surgery were interviewed to learn how much they and their families were willing to pay for surgery and how “wealthy” (using ownership of several household objects as a proxy for wealth) the household was. Some of the patients within the study had already received “free” surgical services, and thus their baseline value for the service was effectively zero. This is typified by about two-thirds of the responses reporting that they would pay nothing for the service. However, considering the impoverished nature of the respondents, there may have been strategic response bias- with the belief that if they provide low WTP valuations, then the service will be priced similarly in the future (Lewallen *et al.*, 2006).

Another study by Wiseman and co-authors (2005) sought to determine the WTP for azithromycin treatment for control of trachoma in central Tanzania. About one-third reported not to be willing to pay anything for the treatment, although they were willing to participate in the treatment. It appears as if for a substantial proportion of the population, whether through being provided with insufficient information or methodological deficiencies of the survey, there was a lack of understanding in the distinction between valuing a programme in monetary terms and stating a price in order to purchase/obtain health care (Wiseman *et al.*, 2005). There was some positive correlation between the disease impact (resistance to monotherapy for trachoma) and indicators of wealth to stated WTP values. However, the average obtained WTP for both of these studies was far below the actual cost of providing the service. The finding of low obtained WTPs in relation to the actual estimated end-user prices has also been reported in Uganda (Hansen *et al.*, 2013).

Thus, it has been suggested that in studies that try to establish hypothetical versus actual WTP, careful debriefing of the respondents to better understand their decision-making process is invaluable (Onwujekwe *et al.*, 2005). Nevertheless, WTP valuations remain important

in displaying the relative importance of one commodity over another, as well as the magnitude of differences in preferences between available alternatives (Hanley *et al.*, 2003).

2.2.3 WTP in Dentistry

WTP format has been utilised in various settings and situations in dentistry. Nevertheless, there were no previous retrievable studies that have explored WTP for dental services within the Tanzanian or African context (Table 1). Nair and Yee (2016) conducted a study in Singapore to determine elderly patients' willingness to pay for tooth extraction, filling and cleaning of teeth. They utilized a bidding technique to elicit willingness to pay. Conforming to the critique regarding starting point bias; none of the respondents suggested any amount higher than the chosen starting points. The effect of starting bidding points serving as an evaluation ceiling was also demonstrated by Leung and McGrath (2010) when evaluating preferences for tooth replacements In Hong Kong.

Another study was conducted in Finland to determine the ability and willingness to pay for unexpected dental restorative treatment. Most of the respondents were willing to pay for the smallest amount indicated, and thus public dental services were shown to improve equity in people with low incomes (Widström and Seppälä, 2012). Social desirability of dental fear treatment has also been investigated using WTP format. It revealed that the WTP might change dramatically before and after receiving the studied intervention (Halvorsen and Willumsen, 2004). Preferences in paying for dental gels, implant therapy and implant overdentures have also been studied using WTP format (Matthews *et al.*, 2002; Esfandiari *et al.*, 2009; Leung and McGrath, 2010). The WTP method has also been utilized in Thailand to determine preferences of provided dental services based on differences in settings from which the dental services are provided (Tianviwat *et al.*, 2008).

Cunningham *et al.* (2000) in their study amongst patient undergoing orthognathic treatment showed that WTP and utility were correlated, suggesting that WTP may be used as a measure of preference in dentistry. A preference for dentin regeneration therapy, which is currently unavailable treatment option, has also been evaluated using WTP (Birch *et al.*, 2004). Although Halvorsen and Willumsen (2004) were able to show a positive correlation between WTP and ability to pay, other studies have had contrary results. When assessing patient preferences for management of nonvital molars and application of a caries-prevention intervention, a large variance was noted in the obtained WTP values (Vernazza *et al.*, 2015a). Although WTP were able to accurately predict 63 % of real-life preferences of the patients based on their WTP, the remaining acted contrary to their stated WTP(Vernazza *et al.*, 2015b). Therefore, when comparing hypothetical to real preferences, both over- and under-valuation occurs.

Table 1: Studies utilizing WTP in dentistry, published between 2000 and 2018

Authors ¹	Year	Sample size	Method of WTP elicitation	Location
Re	2018	50	Bidding game	Italy
Sever	2018	265	DCE ²	Croatia
Vernazza	2018	401	Payment card	UK ³
Mubaraki	2017	155	Bidding game	Saudi Arabia
Re	2017	103	Bidding game	Italy
Sendi	2017	16	Bidding game	Switzerland
Farronato.	2016	83	Bidding game	Italy
McKenna	2016	55	Payment card	UK
Nair	2016	83	Bidding game	Singapore
Vernazza	2015a	503	Payment card method	UK
Vernazza	2015b	105	Payment card method	UK/Germany
Augusti	2014	107	Bidding game	Italy
Srivastava	2014	39	Payment card	Canada
Moshkelgosha	2013	200	Open-ended	Iran
Al Garni	2012	100	Bidding game	Saudi Arabia
Widström	2012	704	Open-ended	Finland
Leung	2010	59	Bidding	Hong Kong
Manickam	2010	400	Open-ended	India
Esfandiari	2009	36	Payment card	Canada
Tianviwat	2008	205	Bidding game	Thailand
Atchison	2007	203	Standard Gamble and Bidding game	United States of America
Oscarson	2007	82	Open-ended	Sweden
Birch	2004	611	Open-ended	Canada
Halvorsen	2004	65	Open-ended	Norway
Matthews	2002	293	Bidding game	Canada
Cunningham	2000	40	Payment card and Standard Gamble	UK

¹Referred by first author only²Discrete choice experiment³United Kingdom

2.2.4 *Influence of user fees on healthcare utilization*

Analysis of the national health accounts of 191 WHO member states was conducted to describe the spending on health and means of financing these expenditures by the states. It showed that whereas in LMIC the total health spending is about 2-3% of the GDP, it was generally 8-9% in high income countries. Therefore, those states with the poorest health indicators also devoted the least amount of resources towards health care services. Further, there was a wide variation in spending for healthcare both across low- and high-income countries (Musgrove, 2002). Makinen and co-authors (2002) examined the distribution of service use and health expenditures in eight LMIC and highlighted some of these differences. Richer groups were found to have a higher probability of obtaining care when sick, to be seen by a doctor, and to receive medicines when ill, compared to the poorer groups. Additionally, the poor countries and population groups were shown to have the least social protection by any form of prepayment or risk-sharing mechanisms (McIntyre, 2007). Within populations with low incomes, out-of-pocket expenditure is high on average and varies from 20–80% of the total health expenses incurred by the people utilizing such care (Carrin, 2001).

User fees are a form of out-of-pocket payment structure in health care whereby the patients have to pay some amount of money at the health facility in order to obtain health care (Gilson, 1997). A large study conducted amongst 39 countries with emerging markets and developing economies provides compelling evidence against the rationale of user fees. It revealed that the introduction of user fees had increased revenues only modestly, but significantly reduced the access of low-income and underprivileged people to basic social and health services (Whitehead *et al.*, 2001). When assessing the impact of health expenditures, it was revealed that smaller proportions used dental services compared to medicines and outpatient care (Bernabé *et al.*, 2017). According to the authors this raises two possible interrelated possibilities; the lower availability of dental services or that dental costs per visit may be so high that the households actively avoid them.

Another review was conducted by Lagarde and Palmer (2008) to assess the impact of user fees on utilization of health services in LMIC. Removal or reduction of user fees was found to increase the utilization of treatment and preventive services; however, it was also shown to negatively impact service quality, espe-

cially in situations where the supplementing sources of health finances are to be derived from the LMIC governments. On the other hand, introduction or removal of user fees was associated with rapid and immediate changes to the service utilization patterns. Matee and Simon (2000) conducted a study in Tanzania to compare dental attendance and service utilization a year before and after introduction of user fees. There was a noted 33% reduction in dental attendance after the introduction of user fees. However, the limitations of ecological studies should be taken into account, as only data from the dental clinics was included. The reasons for such a finding are potentially numerous, and it is very difficult to ascertain the change in dental attendance solely due to the policy change regarding user-fees. Nevertheless, this study does highlight the rapidity with which utilization rates may change upon manipulation of financial barriers to health care use. A study by Achembong and co-authors (2012) in Cameroon revealed that only very few tooth fillings were performed overall in the dental clinics. The vast majority of treatment rendered was extractions. The only clinics that offered restorative services were located in urban areas and of these, 50% of the restorations involved also root canal treatment. The costs of root canal treatment were reported to be approximately three times the monthly minimum wage in Cameroon.

2.2.5 User fees and poverty

Catastrophic health expenditures (CHE) are termed as expenditure services devoted to utilization of health care services at levels that are “likely to force households to cut their consumption of other minimum needs, trigger productive asset sales or high levels of debt, and lead to impoverishment” (Russell, 2004). Surveys from 89 countries worldwide reveal that 0-10% of the people, translating into up to 150 million people, suffer from CHE annually. Furthermore, about 100 million people are pushed under the poverty line due to the need to pay for the health care that they have utilized. Greater than 90% of the people who incur CHE also happen to be living in low-income countries (Xu *et al.*, 2007). A recent review (2017) conducted amongst 133 countries reveals that globally, the proportion of CHE has been rising; at 9.7%, 11.4% and 11.7% in the years 2000, 2005 and 2010, respectively. The proportions vary widely, with high proportions of CHE recorded in LMIC (Wagstaff *et al.*, 2018).

In a study conducted in Tanzania, 18% of the households were categorized as experiencing CHE. Presence of a chronic illness, household size of greater than five and domestic violence against women were all significantly associated with

increased likelihood of experiencing catastrophic health expenditures. Wealthy households were largely spared from catastrophic health expenditures (Brinda *et al.*, 2014). Inversely, household wealth itself has been shown to play a significant role in reduction of experiences of illness. A 1% increase in permanent income is projected to lead to a 15% decrease in the probability of an incapacitating illness occurring intra-household. Thus, even modest improvements in economic status can have profound impacts on the health levels of households (Lordan and Soto, 2012).

