ASSESSMENT OF THE EFFECT OF SUPERVISED TOOTH-BRUSHING AND USE OF PLAQUE DISCLOSING AGENT ON ORAL HEALTH STATUS OF PRIMARY SCHOOL PUPILS IN DAR-ES-SALAAM

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By

Mercy Aenea Maya

A Dissertation Submitted in (partial) Fulfillment for Requirements for the Degree of Master of Dentistry (Paediatric Dentistry) of Muhimbili University of Health and Allied Sciences

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CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled ***"Assessment of the effect of supervised tooth-brushing and use of plaque disclosing agent on oral health status of primary school pupils in Dar-Es-Salaam"*** in (Partial) fulfilment of the requirements for the degree of Master of Dentistry (Paediatric Dentistry) of Muhimbili University of Health and Allied Sciences.

_____

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Dr Mbawalla H.S

(Supervisor)

Date: _____

DECLARATION
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I, **Mercy Aenea Maya**, declare that this **dissertation** is my own original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award.

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DEDICATION

This dissertation is dedicated to my mother Dr Margareth Maya, my lovely husband Dr David Isaya Minja, our daughter Michelle David Minja and my uncle Dr Elifuraha G. Maya.

LIST OF ABBREVIATIONS

CPI	Community Periodontal Index
DPGS	Director of Postgraduate Studies
GI	Gingival Index
IRB	Institutional Review Board
MUHAS	Muhimbili University of Health and Allied Sciences
OPCD	Orthodontics Paedodontics and Community Dentistry
PHP	Patient Hygiene Performance
PI	Plaque Index
SOD	School of Dentistry
STB	Supervised tooth brushing
SPSS	Statistical Package for Social Sciences
WHO	World Health Organization

DEFINITION OF KEY TERMS

Supervised tooth brushing (STB); is the act of observing and directing children on how to perform tooth brushing.

Plaque disclosing agent; is a selective dye in solution, tablet or lozenge form used to stain, visualize and identify dental plaque on teeth surfaces.

Plaque control; preventive measures aimed at removing dental plaque and preventing it from recurring.

Oral health; is a state of being free from chronic mouth and facial pain, oral and throat cancer, oral sores, birth defects such as cleft lip and palate, periodontal (gum) disease, tooth decay and tooth loss, and other diseases and disorders that affect the oral cavity.

ABSTRACT

Background

Use of plaque disclosing agent and supervised tooth brushing have shown to be effective in improving children's oral hygiene status in communities where children have good oral health behavior and home care.

Aim

The aim of this study was to examine the effect of using plaque disclosing agent to aid tooth brushing and that of supervised tooth brushing on oral hygiene status, gingival health and tooth brushing skills of primary school pupils in Dar es Salaam.

Methodology

This was a cluster randomized controlled field trial study with two interventions; supervised tooth brushing and use of plaque disclosing agent to guide tooth brushing in 7 to 8 years old children. Cluster sampling design was used to select the participants using a school as a sampling and randomization unit. Following baseline data collection of 245 pupils from ten schools, the schools were randomly allocated into three groups; three schools in each intervention arm and four in a control arm. The pupils were supervised to brush their teeth or to use plaque disclosing agent to aid tooth brushing for three consecutive days and were reminded on the interventions done once a week for a period of two weeks.

Interviews (social demographics and oral health related behaviors), dental clinical examination (dental plaque and gingival bleeding) and observation of required tooth brushing skills were used for data collection before and after intervention.

Data entry and analysis was done by using SPSS version 20.0. Frequency distribution for proportions, means for intervention outcomes were computed and cross tabulation was conducted to bivariately compare the variables. Paired t-test and one way analysis of variance (ANOVA) were used to compare intervention outcome means from baseline to follow up and examine influence of individual intervention on the intervention outcomes, respectively. Multinomial logistic regression was performed to adjust for the effect of socio-demographics and oral health behaviors on observed changes and was reported as odds ratio and 95% confidence interval; p-value<0.05.

Results

A total of 245 pupils participated at baseline and 231 at follow-up. They were equally distributed in terms of sex (Female=50.2%) and age (8 years=50.2%), with parents of average education and occupational status. Children who brushed at least twice a day were only 8.2% and less than quarter (26.5%) were supervised during tooth brushing.

At baseline, mean plaque score, gingival bleeding and tooth brushing skills were 26.0, 5.8 and 0.2, respectively. They were respectively, 20.3, 3.4 and 0.7 at follow up.

Use of plaque disclosing agent had statistical significant effect on plaque and gingival bleeding score. The mean differences for the effect were 2.8 (0.8, 4.8) for plaque and 1.2 (0.4, 2.0) for gingival bleeding. The mean difference for the effect of supervised tooth brushing were 2.2 (0.1, 4.1) for plaque and -1.0 (-1.2,-0.6) for tooth brushing skills.

Conclusion

Majority of the children had poor oral hygiene, unhealthy gingiva and had no tooth brushing skills at baseline. Supervised tooth brushing showed positive effect on pupil's tooth brushing skills and oral hygiene status. The use of plaque disclosing agent to aid tooth brushing positively influenced pupils' oral hygiene status and gingival health. Most socio-demographics and oral hygiene practices had an insignificant influence on the observed outcomes of the interventions.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND

Tooth brushing is the process of using a toothbrush to remove soft deposits and provide gingival stimulation (Dictionary O.E, 2007). Different tooth brushing techniques are effective; these are horizontal scrub technique, Bass technique, Stillman's technique, Fones technique, modified Bass and Stillman's techniques (Vuran, 2013). Tooth brushing helps to remove dental plaque, a soft deposit that forms the bio film adhering to the tooth surface (Rosan et al., 2000).

The dental plaque is the diverse microbial community found on the tooth surface embedded in a matrix of polymers of bacterial and salivary origin (Marsh and Bradshaw., 1995). It is the cause of gingivitis and other periodontal diseases (Axelsson et al., 1981; Gallagher et al., 2009). The dental plaque biofilm cannot be eliminated but its pathogenic nature can be diminished by reducing bio-burden and maintaining normal flora through appropriate oral hygiene methods that include daily tooth brushing, flossing and rinsing with antimicrobial mouth rinse (Saini et al., 2015).

The professional recommendation for tooth brushing is to clean all teeth surfaces (the outer surfaces, the inside surfaces and the chewing surfaces) twice daily for 2–3 minutes applying gentle force. The brushing should be done in the morning preferably after breakfast and in the evening before going to bed (Davies et al., 2003; Ganss et al., 2009). A soft-bristled brush is best for removing plaque and debris from teeth and it is advised to replace the tooth brush after every three or four months, or sooner if the bristles are frayed (ADA, 2012). A tooth brush should be positioned at an angle of 45^{o} to the gums, held in a pen grip using the thumb and forefinger. Furthermore, the tooth brush should be gently moved back and forth in short strokes to dislodge plaque at the gum margins and teeth surfaces which are the outer surfaces, the inside surfaces and the chewing surfaces. During cleaning of the inside surface of the front teeth, a tooth brush should be positioned vertically and be moved to make several up-and-down strokes (DHF, 2017; ADA, 2012).

With respect to children, it is recommended that parents/caregivers should start to clean children's teeth as soon as the first tooth emerges in the oral cavity. They should institute regular tooth brushing upon emergence of the first deciduous molar tooth around two years of age. The parents/caregivers should continue to brush children's teeth up to the age of six years (DHF, 2017). This is due to the fact that young children are not cognitively developed to be able to follow the tooth brushing instructions nor do they have the manual dexterity required to brush their teeth effectively. Then parents should supervise the children's brushing exercise up to the age of nine years to ensure effectiveness. After the age of nine, children can brush on their own (Deery et al 2005; ADA, 2008).

Supervised tooth brushing in children is an act of observing and directing a child on how to perform tooth brushing (Online medical dictionary). It is done in order to ensure children's effective and appropriate oral hygiene practice. The supervision may be aided by plaque disclosing agents which are supplied in different colors. The contrasting color of a disclosing agent provides help to differentiate plaque from similarly colored tooth surfaces. This facilitates visibility and appreciation of plaque retentive areas and thus its removal (Chounchaisithi et al., 2014). If well done, it will result in children's good oral hygiene status (Shenoy et al., 2010) that is; good level of cleanliness of the mouth and teeth which is pivotal in the prevention of the common oral diseases; dental caries, gingivitis and periodontal diseases.

In Tanzania, there is no universal norm for tooth brushing in children or the recommendation for parental/guardian supervision adhered to in routine family practices. Generally, children brush their own teeth at the ages when they should be brushed or supervised. Consequently, most children often have gingivitis. Supervised tooth brushing at school by dental professionals may help children to attain the required level of oral hygiene. Therefore, the purpose of this study is to examine the effect of supervised tooth brushing and the use of plaque disclosing agent on tooth brushing effectiveness and oral hygiene status of primary school pupils in Dar es Salaam.

1.2 LITERATURE REVIEW

Oral hygiene status of school children

Globally several studies have reported the prevalence of dental plaque in children aged 5 to 15 years ranging from 38.3% to 54% (Dwivedi et al., 2011; Dawani et al.,2012). Furthermore, other studies on oral hygiene status which were done in United States of America by Harowitz et al. (1976), Yemen by Al-Haddad et al. (2013) and Pakistan by Mohiuddin et al. (2015) among children aged 5,6 and 12 years reported the mean plaque index to vary from 0.35 to 3.15. In Africa the prevalence of dental plaque among children aged 6 to 15 years old was 95.3% in Ghana (Ndalu et al., 2015) and 67.3% in Ethiopia (Mulu et al., 2014). Other studies among children of similar age group in East Africa reported the prevalence to range from 30.2% to 68.8% (Kikwilu et al., 2001; Batwala et al., 2007).

Gingival health of school children

Different studies were done to assess gingival bleeding among children of different age groups. The prevalence of gingival bleeding among children between age group 4 to 15 years reported to range from 18.3% to 71.1% in Jordan by Sayegh et al. (2005), the rest of Africa (Kolawole et al., 2011; Ndalu et al., 2015) and Tanzania by Kikwilu et al. (2001). In United States of America and Middle East the mean gingival bleeding score among school children aged 5 to 12 years reported to range from 0.11 to 5.8 (Harowitz et al., 1976; Al-Haddad et al., 2013; Mohiuddin et al., 2015).

Tooth brushing skills among school children

A number of studies to asses tooth brushing skills have been done from different countries. A study on assessment of fine motor skills and tooth brushing skills in 5-6 year olds in Tehran, Iran showed that brushing skills improved with increase of age. The 6 year old children had better brushing skills than 5 years old children (Mahmoodi et. al., 2014). Similar results were reported in a study on evaluation of tooth brushing skills in children aged 6-12 years (Pujar et. al., 2013). Another study done in Canada by Hawkins et al. (2001) reported that most children were able to hold the tooth brush properly but few were able to show the studied tooth

brushing skills. A study done in Sweden on tooth brushing behavior in children: a study of pressure and stroke frequency among children aged 7 and 11 years old found that very few participants 7 years were able to show horizontal and short stroke**,** while 11 years old most participants were able to show the same skills (Sundell et al., 1982). In Tanzania there is limited number of studies assessed tooth brushing skills.

Effectiveness of supervised tooth brushing on oral hygiene status, gingival bleeding and tooth brushing skills among school children

Several studies have been done to measure the effectiveness of supervised tooth brushing in oral hygiene status, gingival bleeding score and tooth brushing skills. A 3 days study done among 5 to 6 years old in Brazil reported a reduction of plaque index from 58% to 20% when supervised tooth brushing was done (Leal et al., 2002). A study in India among 12 to 15 years old adolescents with a follow up period of three months reported a mean plaque score reduction of up to 0.82 from 2.91 among boys and 0.95 from 2.78 among girls. Gingival bleeding index in the same study was slightly reduced up to 0.29 from 0.31 and 0.21 from 0.23 for boys and girls respectively (Damle et al., 2014).

Brushing skills were reported to improve among children after provision of dental health education; in a study done to first grade children in Jerusalem, Israel showed improved brushing skills after a demonstration by a dentist the highest being from 92.3% to 98.5% and the lowest 8.2% to 43.1% (Livny et al., 2008).