Another study analysed data from adults in 40 LMIC to determine the impact of out of pocket payment on dental care. The proportion of households with dental out of pocket expenditure ranged from 1.5% to 7.0% within the last four weeks. Households that had paid for dental care had almost twice (1.88) as high likelihood to incur CHE compared to those that did not pay. However, the impact of paying for dental care was revealed to be much lower than that due to medication and hospitalization (Bernabé, Masood and Vujicic, 2017). Nevertheless, the poor households in Thailand have been shown to be more likely to pay out of pocket for their health problems, and to pay a bigger proportion of their household income compared to the wealthier counterparts. The poor are also less likely to be beneficiaries of social health schemes and funds (Pannarunothai and Mills, 1997).

The significant financial impacts (SFI) is another measure which has been used in health research to quantify the ability to pay and affordability of health services. It has been previously utilized among patients and households dealing with chronic illnesses such as TB and HIV that use out-of-pocket payments for utilization of health services (Aspler *et al.*, 2008). Unlike CHE which is an official indicator with a stringent and well-defined criterion (Wagstaff *et al.*, 2018), SFI is defined as per-case basis and functions as a proxy of financial hardship and ability to pay. Nevertheless, the financial burden is calculated as a proportion of income in a defined time-span used towards financing health care (Kankeu *et al.*, 2013). It remains up to researchers to determine what proportion is “significant” to the households, as for poor households, even very small expenditures can be significant.

The role of cost and the requirement of financial resources for utilization as barriers towards utilization of dental services cannot be understated. The deleterious effects of cost are not evident only within LMIC. In Canada for instance, approximately 17.3 percent of respondents had avoided a dental professional because of cost within the previous year, and 16.5 percent had declined recom-

mended dental treatment due to the same reason. The respondents with low incomes and without dental insurance were over four times more likely to avoid a dental professional and two and a half times more likely to decline recommended dental treatment because of cost (Thompson *et al.*, 2014). Likewise, amongst 89% of the irregular dental attendees in a Jordanian population, about a quarter (26.9%) reported cost as the major reason for their non-attendance (Obeidat, Alsa'di and Taani, 2014). In the US, the source of payments for dental care (e.g., private insurance, out-of-pocket, or public insurance) varied among individuals who had any dental expenses. Uninsured individuals, who also happen to have lower socioeconomic status, pay nearly three quarters of their annual dental expenses out of pocket (74.7 percent) compared to individuals with private insurance and those with public insurance (National Research council, 2011).

3 AIMS OF THE STUDY

The overall aim of this study was to determine the availability of selected dental services, attitudes towards them and economic factors associated with their utilization in a low-income country (Tanzania). The specific objectives were:

- To determine the availability of dental services, materials and equipment in public dental care facilities (**Paper I**).
- To determine the attitudes of patients towards tooth filling treatment and how previous fillings are associated with them (**Paper II**).
- To determine patients' willingness to pay and costs incurred when utilizing dental services (**Paper III and IV**).

4 MATERIALS AND METHODS

4.1 Ethical aspects

Approval for study I was obtained from the Ethical Committee of the Muhimbili University of Health and Allied Sciences, through letter referenced: MU/DRP/AEC/Vol. XVIII/118. Additional permission to conduct the study was obtained from the regional and district administrative secretaries from which the dental facilities were located.

Approval for studies II, III and IV were obtained from the Ethical Committee of the Muhimbili University of Health and Allied Sciences (2015-06-12/AEC/Vol. IX/108). Permission to conduct this study in regional hospitals was obtained from the regional administrative secretaries of the respective regions (Dar es Salaam, Mwanza, Kilimanjaro and Mbeya). Permission was also obtained from the medical officers' in-charge of the regional hospitals.

The consent form for participation used in this study was provided by the ethical committee of the Muhimbili University of Health and Allied Sciences. The consent form clearly stipulated the expected benefits to the community and society at large. Additionally, it ensured that participants were not exposed to undue influence or intimidation. Consent was sought only after the patients had read the form and understood the relevant facts of the study. Participants were informed of the voluntary nature of the study, assured of their confidentiality and right to withdraw at any point. They were then given verbal and written information about the study and confidentiality was assured. Signed, informed consent was obtained from all participants.

4.2 Study designs, subjects and sampling procedure

Tanzania is divided into seven geographical zones; six in the mainland and one in the isles. Each zone comprises a cluster of regions. There are a total of thirty-one regions in Tanzania, and twenty-six of them are located in mainland Tanzania. Regions are further subdivided into several districts, subject to the size and population of the respective region. All regions have designated regional and district hospitals within which the public dental clinics are placed. At the time of the study, four of the zones in the mainland had designated zonal referral hospitals. These hospitals were situated in Mbeya, Mwanza, Kilimanjaro and Dar-es-Salaam regions for Southern highlands, Lake, Northern and Coastal zones, respectively. Due to practical and logistical reasons, regions from the isles were excluded. The presence of zonal referral hospitals within these regions may

be considered as a sign of well-developed and better health care infrastructure compared to other regions. Therefore, regional and district hospitals within these regions were purposively selected for conducting studies I-IV.

Study I was a survey conducted in dental facilities of the four selected regions in Tanzania. All district and regional hospitals ($n = 30$) within these four regions were selected to be involved in the study. It was not possible to get access to the regional hospital in Kilimanjaro and one district hospital in Mwanza due to logistical difficulties. A total of 28 facilities were therefore included in this study. Of these, 9 were from Mbeya, 6 from Kilimanjaro, 7 from Mwanza and 6 from Dar es Salaam region (Figure 1). All the dental practitioners and officers in charge in all the district hospitals within selected regions were eligible to be included in the study. Overall, 28/30 facilities and 56/97 practitioners participated. This study determined the price of selected dental services and availability of dental materials and equipment within these facilities.

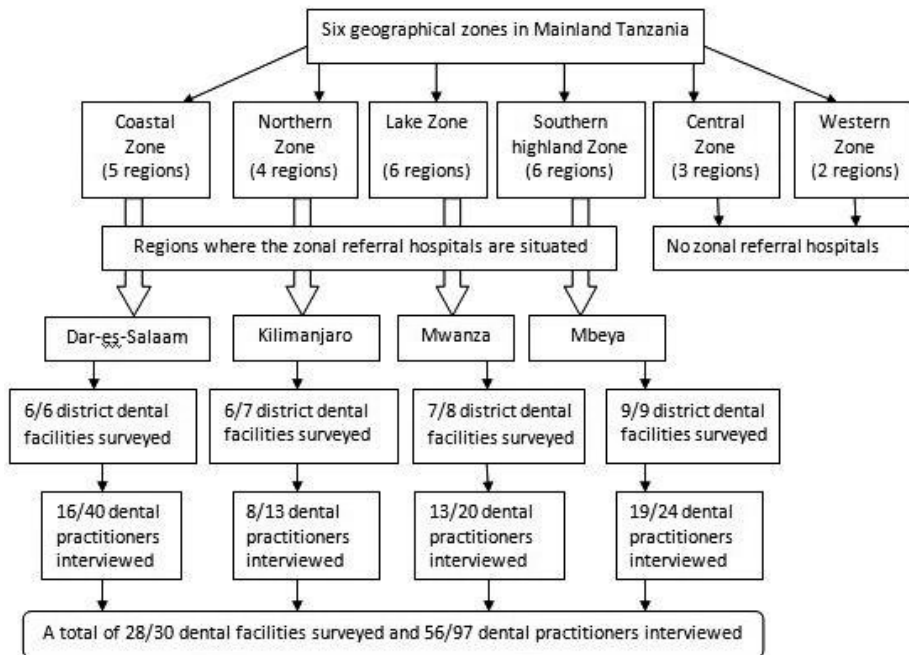


Figure 1: Sampling procedure for Study I

Studies II and III were cross-sectional studies conducted among outpatients attending four selected regional hospitals in Tanzania. Amana, Mawenzi, Sekou-toure and Vwawa hospitals in Dar es Salaam, Kilimanjaro, Mwanza and Mbeya regions, respectively, were selected to participate in these studies. Study II investigated patient attitudes towards tooth filling services and its relationship with previous tooth filling treatment, whereas study III assessed their willingness-to-pay for tooth filling and extraction ser-

vices. All medical and dental outpatients aged 18 or more attending the selected hospitals during the time of the study were eligible for participation and included into the study (Figure 2).

There was no previous information on patients' willingness to pay (WTP) for dental services in societies with limited restorative services. Therefore, based on literature review of previous studies conducted elsewhere a total of 400 outpatients from each hospital were considered sufficient to study both the WTP and attitudes of the patients towards tooth filling services. Adult outpatients attending the regional hospitals for the one-month duration of the study were consecutively invited to participate in the study. Patients were approached at the waiting area, informed of the purpose of data collection and invited to participate. A total of 1541 patients were approached of which 19 refused to participate due to various reasons. Since the number of refusals was low, none of their additional information was recorded. Therefore, 1522 patients were enrolled and participated in these studies with a response rate of 99%.

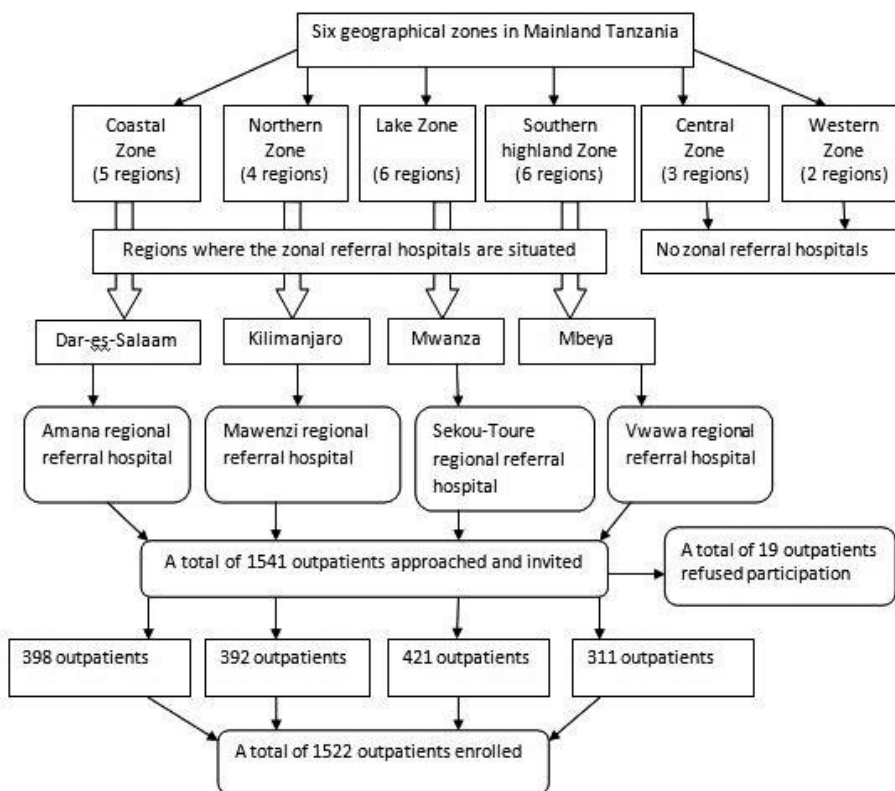


Figure 2: Sampling procedure for Studies II-III

Study IV was a costing study from a patient perspective conducted on a subsection of dental outpatients obtained from Study II and III. In order to accurately calculate financial expenditures and variation in purchasing behaviour based on available resources, only patients that utilised out-of-pocket payments (OOP) were involved in this study. A total of 489 dental outpatients were therefore identified and recruited. However, due to incorrectly filled-in data and many missing values, only 423 patients were finally included for the analyses (Figure 3).

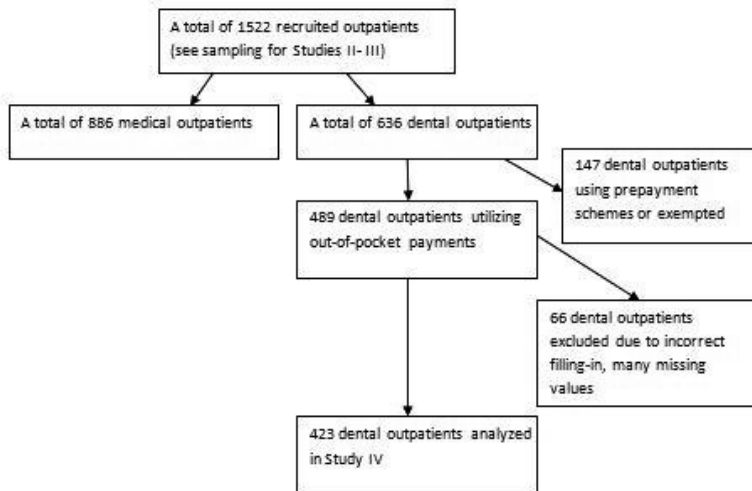


Figure 3: Sampling procedure for Study IV

4.3 Study variables and data collection

Questionnaires were administered to the dental clinic managers which dealt with the availability of the dental services, materials, equipment and structural factors that might affect dental service provision and to the dental practitioners which inquired on provider competency.

Availability and provision of the following dental services was assessed at the facilities: tooth extractions, tooth fillings, root canal treatment, tooth scaling and fabrication of removable dentures. The availability in the previous 12 months of the following basic dental materials was inquired at the facilities: Zinc-oxide Eugenol, Calcium hydroxide-based liner, Glass-ionomer cement, Composite and Amalgam. The availability of dental materials was investigated using a numerical rating score (NRS) with a scale of 0 (Not available at all) to 10 (available throughout the year). Dental equipment assessed for availability was: Dental radiography machines, dental autoclaves, amalgamators, com-

posite light-cure machines, dental hand pieces, dental chairs and compressors. These were scored as: Not available; Not in use (faulty); Not in use (functional); In use (faulty); In use (functional) (Study I).

The local structural factors affecting availability of dental restorative services assessed were: timeliness in delivery of dental materials, budgetary sufficiency for procurement of dental materials and reliability in acquiring materials once ordered during the last one year. These were investigated using an NRS with a scale of 0 (worst possible situation) and 10 (best possible situation). The segment extremes were; for material availability “never available” (0) and “always available” (10); for budgetary sufficiency “highly insufficient” (0) and “highly sufficient” (10); for reliability “highly unreliable” (0) “highly reliable” (10); and for timeliness “never delivered on time” (0) and “always delivered on time” (10). Questions on provider self-rated competency assessed tooth extractions and fillings using zinc oxide eugenol, amalgam, glass-ionomer cement and composite materials. Additionally, self-rated competency in application of calcium hydroxide-based liner during tooth filling procedure was assessed. The responses to competency questions were also scored along an NRS with a scale of 0 (*not competent at all*) to 10 (*extremely competent*) (Study I).

Another questionnaire measuring attitudes towards tooth fillings was developed through several stages in the local language, Kiswahili. The final questionnaire had a total of 8 attitude statements and a number of socio demographic variables.

The attitude statements used for this study were: *Tooth extractions are the only effective means of treating a toothache; Despite tooth fillings, you will have to extract your tooth eventually; Tooth fillings cause harm by being the source of another toothache; Tooth fillings cause filled tooth to fracture; Tooth fillings are expected to dislodge after a short while; Tooth fillings are better than extractions for management of toothaches; Tooth fillings completely eliminate toothache and Tooth fillings allow an individual to eat hot/cold foodstuffs with no problem.* The responses to these questions were on a 6-point Likert scale, spanning from “completely agree” to “completely disagree”. The scoring of selected response options was adjusted such that the most positive attitude scored +3 to -3 denoting the most negative attitude. A sum attitude score was constructed for each patient through summation of the obtained attitude scores from all eight questions (Study II).

The sociodemographic variables included for the study were age, sex, highest level of education (low; no formal education/primary school, medium; did not finish secondary school/finished secondary school, and high; college/university), monthly household income (100,000 Tanzanian Shillings (Tshs) or less, 110,000–500,000 Tshs and

550,000 Tshs and above) and payment modality for health care (out of pocket, health insurance). Previous tooth filling experience was determined via dichotomisation of the responses to the question “*How many tooth fillings have you ever had?*” into 0 (none) and 1 (at least one) (Studies II and III).

A contingent valuation survey utilizing an open-ended willingness-to-pay format was utilized for assessment of treatment preferences amongst outpatients. The survey was conducted at the hospitals’ waiting rooms for both medical and dental outpatients. The interviews were conducted by research assistants who had been specially trained in WTP technique. They briefly described the purpose and importance of the study and allowed the patients to read the scenario by themselves.

The scenario presented to the patients defined dental caries, its association with a tooth-ache and a brief description of available treatment options. The treatment options to be considered by the patients were tooth extractions and tooth filling. The patients were thereafter asked to state the maximum amounts they would be willing to pay for either of the treatment options. The maximum WTP amounts were asked separately for extraction and filling of anterior/posterior and upper/ lower teeth (see appendix p.78).

The research assistant provided clarifications when needed and emphasized to the participants that the amount filled in will have no effect on the charges that will be incurred at the hospital on that day (Study III).

The questionnaires for studies II and III were administered to all outpatients enrolled in the respective hospitals.

A self-administered questionnaire was used to determine costs incurred by dental outpatients during their current visit. Patients were asked to provide information on the fees paid for their current treatment, investigation and registration. These fees were considered as the direct costs. Indirect costs were calculated as a sum of cost of waiting and treatment times as a function of a household’s monthly income, and travel costs for the patient (and escorts, if any). Only dental outpatients that utilized out-of-pocket payment modality were selected for analyses in this study (Study IV).

All the used forms and questionnaires for the study are included as appendices.

4.4 Outcome measures

Study I had several main outcomes: The availability and prices of dental services relative to patients’ daily resources for consumption; availability of dental materials

throughout the preceding 12 months categorized from the NRS responses as poor, moderate and good; proportion of facilities with all studied equipment that were functional and in use; and the self-rated competencies of dental practitioners in carrying out restorative and extraction services.

The mean attitude score towards tooth filling services and the differences in mean attitude scores by previous tooth-filling experience were the main outcome measure for study II. The main outcome measure for study III was the maximum amount of money that patients were willing to pay (WTP) for tooth filling and extraction services of anterior and posterior teeth and variability in WTP values by age, sex, education, monthly household incomes, health insurance status and previous tooth filling.

In study IV, direct and indirect costs were calculated from patients' collected data. Significant financial costs (SFI) were defined as the proportions of households needing to utilize at least 10% of their monthly household income in order to finance their current utilization of dental services. Therefore, the total indirect and direct costs incurred by patients due to utilization of dental services as well as households with SFI were the main outcome measures for study IV.

4.5 Statistical methods

In all studies, probability values of less than 0.05 were considered statistically significant. All statistical analyses (Table 2) were conducted using Statistical Package for Social Sciences for Windows, Version 20 (SPSS Inc., Chicago, IL, USA)

In study I, separate analyses were performed for the facilities and for the dental practitioners. Frequency distributions and the variation of local structural factors, prices and availability of dental materials and equipment were determined. The differences in practitioners' average perceived competencies were tested using Student's independent samples t-test. Relative patient costs were calculated as a proportion of the daily resources required for consumption (DRC) for an average Tanzanian (Tanzania Bureau of Statistics, 2013).

In study II, frequency distributions were determined and differences in proportions compared using chi-square tests. Independent samples t-tests and analysis of variances (ANOVA) were carried out to test differences in the mean attitude scores in the dependent variables; sex, age, marital status, education, monthly household income, payment modality and previous tooth filling. Hierarchical linear regression analysis was used to explore the associations of socio-demographic variables with sex (male/female), age (18–24 years/ 25–34 years/ 35–44 years/ 45 years and above), education (low: no for-

mal education, primary school/ medium: did not finish secondary school, finished secondary school/ high: college, university), income (low: 100,000 Tshs or less/intermediate: 110,000 – 500,000 Tshs/high: 510,000 and above) and health insurance(yes/no) on attitudes towards tooth filling treatment. In the first regression model: sex, education, income and health insurance were added. After controlling for these variables, the effect of main predictor variable under investigation, “having a previous tooth filling” was determined.