In the United States a study on developing brushing performance in second graders students showed that children in the control group had 47% more plaque compare to a group where education on oral health and hygiene performance was provided (Martens et al., 1973). Another study in America found that an increase in time taken when performing oral hygiene had a positive effect on plaque removal before and after intervention from mean plaque score of 2.95 to 2.13 at 30 seconds, 2.98 to 2.06 at 120 seconds and 3.00 to 2.01 at 180 seconds (Gallagher et al., 2009). On the other hand a study in Tanzania by Palenstein et al. (1997) on tooth brushing supervision done by primary school teachers reported a reduction in mean

plaque score from 20.5 to 15.9 and mean gingival bleeding score from 4.9 to 3.5 at three months following supervised tooth brushing intervention.

Effect of using plaque disclosing agent to aid tooth brushing on oral hygiene status among school children

Previous studies have revealed that tooth brushing using plaque disclosing agents has remarkable results in improving oral hygiene status. Studies done in Brazil and Thailand among children and adolescents on the effect of plaque disclosing agent on oral hygiene performance showed a noticeable improvement on plaque reduction among those who were in intervened compared to the control (Chounchaisithi et. al., 2014; Frazão et al., 2004; Leal et al., 2002). Another study done in United States of America used plaque disclosing agent as a mean to identify/display plaque during supervised tooth brushing intervention and the results showed reduction of mean plaque score and mean gingival inflammation from 3.17 (0.04) to 2.14 (0.05) and 1.14 (0.02) to 0.18 (0.03), respectively (Harowitz et al., 1976).

Influence of socio-demographic factors on effect of supervised tooth brushing on oral hygiene status, gingival health and tooth brushing skills

Different studies have assessed the influence of socio-demographic factors of supervised tooth brushing on oral hygiene status and gingival health. A study done in Vietnam among 6 years old primary school pupils who were supervised on tooth brushing reported that there was a reduction of plaque after tooth brushing supervision for both boys and girls which were statistically significant (Lindmark et al., 2012). Damle et al. (2014) reported that there was reduction of plaque and gingival index scores from baseline to follow up for both boys and girls in both rural and urban supervised tooth brushing groups as compared to control. Another study in Jerusalem among grade one pupils reported girls improved on assessed tooth brushing skills compared to boys after supervision of tooth brushing (Livny et al., 2008).

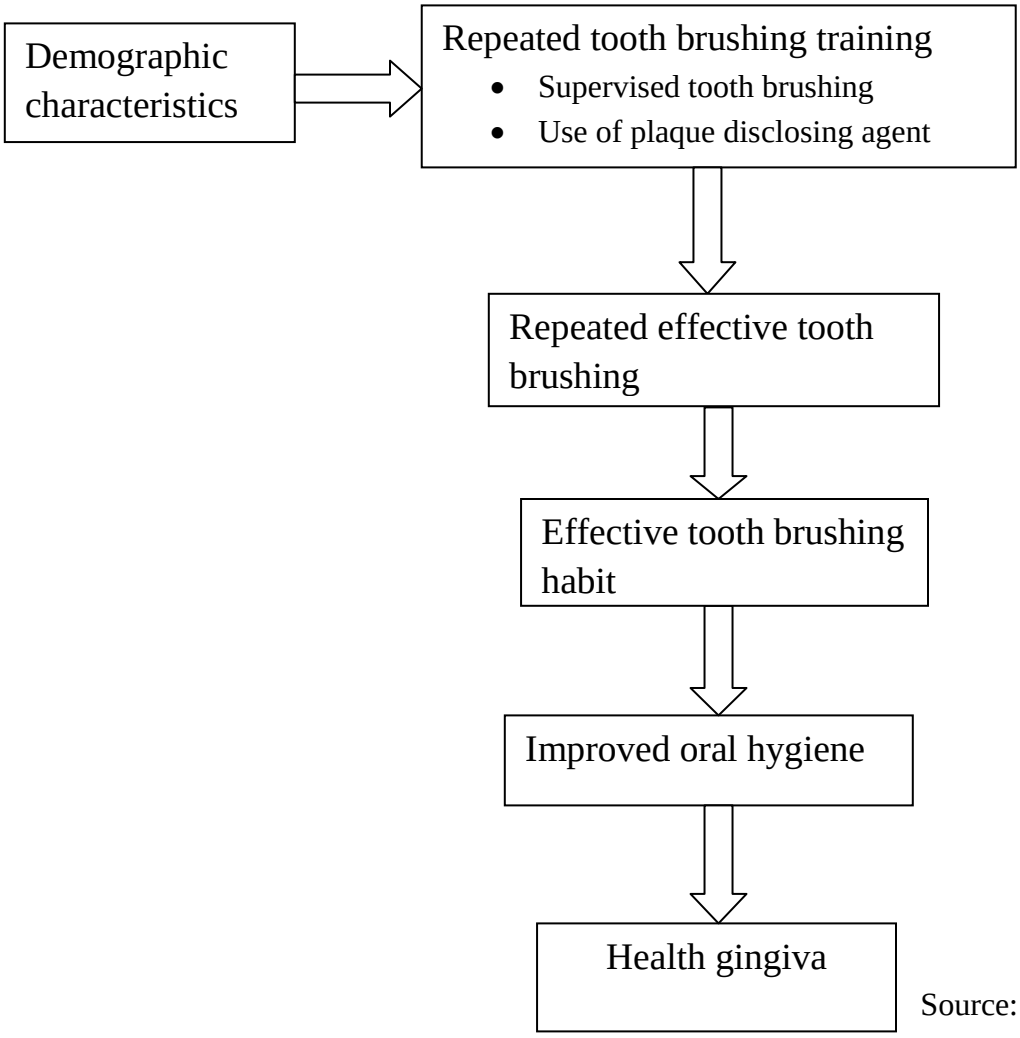
Influence of socio-demographic factors on effect of plaque disclosing agent on oral hygiene status, gingival health and tooth brushing skills

A study in Thailand on the use of plaque disclosing agent among primary school pupils and its effect on oral hygiene status measured by patient hygiene performance score reduction reported that, there was no influence on sex of participants and parent's supervision on oral hygiene on the reduction of patient hygiene performance score (Chounchaisithi et. al., 2014).

There was a limitation on assessing other studies which only used plaque disclosing agent to assess effect on oral hygiene status, gingival health and skills on tooth brushing.