In study III, statistical differences in proportions were compared using chi-square tests; Mann Whitney and Kruskal-Wallis were used to test differences between the mean values. Direct multiple regression analysis was used to explore the associations of background factors with WTP valuations for tooth filling and extraction services. For multiple regression analysis, $\ln(WTP+1)$ function was used to produce natural logarithmic values of the stated WTP values. These converted and normalized WTP values for respective treatment and tooth types were considered as the dependent variables. Sex, age, education, monthly household income, patient type, payment modality, status of teeth, previous extraction and filling were the independent variables. The computed linear models were used to explain the effects of background variables on magnitude of WTP.

In study IV, travel, treatment and investigation fees were summed to form the cash expenditures related to obtaining current dental treatment. The cash expenditures were converted to a percentage of the calculated mean monthly household income. If the overall expenditure exceeded 10% of the monthly household income, it was considered to result into SFI. In order to determine changes in proportions incurring SFI in poor households, a set of sensitivity analyses (Meltzer, 2001) were conducted amongst patients belonging in the lowest income category. The household monthly income was varied in increments from the median value within the category while holding all other values constant. Statistical differences in proportions were compared using chi-square tests.

Table 2: Statistical tests utilized for studies I-IV

Study	Types of Analyses
I	Frequency distributions Student's independent sample t-test
II	Frequency distributions Chi-square test Student's independent sample t-test Analysis of variance (ANOVA) Hierarchical linear regression

III	Frequency distributions Kruskal-Wallis H test Mann-Whitney U test Logistic regression Linear regression
IV	Frequency distributions Medians with Inter-quartile ranges Sensitivity analyses

5 RESULTS

5.1 Availability of dental materials and equipment (I)

Dental materials and equipment were inconsistently available in the dental facilities. Dental composite, glass-ionomer cement and calcium hydroxide were reported as never having been available during the preceding 12 months by about one-third of the facilities. Alternately, dental amalgam, composite and Zinc-oxide eugenol were the most consistently available dental materials. Close to a half (42.9%) of the facilities reported them as being available throughout the preceding 12 months.

Regarding local structural factors affecting dental material availability, timeliness in delivery of the materials was rated as “poor” by 64.3% of the facilities (median score =0). Reliability in acquisition of dental materials once the order has been placed, and the sufficiency of the budget for procurement of dental materials was rated “poor” by 35.7% and 28.6%, respectively.

Dental radiography units were not available in half (53.6%) of all studied facilities, and only a quarter of facilities had fully functional units. Slightly less than half of the facilities either do not possess or have broken dental autoclaves. Amalgamators and light cure machines were not available in a quarter of the dental facilities. Equipment that was most frequently reported to be available, fully-functional and in use were as follows: dental chairs, compressors and light cure machines (Table 3).

Table 3: Availability of dental equipment in studied dental facilities (n = 28)
Modified from Original publication I

	Not available (%)	In use, fully functional (%)
Dental x-ray	53.6	25.0
Autoclave	28.6	50.0
Amalgamator	25.0	42.9
Light cure machine	25.0	60.7
Hand piece	14.3	53.6
Compressor	10.7	64.3
Dental chair	3.6	67.9

There was also equipment which were available and functional, but not in use due to various reasons. Amalgamators (21.4%) were not in use due to lack of amalgam capsules or as a consequence of dental facility policies of stopping the usage of amalgam for restorative purposes. Dental radiographs (10.7%) and light cure machines (10.7%) were not in use due to lack of developing fluids or radiograph films and lack of dental composite material, respectively. One facility had none, and two did not have at least four pieces of equipment, whereas three facilities had all the seven investigated equipment fully functional and in use.

5.2 Dental service availability, their relative costs and practitioner competency (I)

Tooth extractions were provided by all studied facilities, scaling by 86%, fillings by 79%, root canal treatment by 46.4% and fabrication of removable partial dentures by 32%. Despite more than three-quarters of the facilities reporting provision of tooth filling services, they constituted a small proportion (6%) of overall treatment. The treatment profile revealed a total of 823 tooth fillings and 12,874 extractions.

Table 4: Mean self-rated competency scores (95% CI in parentheses) of dental officers and other cadres for different treatment options in facilities (modified from Original publication I)

	Dental practitioners (n= 29)	Other cadres (n = 27)	p value
Extractions	9.7 (9.4, 9.9)	9.1 (8.3, 9.9)	0.187
Amalgam restorations	9.0 (8.5, 9.6)	6.5 (5.2, 7.8)	0.001
Compositerestorations	9.1 (8.7, 9.6)	6.7 (5.4, 8.1)	0.001
Glassionomercementrestorations	9.3 (9.0, 9.7)	7.4 (6.1, 8.8)	0.005
Zincoxiderestorations	9.8 (9.6, 10.0)	8.1 (6.7, 9.5)	0.05
Calciumhydroxidelineraapplication	9.5 (9.0, 9.9)	6.4 (4.8, 7.9)	0.001

The median of relative costs for consultation, tooth extractions and tooth fillings were 2.47, 4.11 and 8.22, respectively. The lowest charged fees at the facilities for consultation, tooth extraction and tooth fillings ranged from 1,000 Tanzanian shillings (Tshs) to 3,000Tshs. The highest charged fees at the facilities for these services ranged from

10,000 to 40,000 Tshs. The difference in prices of various services varied approximately 10-fold across facilities. Tooth extractions and consultations were priced at a median fee of 3,000 each. Amalgam, composite and glass-ionomer cement fillings were priced at a median fee of 10,000, 20,000 and 10,000 Tshs, respectively.

There were various dental cadres instituting care in the facilities, with those classified as “dental practitioners” (dental officers and assistant dental officers) reporting higher restorative care competencies than “others” (dental therapists, dental auxiliaries, health attendants, clinical and assistant medical officers). Tooth extractions had the highest self-rated competencies among the two groups and were the only service whereby the skill level was rated similarly between them (9.7 and 9.1 for dental practitioners and other cadres, respectively) (Table 4).

5.3 Attitudes of patients towards tooth fillings and the association of previous tooth fillings towards such attitudes (II)

The statements perceived most negatively (with their mean scores in parentheses) were: *Tooth extractions are the only effective means of treating a toothache (-1.23)*, *Despite tooth fillings, you will have to extract your tooth eventually (-1.07)*, *Tooth fillings cause harm by being the source of another toothache (-0.99)* and *Tooth fillings cause filled tooth to fracture (-0.12)*. The statements perceived most positively (with their mean scores in parentheses) were: *Tooth fillings completely eliminate toothache (0.62)* and *Tooth fillings allow an individual to eat hot/cold foodstuffs with no problem (0.83)* (Table 5).

Table 5: Statement- specific mean scores and confidence intervals (95 CI) of attitudinal statements towards tooth fillings with score +3 being most positive attitude and -3 the most negative one (From Original publication II)

<i>Attitude statements</i>	<i>n</i>	<i>Mean score</i>	<i>95 CI</i>
<i>Tooth extractions are the only effective means of treating a toothache</i>	1472	-1.23	-1.33, -1.12
<i>Despite tooth fillings, you will have to extract your tooth eventually</i>	1461	-1.07	-1.17, -.97
<i>Tooth fillings cause harm by being the source of another toothache</i>	1462	-0.99	-1.09, -.90

<i>Tooth fillings cause filled tooth to fracture</i>	1456	-0.12	-.22, -.01
<i>Tooth fillings are expected to dislodge after a short while</i>	1453	-0.06	-.17, .04
<i>Tooth fillings are better than extractions for management of toothaches</i>	1478	0.03	-.08, .92
<i>Tooth fillings completely eliminate toothache</i>	1468	0.62	.52, .71
<i>Tooth fillings allow an individual to eat hot/cold foodstuffs with no problem</i>	1453	0.83	.73, .92
Overall attitude scores	1389	-1.99	-2.42, -1.55

Most of the patients had a negative overall attitude (-1.99) towards tooth filling treatment. Having low levels of education (no formal education/ primary school) and low household monthly incomes (below 100,000 Tshs) were associated with more negative attitudes towards tooth filling treatment. Attitude was not shown to vary by sex, age groups or payment modality for health services. On the contrary, those with previous tooth filling experience had more positive attitudes (1.00) towards the service compared to those that did not (-2.37).

A small proportion (11.5%) of the respondents reported to have had a previous tooth filling. Women, users of health insurance, and those with high levels of education (college/university) and monthly household incomes (more than 510,000 Tshs) had correspondingly higher proportions reporting to have ever had a tooth filling. Controlling for socio-demographic variables, having a previous tooth filing was shown to be positively associated with attitudes towards tooth filling ($\beta = .113, p < 0.01$). Having a high level of education was the only socio-demographic variable shown to be independently associated with having a positive attitude towards tooth filling. Nevertheless, the chosen variables were only able to explain a small proportion (2.5%) of the total variance in attitudes.

5.4 Patients' willingness to pay (WTP) and costs associated with dental care utilization (III and IV)

The proportion of missing WTP values ranged from 8.5% -9.3%, whereas 2.0% - 5.0% were valued at zero, depending on treatment and tooth types. Therefore, most patients were willing to pay a certain amount for tooth filling and extraction treatment. The mean WTP values for tooth filling (7,398 and 7,726 Tshs for anterior and posterior teeth, respectively) were higher than for tooth extraction irrespective of tooth type (5,448 and 6,188 Tshs, respectively). Both differences were statistically significant, $p < 0.001$. One US\$ = 2,187 (Table 6).

Table 6: Mean willingness to pay (WTP) and 95% confidence intervals (95 CI) for tooth extraction and filling services by tooth types (Modified from Original publication III)

	Mean WTP Tshs (USD)	95% CI	No. of re- sponses	Mann Whitney test P-value
Anterior teeth				
Extraction	5448 (2.5)	5183, 5713	1393	< 0.001
Filling	7398 (3.4)	7074, 7721	1380	
Posterior teeth				
Extraction	6188 (2.8)	5917, 6459	1393	< 0.001
Filling	7726 (3.5)	7398, 8055	1386	

Those with perceptions of having poor dental status (8,059 and 8,243 Tshs for anterior and posterior teeth, respectively) with previous tooth filling experience (9,018 for posterior teeth) and with previous tooth extraction experience (8,003 and 8,353 Tshs for anterior and posterior teeth, respectively) reported higher WTPs for tooth filling services than their counterparts. Dental outpatients reported higher WTP values for both tooth filling (8,799 and 8,983 Tshs for anterior and posterior teeth, respectively) and extraction (5,795 and 6,739 Tshs for anterior and posterior teeth, respectively) compared to medical outpatients ($p < 0.001$, Mann-Whitney u test). Those belonging in the highest income category also reported higher WTP values for tooth filling (9,001 and 9,3536 Tshs for anterior and posterior teeth, respectively) and extraction (6,127 and 6,672 Tshs for anterior and posterior teeth, respectively) than those in the lowest income category ($p < 0.001$, Kruskal-Wallis test). Belonging in age group of 45+ years was associated with reporting lower WTP values for tooth filling services and for tooth extraction of anterior teeth, compared to others.

Multiple regression models revealed that respondents belonging in the oldest age category (45+ years) were more likely to offer lower WTP values (β -0.070 and β -0.078 for filling of anterior teeth and posterior teeth, respectively; and β -0.067 for extraction of posterior teeth) compared to other age groups. Those with high income levels were more likely to offer high WTP values for tooth filling and extraction services compared to other income groups, irrespective of tooth types.

Approximately 70.0% (489) of all dental patients approached utilized out of pocket payments and were included for the costing analyses. Slightly more than half of the patients were female (54.3%) and 43.6% had primary level as their highest education level. Most of the patients reported to dental clinics due to toothache and they mostly expected to receive tooth extraction treatment at the dental facility. When restorative services were present, the expectation of receiving a tooth filling was almost 4-fold (15.6%) compared to the absence of them (3.9%) (Table 7).

Table 7: Characteristics of the study population by dental provider service profile, p-values for chi square test (n= 423) From Original publication IV

	Restorative services absent n (%)	Restorative services present n (%)	Total n (%)	p-value
Age				
18-24 years	101 (39.5)	53 (33.5)	154 (37.2)	
25-34 years	88 (34.4)	65 (41.1)	153 (37.0)	
35-44 years	40 (15.6)	24 (15.2)	64 (15.5)	
45+ years	27 (10.5)	16 (10.1)	43 (10.3)	.541
Sex				
Male	123 (47.7)	69 (42.6)	192 (45.7)	
Female	135 (52.3)	93 (57.4)	228 (54.3)	.359
Education				
Primary	117 (45.2)	66 (41.0)	183 (43.6)	
Secondary	105 (40.5)	68 (42.2)	173 (41.2)	
Tertiary	37 (14.3)	27 (16.8)	64 (15.2)	.647
Household income/month (x1000 Tshs)				
<100	140 (54.9)	78 (50.3)	218 (53.1)	
110 – 250	68 (26.7)	35 (22.6)	103 (25.1)	
260 – 500	26 (10.2)	21 (13.5)	47 (11.5)	
510 – 750	10 (3.9)	12 (7.7)	22 (5.4)	
760 – 1,000 Tshs	8 (3.7)	8 (5.2)	16 (3.9)	
>1,000 Tshs	3 (1.2)	1 (0.6)	4 (1.0)	.318
Presenting complaint				
Toothache	245 (94.6)	146 (89.6)	391 (92.7)	
Gum disease	3 (1.2)	3 (1.8)	6 (1.4)	
Others	11 (4.2)	14 (8.6)	25 (5.9)	.151
Expected treatment				
Tooth extraction	232 (89.6)	115 (71.9)	347 (82.8)	.000

Tooth filling	10 (3.9)	25 (15.6)	35 (8.4)	
Periodontal treatment	0 (0.0)	1 (0.6)	1(0.2)	
Consultation	12 (4.6)	12 (7.5)	24 (5.7)	
Others	5 (1.9)	7 (4.4)	12 (2.9)	
Restored tooth				
None	243 (94.6)	129 (81.6)	372 (89.6)	
At least one	14 (5.4)	29 (18.4)	43 (10.4)	.000
Self-perceived status of teeth				
Poor	211 (81.5)	113 (70.6)	324 (77.3)	
Good	48 (18.5)	47 (29.4)	95 (22.7)	
				.014

Only 7.1% of the patients that attended the dental clinics received a tooth-filling. There were significant differences in median treatment fees between those that received tooth fillings (15,000 Tshs) and those that had tooth extractions (5,000 Tshs). Small proportions (2.6%) of the patients were prescribed any investigations, however, the resultant median fees were also some of the highest, at 15,000 Tshs.

Direct costs due to treatment and investigation fees contributed about 80% of total costs incurred when utilizing dental care whilst the remaining 20% was due to indirect costs. About half (54.7%) of the SFI were observed in higher proportions amongst households with low levels of income, the proportion being the highest (92.2%) in the lowest income category, where 53% (Table 7) of the subjects were belonging.

6 DISCUSSION

The findings on the availability of dental materials, equipment and services, attitudes towards tooth fillings, willingness to pay for dental services and costs associated with utilization of such services as provided by the conducted research clearly suggest that there are a multitude of factors that influence the observed dental treatment patterns in Tanzania.

Dental materials are intermittently available and not all required equipment present in the dental facilities. Therefore, even if the patients demand restorative services in these facilities, they can be expected to be unable to utilize them. Additionally, the attitudes of the patients were found to be mostly negative towards tooth filling treatment; failure of restorations and belief of tooth extractions being the only treatment towards tooth aches being cited extensively. WTP survey revealed a preference towards tooth filling, albeit at a much lower price range than the fees requested at the health facilities. Finally, the costs associated with utilization of dental services were significant, with more than 50% of the outpatients, and more than 90% out of those belonging to the lowest income category, consuming 10% or more of their monthly incomes to utilize dental services. Utilization of tooth fillings resulted in costs several times higher than tooth extraction services.

6.1 Methodological issues

6.1.1 *Representativeness*

Tanzania mainland has a total of 26 regions and more than 190 districts. The four regions selected for this study have designated zonal referral hospitals within them. This implies that the health system within these regions is sufficiently robust to enable adequate referral processes. Therefore, the findings regarding dental service provision and availability of services might be presenting an overall optimistic picture of the actual situation, when compared to other regions in the country. Nevertheless, selection of health facilities from these regions was necessary in order to maximise the likelihood of restorative service provision within the dental facilities and encountering outpatients with a history of previous tooth filling. Nonetheless, the obtained findings on dental service availability may not be an accurate portrayal of the situation throughout Tanzania.

The adult outpatients involved in the study may be considered as representative of other adult patients attending dental clinics within regional hospitals in Dar es Salaam, Mwanza, Mbeya and Moshi regions. Considering the large sample size, high response rates and the duration of data collection, it is unlikely that the enrolled patients differ substantively from those attending during other periods of the year. However, it remains difficult to ascertain whether the outpatients investigated are representative of all outpatients in the studied regions. Regional hospitals are located in areas that are the regional administrative headquarters in mostly urban areas. Nevertheless, most Tanzanians reside in rural areas (Tanzania Bureau of Statistics, 2013) and the distance from administrative headquarters and other rural areas can be quite significant. Consequently, the proportion of rural outpatients might have been underestimated in our studied sample. The findings from this study can therefore be considered to be representative of people residing in urban areas of Tanzania.

Regional hospitals are close to the top of the health referral system within Tanzanian regions (Kwesigabo *et al.*, 2012). To discourage attendance without appropriate referral to these hospitals, the service provision is priced at a much higher rate, compared to other district facilities. Thus, the patients attending these facilities can be considered to be relatively better-off than the average population or with health conditions that necessitated referrals. Current findings reveal that more than half (55%) of the participants were classified as belonging in the lowest income bracket (less than 50 USD per month). Considering that this study was conducted in urban areas that have comparatively wealthier residents, the situation may be worse in other areas of the country.

Caution is required when attempting to generalize these findings to the whole of Tanzania. Further data is required in order to confirm, refute or extend current findings. Applicability of the findings to other low-income countries might be difficult due to the wide variability in economic capacities even within countries placed within the same economic grouping. However, these findings might be generalizable to other low-income African countries with similar country profiles to Tanzania.

6.1.2 Reliability and validity:

Reliability is concerned with the degree of consistency or repeatability with which an instrument can measure a specified attribute. Cronbach's alpha was used to assess internal consistency reliability in phase II of data collection (Paper II). The more homogeneous the items, the higher the correlation between them. Nevertheless, this homogeneity must be balanced to ensure that the individual

items are not measuring the construct from the same perspective, but rather that the construct is measured from different perspectives. Internal consistency reliability for the developed “tooth filling attitude scale” was 0.799, indicating good internal consistency (Abramson and Abramson, 1999).

A measure, test or scale is said to be valid if it measures what it claims to measure. Internal validity deals with whether a true measure is obtained for the subjects under study. External validity refers to whether the findings from the studied sample can be generalized and applied to a wider population. Demonstration of the validity of a measurement is challenging. This is because one requires having a gold standard which can serve as a true value to establish validity (Kingman, 2002). Despite the challenges in demonstrating validity, efforts were made to ensure that the measurements undertaken have at least face validity.

Firstly, the dental materials and equipment whose availability was measured in phase I of data collections was obtained from the central oral health unit (COHU) of the Ministry of health, Tanzania. Thus, these were the materials expected to be available in dental facilities in Tanzania. The NRS has been used for self-assessment of various health related tasks. It was deemed to be appropriate for use in this particular setting. Furthermore, dental service and equipment availability was assessed and verified on site, since the principal investigator (KKN) attended all the facilities physically.