1.3 CONCEPTUAL FRAMEWORK

Tooth brushing training in children in a form of supervised tooth brushing and use of plaque disclosing agent to guide tooth brushing will ensure effectiveness in tooth brushing. The repeated training and effectiveness in tooth brushing will result into a positive tooth brushing habit and improved oral hygiene. However, training on tooth brushing is usually influenced by the child's basic socio-demographic characteristics such as their age, parental educational level and their occupation. These will affect the duration of training such that some children will take longer time than others and some will not acquire skills at all as a result a desired habit cannot be attained. The effective tooth brushing habit will ultimately affect oral hygiene performance hence ensure gingival health.



Source: Maya, 2016

1.4 STATEMENT OF THE PROBLEM

Most Tanzanians both children and adults report to brush their teeth regularly. However, during screening exercises most of them are found to have oral hygiene related diseases, indicating that oral hygiene is not done appropriately. In addition, the arena for learning this appropriate oral hygiene practices is not well identified. In practice, Tanzanians learn oral hygiene practices and skills from their parents who on their side may neither be well informed nor equipped. Only a few Tanzanians who seek dental consultation may get an opportunity of receiving such information from oral health professionals during chair side teaching. This is usually late when diseases have occurred instead of being trained at a young age and before they get diseases. Unfortunately, it is not known how effective is professional training through supervised tooth brushing or use of plague disclosing agent on children's tooth brushing skills, plaque score and gingival health.

1.5 RATIONALE OF THE STUDY

The results of this study will benefit the dental community by providing new information on how supervised tooth brushing and use of plaque disclosing agent affect children's oral hygiene status and it will give baseline information to dental scientific community where other studies can be built on. It will form a basis for recommending to Kinondoni municipal, dental professionals as well as the Tanzanian government on the importance of establishing supervised tooth brushing programs to primary school children during school visits. In addition, the study is a partial fulfillment for completion of MDent Paediatric Dentistry studies.

1.6 RESEARCH HYPOTHESIS

Null hypothesis:

1. Use of plaque disclosing agent to aid tooth brushing will not improve tooth brushing effectiveness and oral hygiene status of primary school pupils in Dar es Salaam.
2. Supervised tooth brushing will not improve tooth brushing effectiveness and oral hygiene status of primary school pupils in Dar es Salaam.

Alternative hypothesis:

1. The use of plaque disclosing agent to aid tooth brushing will improve tooth brushing effectiveness and oral hygiene status of primary school pupils in Dar es Salaam.
2. Supervised tooth brushing will improve tooth brushing effectiveness and oral hygiene status of primary school pupils in Dar es Salaam.

1.7 OBJECTIVES OF THE STUDY

1.7.1 Broad objective

To examine the effect of using plaque disclosing agent and that of supervised tooth brushing on oral hygiene status, gingival health and tooth brushing skills of primary school pupils in Dar es Salaam.

1.7.2 Specific objectives

i. To determine oral hygiene status among 7-8 years old primary school pupils in Dar es Salaam at baseline.
ii. To determine gingival health among 7-8 years old primary school pupils in Dar es Salaam at baseline.
iii. To determine tooth brushing skills among 7-8 years old primary school pupils in Dar es Salaam at baseline.
iv. To determine the effect of using plaque disclosing agent while brushing teeth on oral hygiene status, gingival health and tooth brushing skills of 7-8 years old primary school pupils in Dar es Salaam.
v. To determine the effect of supervised tooth brushing on oral hygiene status, gingival health and tooth brushing skills among 7-8 years old primary school pupils in Dar es Salaam.
vi. To compare the effect of supervised tooth brushing and using of plaque disclosing agent as they influence oral hygiene status, gingival health and tooth brushing skills among 7-8 years old primary school pupils in Dar es Salaam.

vii. To examine the association between socio-demographics and supervised tooth brushing as they influence oral hygiene status, gingival health and tooth brushing skills.

viii. To examine the association between socio-demographics and the use of plaque disclosing agent as they influence oral hygiene status, gingival health and tooth brushing skills.

CHAPTER TWO

2.0 MATERIALS AND METHODS

2.1 Type of the study

The study was a cluster randomized controlled field trial which tested an oral health education program on tooth brushing among primary school pupils. Primary schools were the clusters. Baseline information was collected followed by random allocation of the clusters into intervention and control groups. Pupils of the intervention clusters received the intervention and were evaluated for anticipated outcome.

2.2 Study Area

This study was conducted in Kinondoni municipal, Dar-es-Salaam, one of the five municipals in the region namely; Temeke, Kigamboni, Ilala, Kinondoni and Ubungo. Kinondoni was conveniently selected because it had an ongoing school health program whereby pupils in standard I and II received health information including oral health education and were examined for oral diseases. Consequently, parents of Kinondoni municipal were aware of the school health programs and therefore they were expected to cooperate during the study. Furthermore, municipal authorities' cooperation was expected since school health programs is one of the activities they have to perform.

2.3 Study population

The study involved standard II primary school children, aged 7–8 years as of their last birthday from 10 schools in Kinondoni municipal.

Children at this age are expected to have started to brush their teeth under parental supervision. Furthermore, these children might have established school socialization life, sense of learning new simple skills and accept new roles in childhood community. Therefore, they were expected to understand, follow simple instructions and retain the gained knowledge and skills up to their adulthood.

2.3.1 Inclusion criteria

Children aged 7-8 year as of their last birthday attending standard II at the selected schools were eligible to take part in the study.

2.3.2 Exclusion criteria

Excluded from the study were children who had significant oral pathologies other than gingivitis, dental caries and those with marked disabilities.

2.3.3 Number of eligible participants

There were 140 public primary schools in Kinondoni municipal enrolling 152,426 students. With standard I enrolment of approximately 11,536 pupils per year, about 70 pupils per school were expected to continue to standard II each year per school (Kinondoni Council 2014). Among these, 90% were estimated to be 7 – 8 years. Being the schools owned by the municipal authorities, it guaranteed full participation by the children.

2.3.4 Acceptability of participants

Most pupils agreed to take part in the study probably because school oral health programs were routine to these schools. Furthermore, the need for oral health care in children was high, thus an oral health intervention in the schools was supported by both; school authorities and the communities around the schools.