Secondly, the current study utilized self-reported data in the assessment of socioeconomic status, subjective oral health status and in construction of tooth-filling attitude scale in phase II of data collection. Since there was no available scale that could be used in this setting to determine the attitudes towards tooth-filling treatment, we had to develop one. This development was through several stages, and was based on guidelines by Norman and Steiner (Streiner, Norman and Cairney, 2008). The final scale was able to depict differences in attitudes towards tooth filling treatment by previous tooth filling history, education level and incomes: all factors which have been positively correlated to health literacy. Despite not being validated through rigorous psychometric tests, the resultant tool was considered acceptable and to have adequate internal validity for the purposes of the undertaken study.

6.1.3 Strengths and weaknesses of the study

The main strength of the current study is due to its study design, which has allowed for many variables from a large number of people to be collected. Furthermore, phase I of data collection did not utilize any sampling procedure; all

the district dental facilities in selected regions participated, effectively functioning as a regional census and providing the investigated information on the facilities with low levels of uncertainty. Nevertheless, due to the voluntary nature of participation in phase II of the study, some systematic errors might occur. Errors due to selection bias; self-selection for participation or non-participation due to a consistent underlying reason and information bias; providing untrue or selective information to the investigator, might have occurred. Nonetheless, there was a greater than 95% and 60% response rates for the approached outpatients and dental officers, respectively. Both of these response rates can be considered to be acceptable, minimizing the likelihood of self-selection affecting the current findings.

The gold standard for measuring monthly household incomes would have been measurement of all consumption within the household, and earnings from each member for the duration of a month. However, considering the intensive nature of such an endeavour, patients were instead asked to provide an estimate of their monthly income. During development of the questionnaire, it was found that most patients had difficulty with point-estimations of their exact income. This is because many Tanzanians are informally employed, without a regular monthly income. Additionally, there may even be seasonal variations depending on the income-generating activities of the respondent in question. Therefore, monthly household incomes were presented as pre-specified ranges of income based on findings from a pilot survey. Despite limitations inherent to categorical variables, we believe that the monthly household incomes utilized throughout this study are valid and allow differentiation of the respondents by their socioeconomic status.

WTP method utilizing an open-ended format was used to determine preferences of patients towards tooth filling and extraction treatment for management of tooth aches on specified tooth types. One of the biggest criticisms of the WTP measure is that it elicits hypothetical answers as a necessary result of the hypothetical survey situation; often termed “hypothetical bias”. Individuals may have little or no experience of purchasing the commodity in question, or, potentially close substitutes, and thus have little or no underlying information or preference upon which to base their decision concerning its value (Smith, 2003). Concern exists that hypothetical willingness to pay questions may overestimate actual willingness to pay (Blumenschein *et al.*, 2008).

By asking respondents to consider and focus on a specified intervention in isolation may act to magnify the resultant WTP valuation. In other words, when people are asked to value an item in isolation, their willingness to pay may be larger than their “real” WTP, whereby there are many other “background” items being factored in (Cookson, 2003). Nevertheless, in this particular study patients were

essentially requested to evaluate more than one alternative at once. Although in the grand scheme of things there might have been an overestimation in terms of the actual monetary units stated, the comparative differences in expressed preferences for tooth filling and extraction services retain their validity. Additionally, an attempt was made to minimize strategic response bias by clearly explaining to the respondents that whatever amount that they will opt to fill-in will not have any bearing to their current fees.

6.2 Main findings and their relation to other studies

6.2.1 Availability of dental materials and equipment

Many of the studied dental facilities had an intermittent availability of dental materials. Only a very small proportion of the facilities had all the studied materials and equipment available throughout the year. Due to the observed widespread lack of dental materials, the logical outcome would be negligible availability of restorative services. Indeed, the overwhelming majority of the services rendered to the patient population were tooth extractions. Nevertheless, an intermittent availability of restorative materials might only serve to explain one aspect of the rendered services. At the time of the study (2014 -2015), the authority tasked with supply of medical and dental equipment in public health facilities in Tanzania (medical stores department) did not stock any dental materials. This might be a possible explanation for difficulties in obtainment of such materials within the facilities as the hospitals had to rely on private vendors for procurement of such supplies, bureaucracy associated with such an endeavour notwithstanding. However, for the year 2018-2019, the medical stores department has started to offer dental materials as some of the items that it procures (Medical stores department, 2018). It remains to be seen what the effect of such provision will be on the availability of dental materials and equipment in the facilities in the future. There were no retrievable studies from other low-income countries in Africa that had estimated the actual availability of dental equipment in the clinics.

Factors such as practitioners' restorative competencies and the patients' demand for restorative services are important determinants of service utilization in this population. Many of the practitioners working in the dental facilities were categorized as "other dental professionals"; constituting of dental therapists and low-level medical practitioners with some basic on-job training on management of dental emergencies. Most of the practitioners assessed their competencies to perform restorative procedures to be poor. Perceived competency of the practitioners in carrying out certain actions has been shown to have a direct effect on their intention to practice such action (Millstein, 1996;

Brennan and Spencer, 2005). Low perceived competency in carrying out restorations casts a shadow of doubt on the quality of the restorations and the clinical acceptability of the fillings that these practitioners will provide, even when the necessary dental materials and equipment are made available.

6.2.2 Attitudes towards tooth fillings

Patients exhibited generally negative attitudes towards tooth filling services and expressed strong opinions on tooth extractions being the only effective means of treating a toothache and that despite undergoing a tooth filling, you will have to extract the tooth eventually. Attitudes have been shown to play an important role in determining health practices and service utilization (Koyio *et al.*, 2013; Teusner, Brennan and Spencer, 2013). The strong expressions of uncertainty regarding a positive outcome of a tooth-filling service might contribute towards nudging the patients to choose tooth extractions over tooth-filling in real-life situations. Nevertheless, those with high monthly income levels also had higher proportions that reported to have ever had a tooth filling (data not shown). Therefore, it has been suggested that those with a better socioeconomic status perceived their oral-health related quality of life higher compared to their counterparts even when their initial illness was similar (Tan *et al.*, 2016). The present finding of the difference in dental care utilization patterns is in line with a previous study, where even within relatively impoverished societies a clear sign of existing inequalities in health outcomes are shown (Watt *et al.*, 2015). Strong and directed social actions are required to ensure that this observed inequality does not widen any further.

Toothaches were shown to be managed mainly by extractions, in line with previous studies from other LMIC (Sanya, 2004; Varenne, Petersen and Ouattara, 2004; Adekoya-Sofowora *et al.*, 2006) However, those that have had a previous tooth-filling also had more positive attitudes towards tooth filling treatment. Due to the study design, it is not possible to determine whether these positive attitudes were a result of the undergone restorative treatment, or that their positive attitudes towards tooth fillings were the primary reasons and motivation for undertaking tooth filling treatment in the first place.

6.2.3 Willingness to pay and costs for utilizing dental services

All respondents were willing to pay more for tooth filling than for extraction, irrespective of their past history with either of them. It may well be that those that have had previous tooth fillings were satisfied with the service, and therefore would like to have it again. Alternately, since positive attitudes towards tooth-filling were positively corre-

lated to education, these patients might be those that are aware of various treatment options for toothaches, and would therefore carefully consider all available options prior to undertaking a tooth extraction.

On the other hand, the finding that even those who had a previous tooth extraction would pay more for a tooth filling than a tooth extraction raises a number of issues. It appears as if patients place more value in services that enable retention of their teeth. Therefore, are those that have undergone a previous tooth extraction more reserved and reluctant to lose any more teeth? Could it be that the initial tooth extraction was not their preferred choice of treatment, everything else being equal? Perhaps there is an incongruity between the amount which is required to be paid for restorative services and the amount that patients are willing to pay for the services. Dental care utilization patterns in Tanzania are dominated by extractions, despite WTP revealing preference for tooth fillings by most of the outpatients. This possibility of allowing for elicitation of preferences between different health interventions is a hallmark of WTP surveys (Hanemann, 1991).

Tooth filling treatment was found to result in significant costs to the households of the patients. Further, there was a considerable discrepancy in the incurred costs by dental service utilization. Tooth filling treatment resulting into a three-times larger cost than tooth extraction services is in line with a previous study reporting tooth filling costs as obstacles hindering patients from utilizing them in this setting (Kikwilu *et al.*, 2009c). Considering that out-of-pocket modality is employed by close to three-quarters of the served population, the opportunity cost of tooth-filling services is non-trivial. Indeed, the current utilisation of dental services would have led to significant financial expenditure to more than half of the respondents. These significant expenditures were mostly clustered around households with low income levels.

6.2.4 Implications for dental public health practice

There is a need for provision of oral health education to the Tanzanian population on the advantages of retaining natural dentition and on availability of restorative services at dental facilities. However, provision of oral health education has also been shown to contribute to the increasing inequality. Those that have the best ability to adequately respond to the provided education will also be the people that have the (financial) means to do so (Watt, 2007). Thus, this education has to be coupled with other appropriate social measures to minimize this unintended side-effect.

Additionally, there needs to be a strengthening in clinical training to ensure that all cadres working in oral health facilities are competent in performing tooth fil-

lings. Nevertheless, utilization of tooth filling services depends on availability of restorative materials and equipment as well as ability of the patient to purchase the restorative service. Ensuring reliable and consistent availability of dental materials and equipment in all dental facilities may result in increased rates of retention of natural dentition and overall improvement in oral health-related quality of life across the population.

7 CONCLUSIONS

Dental materials were sporadically available and a full set of functional equipment was rarely present in the dental facilities. Furthermore, fees for similar dental services varied widely across the facilities. Although patients generally had negative attitudes towards tooth filling treatment those who had previously received fillings had more positive attitudes. Patients were willing to pay more for tooth fillings rather than tooth extractions, irrespective of their previous experience with either of the services. The stated WTP values for tooth fillings were consistently lower than the fees charged by the dental facilities. Utilization of dental services was shown to result into significant costs to the households of the patients. A large proportion of the patients with low levels of household incomes incurred SFI as a result of their dental care utilization.

7.1 Recommendations

Provision of universal health insurance may be required to ensure both provision of services (via procurement of necessary materials and equipment) and means of purchasing such services by the population. Universal health insurance scheme will increase the available resources to the health system (supplier), which may enable assured availability of dental materials and equipment in the facilities throughout the year. However, reliable provision of materials and equipment remains subject to the importance given to oral health care by the politicians and decision makers. It is quite possible that oral health care services may remain overlooked, and funds be directed elsewhere, despite the growth of the available financing pool.

Concerted oral health promotion efforts are essential for addressing the attitudes of the patients towards tooth filling treatment. Additionally, it would be necessary to assess the attitudes of the general population towards tooth filling treatment. This may assist in determining the intensity and extent of oral health education and promotion programs that might be required to have positive effects on population level. Further studies on utilization patterns of restorative services amongst the insured Tanzanian population and survival rates of the performed restorations should be considered.

ACKNOWLEDGEMENTS

I would like to acknowledge with great appreciation the Hospital district of southwestern Finland, Turku University foundation and Muhimbili University of Health and Allied sciences (MUHAS) for their financial support at various levels to enable the pursuit of this study. My heartfelt gratitude is due to my supervisors Professors Satu Lahti and Risto Tuominen whose tireless efforts and commitment have allowed me to thrive academically and made this work successful. I am greatly indebted to them for having taken a risk on me, for their advice, constructive criticisms, encouragement, support, chuckles, some more criticisms and occasional downtime. Truly, I consider myself lucky and it has been my greatest privilege to have worked under their tutelage. Their different but complementary styles in how they approach various issues has allowed me to appreciate dual views and expanded my perceptions of various study matter. They have left an indelible mark in my life, and I thank them profusely for affording me this opportunity (I can already hear their voices chastising me for using overly flowery language).

Special thanks to my thesis reviewers; Professors Anne Åstrom and Eero Kerosuo. Their comments have been instrumental and invaluable in the synthesis of the finalized thesis. My sincere appreciation to all members of staff at the department of Community dentistry, Turku for their kind assistance throughout the course of this study. Special thanks to my fellow doctorate colleagues from the Nurkkahuone room, Anu: for being a sympathetic ear whenever the doldrums of doctorate work got me down, Katri: for an Aura whenever the occasion called for it, Outi: for being an all-round awesome person, Jaakko: for your encouragement and pointers on how to navigate some of the tricky and technical aspects of doctorate work.

I extend my sincere appreciation to the regional administrative secretaries (RAS) in Dar es Salaam, Mbeya, Mwanza and Moshi regions. Special thanks also to the regional and medical officers of the aforementioned regions. Many thanks to my research assistants and all the participants without whom this study would not have been possible.

I thank my parents and brothers for having given me a foundation, for showing interest in what I do, for vicariously undergoing the PhD journey with me, and for being one of the most prominent sources of my inspiration.

I am forever indebted to my spouse Adelyne Emilton Ndanshau for her understanding and unwavering support throughout the journey, for taking over my paternal responsibilities, for being an ever-present anchor in the tumultuous seas of

doctorate training and for the sacrifices she has made to further my career. My boys, Killian and Katriel, whose love was felt at a distance despite my physical absence; I'm incredibly fortunate to have them in my life.

Last but not least; I thank all the powers that may be for continually rolling the dice in my favor; keeping me safe, strong, healthy and (mostly) sane throughout my study period.

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APPENDICES



MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DIRECTORATE OF RESEARCH AND PUBLICATIONS, MUHAS

INFORMED CONSENT FORM

ID-NO: _____

Consent to participate in an interview.

Greetings! My name is Dr. Kasusu Klint Nyamuryekung'e and I am a dentist working on this research project with the objective of determining the availability and prices of selected dental services in government oral health facilities.

Purpose of the study

We are assessing the availability of selected dental materials, dental equipment as well as availability of services and their prices in various government oral health facilities.

What participation involves

If you agree to participate in the study, you will be interviewed on availability of selected dental materials, provision of selected dental services in your facility, the payment modalities accepted for the purchase of the aforementioned services and other questions related to procurement, and accessibility of services.

Confidentiality

All information we collect on forms will be entered into computers with only study identification number.

Risks

We do not expect that any harm or injury will happen to you because of joining this study.

Rights to withdraw

Taking part in this study is entirely your choice. You can stop participating in this study at any time, even if you already have given consent. Refusal to participate or withdraw from the study will not involve penalty or any loss on your part.

Benefits

If you agree to take part in this study, you will be offering information that is valuable towards betterment of dental services in Tanzania. As an important stakeholder within the health sector, the information you offer will provide important insights into the oral health service delivery patterns, as well as allow areas of intervention for improvement

Whom to contact

If you ever have questions about this study, you should contact the principal investigator, Dr. Kasusu Klint Nyamuryekung'e, Muhimbili University of Health and Allied Sciences, (P.O Box 65013, Dar es Salaam). If you ever have questions about your rights as a participant, you may call Prof. Mainen J. Moshi, Chairman of the Senate Research and Publications Committee, P.O. Box 65001, Dar es Salaam. Tel: 2150302-6, 2152489.

Signature

Participant does NOT agree: _____

I have read the contents in this form. My questions have been answered. I agree to participate in this study.

Signature of participant: _____

Signature of research assistant: _____

Date of signed consent: _____

Questionnaire for dental facilities (Study IA)

SN: _____ Region: _____

District: _____ Hospital Name: _____

1. Professionals available in your facility:

Qualifications	Number
1) Dental Therapist	_____
2) Laboratory Technician	_____
3) Assistant Dental Officer	_____
4) Doctor of Dental Surgery	_____
5) Health attendant	_____
6) Specialist: _____	_____
7) Others: _____	_____

2. How many patients were seen in this facility within the last 3 months? _____ (verify from attendance roster?)

3. What are the acceptable modes of payment for dental services in your facility?

- | | | |
|--|--------|-------|
| 1. Out of pocket | 1. Yes | 2. No |
| 2. National Health Insurance Fund (NHIF) | 1. Yes | 2. No |
| 3. TIKA (TibakwaKadi) | 1. Yes | 2. No |
| 4. CHF (Community Health Fund) | 1. Yes | 2. No |
| 5. Others: _____ | | |

4. How many patients utilized the following modes for payment of services? Within the last 3 months? (verify from roster)

- | | |
|------------------|-------|
| 1. Out of pocket | _____ |
| 2. NHIF | _____ |
| 3. TIKA | _____ |
| 4. CHF | _____ |
| 5. Others | _____ |

5. Does your clinic offer any dental restorative services?

1. Yes
2. No

6. What restorative services do you offer in your clinic?

Restorative service offered		
1. Tooth filling	Yes (1)	No (2)
2. Scaling and root planning	Yes (1)	No (2)
3. Root canal treatment	Yes (1)	No (2)
4. Fabrication of removable dentures	Yes (1)	No (2)
5. Fabrication of fixed dentures	Yes (1)	No (2)
6. Others: _____	Yes (1)	No (2)

7. Who is your supplier of dental materials?

8. On a scale of **0-10**, where “**0**” is “**never available**” and “**10**” is “**always available**”, how do you rate the availability of the following dental materials in your clinic in the last one year?

Dental Material	Availability
1. Dental amalgam	
2. Conventional resin composite (light cure)	
3. Packable resin composite (cold cure)	
4. Glass Ionomer cement	
5. Zinc Oxide/ Zinc phosphate	
6. Calcium hydroxide	

9. How many people have attended your clinic within the last 3 months for extractions and restorations using the following materials? (Verify from roster)

Dental Material	Number of patients
Tooth extractions	
Dental amalgam	
Conventional resin composite (light cure)	
Packable resin composite (cold cure)	
Glass Ionomer cement	
Zinc Oxide/ Zinc phosphate	

10.

11. What is the price of the following services in Tshs (single surface, one tooth) using the following materials and payment schemes?

Dental Material	Out of pocket payment (Tshs)	Insurance (Tshs)		
		NHIF	TIKA	CHF
1. Dental consultation				
2. Tooth extraction				
3. Dental amalgam				
4. Conventional resin composite (light cure)				
5. Packable resin composite (cold cure)				
6. Glass Ionomer cement				
7. Zinc Oxide/ Zinc phosphate				

12. On a scale of **0-10**, whereby **“0”** is **“highly insufficient”** and **“10”** is **“highly sufficient”**, how do you rate the sufficiency of the budget for procuring dental materials in your facility in the last one year? _____
13. On a scale of **0-10**, whereby **“0”** is **“highly unreliable”** and **“10”** is **“highly reliable”**, how do you rate the reliability of supply of dental materials in your facility in the last one year? _____
14. On a scale of **0-10**, whereby **“0”** is **“never delivered on time”** and **“10”** is **“always delivered on time”**, how do you rate the timeliness of the delivery of ordered dental materials? _____

15. Do you have the following instruments in your facility?

Dental Instrument	Not available (1)	Not in use, faulty (2)	Not in use, functional (3)	In use, faulty (4)	In use, fully functional (5)
1. Amalgamator	(1)	(2)	(3)	(4)	(5)
2. Light cure machine	(1)	(2)	(3)	(4)	(5)
3. Hand piece	(1)	(2)	(3)	(4)	(5)
4. Compressor	(1)	(2)	(3)	(4)	(5)
5. Dental chair	(1)	(2)	(3)	(4)	(5)
6. Dental x-ray unit	(1)	(2)	(3)	(4)	(5)
7. Autoclave	(1)	(2)	(3)	(4)	(5)
8. Tweezers	Available (1)		Not available (2)		
9. Mixing spatula	Available (1)		Not available (2)		
10. Amalgam carver	Available (1)		Not available (2)		
11. Amalgam carrier	Available (1)		Not available (2)		
12. Condenser	Available (1)		Not available (2)		
13. Plastic filling instrument	Available (1)		Not available (2)		
14. Mouth mirrors	Available (1)		Not available (2)		
15. Probes	Available (1)		Not available (2)		
16. Excavators	Available (1)		Not available (2)		

Questionnaire for dental practitioners (Study IB)

SN: _____ Region: _____

District: _____ Hospital: _____

This section should be answered by all dental practitioners working in the facility.