The project enrolled pupils at the lower grades of primary education who were assessed to be living nearby the school, hence ensured their availability and retention during the study period.

2.4 Sample size estimation

The sample size for this study was obtained based on the formula and assumption below:

$$3N=\frac{2\{Z_{\alpha/2}\sqrt{2P(1-P)}+Z_{\beta}\sqrt{p_o(1-p_o)+p_1(1-p_1)}\}^2}{(p_o-p_1)^2} \quad \ldots\ldots\ldots\ldots (1)$$

$$n_1=3N/3$$

$$n_c= n_1[1 + (m - 1)\rho] \quad \ldots\ldots (2)$$

Whereby:

n_c = Number of pupils/participants in cluster per arm

n_1 = Individual number of participants (pupils) in an arm when considering random sampling

3N = Number of participant (children) in 3 arms

$Z_{\alpha/2}$ = Point on standard normal distribution corresponding to level of confidence of the study estimated to be 1.96 for 95% Confidence Interval

Z_β = Power of the study estimated to be 85%

P_o = Initial proportion of the school children who perform effective tooth brushing estimated to be 20%

P_1 = Proportion of the school children who will perform effective tooth brushing after intervention estimated to be 55%

P = Mean proportion of children performing effective tooth brushing

ρ = Estimated intra-cluster correlation coefficient (ICC) of 0.005

m = Estimated cluster size in this case it is 50 pupils

$$3N=\frac{2\{1.96\sqrt{2x0.375(1-0.375)}+1.03\sqrt{0.2(1-0.2)+0.55(1-0.55)}\}^2}{(0.2-0.55)^2}$$

3N=65.3

N=21.78≈22 pupils

There were 22 pupils per arm when estimated under simple random sampling.

Considering cluster sampling design;

$n_c = n1[1 + (m - 1)\rho]$…….(2)

=22[1+ (50 -1)0.005

= 27.4 ≈ =27 per cluster

Number of students in a cluster was estimated to be 27

Since 10 clusters are the minimum recommended number of clusters for intervention studies with fixed number of participants, in this case primary school classes for maximum achievable

power (Hemming, K et al 2011), therefore in 10 clusters, each having 27 pupils the sample size was estimated to be 10x27=270. A total of 270 school children were expected to take part in the study.

2.5 Sampling technique

To attain a sample size of 270 children and cluster size of 27 pupils in a cluster (school), a two stage cluster sampling technique was used to select the participants. Whereby, schools were the sampling unit in the first stage and an individual pupil was a sampling unit in the second stage.

During the first stage, ten primary schools were conveniently selected from four wards of Kinondoni municipal namely; Ndugumbi, Magomeni, Mzimuni and Kigogo. These four wards were selected for logistics reasons of being closer to MUHAS where the principal investigator was able to effectively supervise and follow up the intervention activities. The schools selected were Mikumi, Mzimuni, Ndugumbi, Turiani, Mwl. Nyerere, A. H. Mwinyi, Magomeni, Mapinduzi, Gilman Rutihinda and Mkwawa primary schools.

In the second stage pupils were selected using a systematic sampling method by utilizing class attendance registers through picking every fourth child in the list, until the required number (27 pupils) was attained.

2.6 Subject recruitment

All pupils who were selected to participate were provided with letters of informed consent to deliver to their parents (Appendix I). The letters informed parents of the study and requested consent for their children to take part. Pupils who brought back signed informed consent form their parents/guardians were recruited into the study. The participation rate at baseline was 90.7% and at follow up was 85.6%.

2.7 Randomization

Randomization of clusters was done immediately after baseline data collection. It is recommended in cluster randomization that controlled studies with two intervention groups the number of clusters in control group be 1.4 times that of the intervention group. Hence, in

this study four schools were allocated to the control group and three schools in each of the intervention groups.

A simple randomization procedure was employed to allocate participating schools into the respective study groups. Ten identical pieces of paper bearing individual names of the schools to take part in the study were put in a container. One person picked a piece of paper from the container where the school name was located to one of the three groups, one at a time and in turns. After the selected school was recorded, the piece of paper was returned back into the container for another round of selection. This was repeated until all the ten schools were allocated to their respective groups.

2.8 Blinding

The study was single blinded; that is only the assessor was not aware of the group assignment and intervention given. This was due to the nature of intervention trial, which was educational. Therefore, interaction between the intervened participants and the investigator could not be avoided; hence blinding the participants was not feasible. Basic oral health information that was provided to all of the ten schools regardless of the group assignment acted as a pseudo placebo.

2.9 Trial Intervention

There were two intervention trials, namely; supervised tooth brushing and use of plaque disclosing agent to guide tooth brushing and a control group.

2.9.1 Supervised tooth brushing

This entailed demonstration group training and coaching on proper tooth brushing procedures appropriate for child population.

Following oral health education which was done in class, children in this intervention group received instructions and demonstration of tooth brushing using a mouth mankin and a tooth brush model. They were instructed on sequential tooth brushing, teeth surfaces to be brushed, horizontal movements of short strokes and recommended duration of tooth brushing (Appendix II).

- *Sequential tooth brushing:* children were instructed to start brushing on upper right side of the jaw then anterior part of the upper jaw followed by the upper left side of the upper jaw. Then the child brushed the lower jaw left side, the anterior part/segment and finally the lower jaw right side.
- *Teeth surfaces to be brushed:* children were instructed to brush the outer surfaces of the teeth, inner surfaces and then the chewing surfaces.
- *Horizontal movements of short strokes*: children were instructed to brush back and forth brush movements with short overlapping steps to cover two to three teeth.
- *Duration of tooth brushing:* children were instructed to count up to ten for each side and surfaces brushed making a total of about 120 counts approximating the recommended two minutes.

2.9.2 Use of plaque disclosing agent

This study utilized plaque disclosing agents in form of bright purple chewable tablets. Before brushing, each child chewed a tablet and rinsed. Therefore, they visualized their teeth via a face mirror. Colored stains on the teeth indicated areas covered with plaque. Coloring facilitated the child to brush and ensure cleaning of all stained areas.