1. Highest professional qualifications:

1) HA 2) DT 3) ADO 4) DDS 5) Others: _____

2. On a scale of **0-10**, where “**0**” is “**not competent at all**” and “**10**” is “**extremely competent**”, how do you rate your competency if performing the following services and restorations using the following materials?

Dental Material	Perceived competency
1. Tooth extraction	
2. Dental amalgam restoration	
3. Conventional resin composite (light cure)	
4. Packable resin composite (cold cure)	
5. Glass Ionomer cement	
6. Zinc Oxide/ Zinc phosphate	
7. Calcium hydroxide application	

3. Do you have the following items in your facility and what is their status?

Item	Availability of utilities when you require them in order to work				
	Not available (0)	Rarely available (1)	Sometimes (2)	Most of the time (3)	Always (4)
1. Electricity					
2. Tap water					

4. On a scale of **0-10**, whereby “**0**” is “**highly unfavourable**” and “**10**” is “**highly favourable**”, how do you generally rate the availability of utilities towards enabling you to carry out restorative services? _____

5. In the last 1 month, have you:

- | | | |
|----------------------------------|--------|-------|
| 1. Performed an extraction | 1. Yes | 2. No |
| 2. Performed any kind of filling | 1. Yes | 2. No |

Questionnaire for Study II and III

SECTION A: Please fill in this section by filling-in or circling the applicable alternative

1. Age (years): _____
2. Sex:
 - 1) Male
 - 2) Female
3. Marital status:
 - 1) Single
 - 2) Co-habiting
 - 3) Married
 - 4) Widowed
4. Highest education level attained:
 - 1) Never attended school
 - 2) Primary school
 - 3) Did not complete secondary school
 - 4) Completed secondary school
 - 5) College/University
5. How many people are currently living in your household?

6. The average monthly income of your household best fits within which category?
 1. Below Tshs 100,000
 2. Tshs 110,000 to Tshs 250,000
 3. Tshs 260,000 to Tshs 500,000
 4. Tshs 510,000 to Tshs 750,000
 5. Tshs 760,000 to Tshs 1,000,000
 6. Above Tshs 1,000,000
7. Is a dental problem the reason for your visit to the hospital today?
 - 1) Yes
 - 2) No
8. What is your modality for payment of health services today?
 - 1) Out of pocket
 - 2) NHIF
 - 3) NSSF
 - 4) CHF
 - 5) Exempted
 - 6) Others: _____
9. How would you describe the state of your teeth?
 - 1) Very poor
 - 2) Poor
 - 3) Good
 - 4) Very good
10. How satisfied are you with the appearance of your teeth?
 - 1) Very satisfied
 - 2) Satisfied
 - 3) Unsatisfied
 - 4) Very unsatisfied
11. Have you ever gone to a hospital because of a toothache?
 - 1) Yes
 - 2) No
12. Have you ever had a toothache?
 - 1) Yes
 - 2) No

13. Does this facility offer the following services?

14. Have you ever had an extraction of one of the following teeth?

- | | | | |
|-----------------------------|---------|--------|----------------|
| 1) Tooth extraction | 1). Yes | 2). No | 3). Don't know |
| 2) Tooth filling | 1). Yes | 2). No | 3). Don't know |
| 3) Scaling and root planing | 1). Yes | 2). No | 3). Don't know |
| 4) Denture fabrication | 1). Yes | 2). No | 3). Don't know |
| 1) Upper anterior tooth | 1). Yes | 2). No | |
| 2) Upper posterior tooth | 1). Yes | 2). No | |
| 3) Lower anterior tooth | 1). Yes | 2). No | |
| 4) Lower posterior tooth | 1). Yes | 2). No | |

When responding to questions 15 and 16, please run your tongue across your teeth in the oral cavity to assist you in counting the number of teeth present in each jaw.

15. How many teeth do you have in your upper jaw? _____

16. How many teeth do you have in your lower jaw? _____

17. Have you ever had a filling on one of the following teeth?

- | | | |
|--------------------------|---------|--------|
| 1) Upper anterior tooth | 1). Yes | 2). No |
| 2) Upper posterior tooth | 1). Yes | 2). No |
| 3) Lower anterior tooth | 1). Yes | 2). No |
| 4) Lower posterior tooth | 1). Yes | 2). No |

18. How many teeth have you ever had filled so far? _____ (If none, write "0")

SECTION B: Read each statement carefully and circle the alternative which is applicable to *you*. Please note, this is not an examination; there is no single correct answer.

1. Tooth filling treatment completely eliminates toothache
 - 1) Completely agree
 - 2) Agree
 - 3) Mildly agree
 - 4) Mildly disagree
 - 5) Disagree
 - 6) Completely disagree
2. Tooth fillings are expected to dislodge after a short while
 - 1) Completely agree
 - 2) Agree
 - 3) Mildly agree
 - 4) Mildly disagree
 - 5) Disagree
 - 6) Completely disagree
3. Tooth fillings may cause harm later by causing another toothache
 - 1) Completely agree
 - 2) Agree
 - 3) Mildly agree
 - 4) Mildly disagree
 - 5) Disagree
 - 6) Completely disagree
4. Tooth fillings lead to a subsequent slow fracture of filled teeth
 - 1) Completely agree
 - 2) Agree
 - 3) Mildly agree
 - 4) Mildly disagree
 - 5) Disagree
 - 6) Completely disagree
5. A filled tooth allows one to eat cold/hot foodstuffs without any problems
 - 1) Completely agree
 - 2) Agree
 - 3) Mildly agree
 - 4) Mildly disagree
 - 5) Disagree
 - 6) Completely disagree
6. Despite receiving tooth fillings, you will have to extract the tooth eventually
 - 1) Completely agree
 - 2) Agree
 - 3) Mildly agree
 - 4) Mildly disagree
 - 5) Disagree
 - 6) Completely disagree
7. Extraction is the only sure way to treat toothache
 - 1) Completely agree
 - 2) Agree
 - 3) Mildly agree
 - 4) Mildly disagree
 - 5) Disagree
 - 6) Completely disagree
8. Tooth fillings are better treatment for toothaches than tooth extractions
 - 1) Completely agree
 - 2) Agree
 - 3) Mildly agree
 - 4) Mildly disagree
 - 5) Disagree
 - 6) Completely disagree

SECTION C:

INSTRUCTIONS: We would like for you to participate in an exercise on decision making. Any decision or response that you will give in this section **will not influence your treatment or impact your treatment fees in any way.** Please listen to the instructions carefully.

Dental caries is a condition which is associated with cavitations in the teeth and if left untreated may lead to severe pain. One of the methods for treating dental caries is through tooth extractions, whereby the offending tooth is removed completely, leaving a gap in the teeth to remain for the remainder of one's life (except in children, if the extracted tooth is a primary tooth).

Dental fillings are one of the other methods which can be used to treat dental caries. Treatment involves restoration of the cavity and allows you to maintain and utilize your natural teeth. The filling material which is used in this case is of the same colour as your tooth. The procedure usually takes about 30-45 minutes.

Now, consider that you are in a hospital that offers these services, and you have a toothache. Let's assume that you will be forced to pay for treatment for your toothache from your own pocket (even if you currently have health insurance).

Taking into account **your own financial situation**, and the type of tooth which has a toothache, what is **the maximum amount** you would be willing to pay for the following treatments for each type of tooth? *(Please fill in a value for each type of tooth and treatment type. If you do not want to have that treatment at all put in a value of "0").*

Type of tooth		
	Maximum amount for extraction	Maximum amount for filling
1) Upper anterior tooth	Tshs:	Tshs:
2) Upper posterior tooth	Tshs:	Tshs:
3) Lower anterior tooth	Tshs:	Tshs:
4) Lower posterior tooth	Tshs:	Tshs:

Questionnaire for Study IV**Dental patient costs for treatment**

Serial Number: _____

Hospital name: _____

1. **Time that patient entered to see the doctor:** _____ **(Recorded by data assistant)**

2. At what time was your departure to the hospital? _____

3. At what time did you arrive at the clinic? _____

4. How much did your travel to the clinic cost? _____

5 Did anybody escort you to the hospital?

1. Yes 2. No 3. If yes, how many? _____

6. How much did you pay for registration?

1. Tshs. _____ 2. I have health insurance 3. I'm exempted

7. What is the reason for reporting to the clinic?

1. Toothache 2. Gum/ gingival problems 3. Others:

8. What treatment are you here for?

1. Extraction 2. Filling 3. Scaling and Root planing 4. Consultation

5. Others (mention): _____

9. **Time that the patient finished treatment:** _____ **(Recorded by data assistant)**

10. What treatment has the patient received?

1. Tooth extraction	1. Yes	2. No
2. Tooth filling	1. Yes	2.No
3. Root Canal treatment	1. Yes	2. No
4. Scaling and root planning	1. Yes	2. No
5. Consultation and advice	1. Yes	2. No
6. Others: _____	1. Yes	2. No

11. How much did the treatment cost? Tshs. _____ (Refer to pricelist for each respective payment method)

12. What investigations were done?

1. X-ray (PA)	1. Yes	2. No
2. Others: _____	1. Yes	2. No
3. Others: _____	1. Yes	2. No

13. How much did the investigations cost? (Refer to pricelist per payment modality)

Investigation:	Price
1. X-ray	_____
2. _____	

3. _____	

14. Were any medications prescribed? 1. Yes 2. No

15. If yes, what medications? (Copy the prescription)

	Price
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____

16. Travel time: _____ (Calculate from given times in minutes)

17. Waiting time: _____ (Calculate from given times in minutes)

18. Treatment time: _____ (Calculate from given times in minutes)

19. Total treatment time: _____

Annales Universitatis Turkuensis



**UNIVERSITY
OF TURKU**

ISBN 978-951-29-7674-4 (PRINT)
ISBN 978-951-29-7675-1 (PDF)
ISSN 0355-9483 (Print)
ISSN 2343-3213 (Online)