2.10 Intervention groups

The study had two matched intervention groups and one control. The interventions were preceded by class presentation on oral health education to all groups. In the first intervention group, pupils were provided with plaque disclosing agent in form of tablets for them to chew then rinse and thereafter brush their teeth on their own way with the help of the face mirror (Appendix IIIA). Pupils in the second intervention group performed tooth brushing under supervision in addition to classroom instructions and oral health education (Appendix IIIB). Children who were in the control group received oral health education and maintained their standard of dental care (Appendix IV).

2.11 Intervention period and quality control.

Two weeks after baseline data collection schools were revisited for execution of the intervention, which was done for three consecutive days by giving similar instructions on each day. This was completed after two weeks followed by monitoring of the intervention at all schools which was done weekly for two weeks. During monitoring children in the supervised group were reminded on tooth brushing procedures this included the surfaces to be brushed, sequence and adequate time recommended during tooth brushing. Children were asked questions on oral health education as a reminder of the information provided. Those who used plaque disclosing agent group were reminded on oral health education only preceded by questions on the same information. Nothing was done in the control group. Lastly follow up data collection was done to all the three groups for two weeks.

Quality of the intervention was assured by requesting the Kinondoni Municipal to refrain from any oral health intervention to the schools involved in the study and use of trained dentist to perform the intervention.

2.12 Intervention outcome

- The primary outcome of the study is tooth brushing skills improvement among the studied groups.
- Secondary outcome is reduction of plaque and gingival score and increase of awareness on oral health.

2.13 Data collection

2.13.1 Data collection schedule

Data was collected in two phases, at baseline and after intervention using the same instruments, i.e. variables assessed at baseline were reassessed during evaluation.

2.13.2 Tools for data collection

Data collection was done using a structured questionnaire (Appendix V and VI), dental clinical examination (Appendix VII) and observation.

The questionnaire inquired on possible confounders for the planned interventions namely; basic socio-demographics and oral health related behaviours. The socio-demographics

included; children's age and sex as well as parents' level of education and occupation. Whereas inquired oral health related behaviors included; frequency of tooth brushing and child's supervision during tooth brushing.

Dental clinical examination was done to score dental plaque and gingival bleeding status. Examination was performed by one trained personnel with subjects sited on a desk utilizing natural daylight. A head torch was used as an additional source of light. Mouth mirrors, and Community Periodontal Index (CPI) probes were used to aid examination.

Observation of children as they brushed their teeth was used as a means of assessing tooth brushing effectiveness. This was recorded on a form particularly designed for this purpose.

2.13.3 Measurements for variables

Plaque was assessed on six index teeth as recommended by Silness and Loe modified and customized for children namely 16, 11, 64, 36, 32 and 84 (Silness and Loe., 1964). On each tooth the following surfaces (M, B, L) were assessed. Scoring for plaque was done as follows;

0 = No plaque

1 = A film of plaque adhering to the free gingival margin and adjacent area of the tooth, which cannot be seen with the naked eye, but only by using disclosing solution or by using probe.

2 = Moderate accumulation of deposits within the gingival pocket, on the gingival margin and/ or adjacent tooth surface, which can be seen with the naked eye.

3 = Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.

Gingival health was assessed on six index teeth as recommended by Silness and Loe., 1963 customized for children namely 16, 11, 64, 36, 32 and 84. The scores were as follows (Poulsen S., 1981);

0 = No inflammation.

1 = Mild inflammation, slight change in color, slight edema, no bleeding on probing.

2 = Moderate inflammation, moderate glazing, redness, bleeding on probing.

3 = Severe inflammation, marked redness and hypertrophy, ulceration, tendency to spontaneous bleeding.

The child's tooth brushing effectiveness was assessed using the following criteria:

- Sequential tooth brushing: child following recommended sequence during tooth brushing scored 1 point and if not scored as 0.
- Teeth surfaces to be brushed: a child brushing all the surfaces of the teeth scored 1 point and if not scored as 0.
- Horizontal movements of short strokes: child brushing with horizontal short stroke movements scored 1 point and if not scored as 0.

Operational definitions

Gingivitis was measured by presence of inflammation of the gum and/or bleeding after gentle probing of the gums.

Tooth brushing sequence was measured by observing children who brushed starting from upper right side of the jaw then anterior part of the upper jaw followed by the upper left side of the upper jaw, there after the lower jaw left side, the anterior part/segment and finally brushes the lower jaw right side.

Tooth surfaces assessed were the outer surfaces, inner surfaces and then the chewing surfaces of the teeth.

Tooth brushing strokes were measured by back and forth brush movements of tooth brush with short overlapping steps.

Tooth brushing duration was instructed and measured by the child to count up to ten for each side and surfaces brushed making a total of about 120 counts approximating the recommended two minutes.

2.14 Validity and reliability of data

Data validity was ensured through the use of trained personnel (dentists) for data collection and recording. Furthermore, the examiner was blinded and intra-examiner.

Data reliability was ensured through pretest of questionnaire, training and calibrating the examiner on plaque and gingival bleeding scoring using Silness and Loe index prior to data collection.

2.15 Compliance and withdrawal

Attendance registry for children under the intervention groups was prepared to ensure their daily attendance during supervised tooth brushing sessions and plaque disclosing agent use accordingly. Seven children who did not attend training session for two or more days were excluded from the intervention.

2.16 Ethical consideration

Ethical clearance was provided by MUHAS Institutional Review Board (IRB). Consultation was done with Kinondoni Municipal authority to obtain permission to undertake the study within the areas of their jurisdiction. Parents/guardians and their children were informed about the purpose of the study, data to be collected and their voluntary participation. Pupils whose parents/guardians agreed with the study and signed a letter of informed consent were invited for enrollment (Appendix I). Only pupils who asserted to participate were enrolled into the study. Confidentiality of the information was maintained and freedom to withdraw from the study anytime was stipulated.

2.17 Data entry, coding and transformation

Data entry was done using a computer software program SPSS version 20.0 which started immediately after data collection to ensure accuracy and consistency of data set. Data cleaning was done by running frequencies and sorting specific variables in ascending/descending order to identify miscoded variables, duplicates, omissions, etc.

Data coding was done to aid analysis as follows;

Schools were grouped in their respective group whereby

- 0= Control group
- 1= Supervised tooth brushing group
- 2= Plaque disclosing agent group.

Plaque at baseline and follow up was assessed according to Silness and Loe., 1964 as;

- 0 = No plaque
- 1 = A film of plaque adhering to the free gingival margin and adjacent area of the tooth, which cannot be seen with the naked eye, but only by using disclosing solution or by using probe
- 2 = Moderate accumulation of deposits within the gingival pocket, on the gingival margin and/ or adjacent tooth surface, which can be seen with the naked eye
- 3 = Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.

To aid analysis these values were coded as;

- 0 =no plaque (have no plaque)
- 1 = those who had plaque (have plaque more than one third of tooth surfaces)

Mean plaque score was obtained from total number of plaque score on teeth surfaces examined and scored for plaque.

Gingivitis was assessed according to Silness and Loe., 1963 as;

- 0 = No inflammation
- 1 = Mild inflammation, slight change in color, slight edema, no bleeding on probing
- 2 = Moderate inflammation, moderate glazing, redness, bleeding on probing
- 3 = Severe inflammation, marked redness and hypertrophy, ulceration, tendency to spontaneous bleeding.

These scores were coded for analysis as;

- 0=healthy gum
- 1=gingivitis

Mean gingival bleeding score was obtained from total number of inflammation score on teeth examined for gingivitis.

Tooth brushing skills were assessed as follows;

Child following recommended sequence, surfaces, time and horizontal movement scored 1 in each skill.

Child who did not manage to perform the skills scored 0 in each skill they failed. Time was removed because it was not reliable.

The skills were then categorized as;

- Have no skills
- Have at least one skill
- Have two skills and have all skills

To aid analysis these were dichotomized and coded as;

- 0= have no skill
- 1= have at least one skill.

Mean tooth brushing score was obtained from total number of skills examined from pupils.

Parents' education was scoded as;

- 1= No formal education
- 2= Primary education
- 3= Secondary education
- 4= College/University.

These values were coded for analysis as;

- 1 to 2=0 which was 'primary or less than primary school
- 3 to 4=1 which was secondary education or higher.

Mothers' occupation was scored as

- 1= House wife
- 2= Small scale business
- 3= Day worker
- 4= Employed
- 5= Business woman
- 6= Self employed.

These were coded for analysis as;

- 1=0 which was 'Have no income generating activities outside home
- 2 to 6 = 1 which was 'Have income generating activities outside home

Fathers' education was scored as;

- 1= Small scale business
- 2= Day worker
- 3= Employed
- 4= Business man
- 5= Self employed.

To aid analysis these were coded as;

- 1,2 and 5=0 which was 'self-employed or small scale business
- 4 to 3=1 which was employed or business men'.

Tooth brushing frequency was scored as;

- 1=Once a day
- 2=Twice a day
- 3=Three times a day
- 4=More than three times a day.

These values were coded and categorized for analysis as;

- 1=0 which was once a day
- 2 to 4=1 which was at least twice a day.

2.18 Data entry and analysis

Data entry and analysis was done by using SPSS version 20.0. Frequency distribution for proportions, means for intervention outcomes were computed and cross tabulation was conducted to bivariately compare the variables. Paired t-test and one way analysis of variance (ANOVA) were used to compare intervention outcome means from baseline to follow up and examine influence of individual intervention on the intervention outcomes, respectively. Multinomial logistic regression was performed to adjust for the effect of socio-demographics and oral health behaviors on observed changes and was reported as odds ratio and 95% confidence interval; p-value <0.05.

2.19 Dissemination of the results

Findings obtained from this study will be presented at the MUHAS scientific conference (2017) and will be published in local & international scientific journals. The dissertation study report will be submitted to the Department of Orthodontics Paedodontics and Community Dentistry as a partial requirement for the fulfillment of the Masters program offered at Muhimbili University of Health and Allied sciences (MUHAS). Furthermore, the dissertation will be submitted to the MUHAS library for posting at the library depository.

CHAPTER THREE

3.0 RESULTS

Two hundred and forty five pupils participated in this study at baseline and 231 pupils were retained at follow up. Participants in the control group were 38.8% (95), supervised tooth brushing group were 30.2% (74) and the group that used plaque disclosing agent were 31% (76) at baseline while at follow up they were 37.7% (87), 30.7% (71) and 31.6% (73), respectively.

Table 1: Distribution of study participants by socio-demographic characteristics and oral hygiene practices

Variable	**Categories**	**% (n)**
Child's age	7 years	49.8 (122)
	8 years	50.2 (123)
Child's sex	Female	50.2 (123)
	Male	49.8 (122)
Mother's education	Primary or less than primary school	54.7 (134)
	Secondary education or beyond	45 3(111)
Father's education	Primary or less than primary school	46.9 (115)
	Secondary education or higher	53.1 (130)
Mother's occupation	Have no income generating activities outside home	35.1 (86)
	Have income generating activities outside home	64.9 (159)
Father's occupation	Self-employed or small scale business	46.1 (113)
	Employed or business men	53.9 (132)
Children's tooth brushing frequency	Once a day	91.8 (225)
	At least twice a day	8.2 (20)
Child being supervised during tooth brushing	Yes	26.5 (65)
	No	73.5 (180)

At baseline participants were equally distributed by age and sex. Those aged 8 years old constituted 50.2% and females were 50.2% (123). A bit more than half of the mothers had primary or less than primary education (54.7%), while a comparable proportion of fathers (53.1%) had secondary education or higher. About two thirds of the mothers (64.9%) had income generating activities outside their home whereas 53.9% of the fathers were either employed or business men.

Regarding oral hygiene practices, most children (91.8%) reported to brush their teeth once per day and only a few of them (26.5%) were supervised during tooth brushing (Table. 1).

Table 2: Distribution of participants' plaque score by socio-demographic characteristics at baseline

Variable	**Categories**	**No plaque present %(n)**	**Presence of plaque %(n)**	**P-value**
Child's age	7 years	27.0 (33)	73.0 (89)	0.917
	8 years	27.6 (34)	72.4 (89)	
Child's sex	Female	30.1 (37)	69.6 (89)	
	Male	24.6 (30)	75.4 (92)	0.335
Mother's education	Primary or less than primary school	24.6 (33)	75.4 (101)	
	Secondary education or beyond	30.6 (34)	69.4 (77)	0.294
Father's education	Primary or less than primary school	27.8 (32)	72.2 (83)	
	Secondary education or higher	26.9 (35)	73.1 (95)	0.874
Mother's occupation	Have no income generating activities outside home	26.7 (23)	73.3 (63)	
	Have income generating activities outside home	27.7 (44)	72.3 (115)	0.876
Father's occupation	Self-employed or small scale business	27.4 (31)	72.6 (82)	
	Employed or business men	27.3 (36)	72.7 (96)	0.978

The oral hygiene status of the study participants was measured by presence or absence of plaque. The proportion of participants with plaque was 72.7% and without plaque was 27.3%. There were no statistically significant differences in the proportions of participants with and without plaque with any assessed socio-demographic characteristics, that is; participants with plaque /without plaque were comparable among the contrasting socio-demographic categories (Table 2).

Table 3: Distribution of study participants' gingival bleeding by socio-demographic characteristics at baseline

Variable	**Categories**	**No bleeding gums %(n)**	**Presence of bleeding gums %(n)**	**P-value**
Child's age	7 years	46.7 (57)	53.3.(65)	
	8 years	18.7 (23)	81.3 (100)	0.001
Child's sex	Female	39.0 (48)	61.0 (75)	
	Male	26.2 (32)	73,8 (90)	0.033
Mother's education	Primary or less than primary school	33.6 (45)	66.4 (89)	
	Secondary education or beyond	31.5 (35)	68.5 (76)	0.733
Father's education	Primary or less than primary school	33.9 (39)	66.1 (76)	
	Secondary education or higher	31.5 (41)	68.5 (89)	0.692
Mother's occupation	Have no income generating activities outside home	34.9 (30)	65.1 (56)	
	Have income generating activities outside home	31.4 (50)	68.6 (109)	0.584
Father's occupation	Self-employed or small scale business	33.6 (38)	66.4 (75)	
	Employed or business men	31.8 (42)	68.2 (90)	0.763

Most study participants (67.3%) had bleeding gums at baseline. Table 3 presents the frequency distribution of gingiva health measured as participants with no bleeding gums and those with bleeding gums by socio-demographic characteristics. There was statistical significant difference in proportion of participants with bleeding gums by age and sex whereby 53.3% of those aged 7 years had bleeding gums compared to 81.3% of those aged 8 years (p=0.001). Likewise, a larger proportion of male participants (73.8%) had bleeding gums compared to 61.0% of females (p=0.033). Other socio-demographic characteristics depicted no statistical significant differences in the presence of bleeding gums between the comparative groups.

Table 4: Distribution of study participants' tooth brushing skills by socio-demographic characteristics at baseline

Variable	**Categories**	**Have no tooth brushing skills %(n)**	**Have at least one tooth brushing skills %(n)**	**P-value**
Child's age	7 years	82.8 (101)	17.2 (21)	
	8 years	86.2 (106)	13.8 (17)	0.463
Child's sex	Female	90.2 (111)	9.8 (12)	
	Male	78.7 (96)	21.3 (26)	0.012
Mother's education	Primary or less than primary school	84.3 (113)	15.7 (21)	
	Secondary education or beyond	84.7 (94)	15.3 (17)	0.939
Father's education	Primary or less than primary school	86.1 (99)	13.9 (16)	
	Secondary education or higher	83.1 (108)	16.9 (22)	0.516
Mother's occupation	Have no income generating activities outside home	83.7 (72)	16.3 (14)	
	Have income generating activities outside home	84.9 (135)	15.1 (24)	0.807
Father's occupation	Self-employed or small scale business	85.0 (96)	15.0 (17)	
	Employed or business men	84.1 (111)	15.9 (21)	0.852

The proportion of participants who had at least one of the studied tooth brushing skills was only 15.2% and those without tooth brushing skills were 84.8%. There was a statistically significant difference in the proportion of participants with tooth brushing skills by sex; whereby among males, 21.3% showed one of the studied tooth brushing skills compared to 9.8% of the females (p=0.012). The remaining socio-demographic characteristics did not show statistically significant differences between the comparative groups (Table 4).

Table 5: Distribution of study participants' socio-demographics and oral hygiene practices by intervention groups at baseline (n=245)

Variable	Categories	Supervised tooth brushing group % (n)	Plaque disclosing agent group % (n)	Control group % (n)	P-value
Age	7 years	34.4 (42)	27 (33)	38.5 (47)	0.263
	8 years	26 (32)	35 (43)	39 (48)	
Sex	Female	32.5 (40)	27.6 (34)	39.8 (49)	0.492
	Male	27.9 (34)	34.4 (42)	37.7 (46)	
Mother's education	Primary and less than primary school	28.8 (34)	28.8 (34)	42.4 (50)	0.715
	Secondary education and beyond	31.5 (30)	31.6 (30)	36.8 (35)	
Father's education	Primary and less than primary school	26.3 (26)	31.3 (31)	42.4 (42)	0.584
	Secondary education and beyond	32.7 (37)	29.2 (33)	38.1 (43)	
Mother's occupation	Have no income generating activities outside home	26.8 (19)	32.4 (23)	40.8 (29)	0.740
	Have income generating activities outside home	31.7 (64)	29.9 (41)	39.4 (56)	
Father's occupation	Self-employed or small scale business	30.5 (29)	29.5 (28)	40.0 (38)	0.968
	Employed and business men	28.9 (33)	29.8 (34)	41.2 (47)	
Tooth brushing frequency	Once a day	30.2 (68)	31.1 (70)	38.7 (87)	0.992
	At least twice a day	30.0 (6)	30.0 (6)	40.0 (8)	
Child being supervised during tooth brushing	Yes	40.0 (26)	26.2 (19)	30.8 (20)	0.113
	No	26.7 (48)	31.7 (57)	41.7 (75)	

Table 5 presents the study participants' socio-demographics and oral hygiene practice by intervention groups at baseline. The participants' socio-demographics and oral hygiene practices were evenly distributed in the three intervention groups; that is, there were no statistically significant differences in the distribution of the participants' socio-demographics and oral hygiene practices between the three groups.

Table 6: Distribution of outcome variables by intervention groups at baseline (n=245)

Variable	**Categories**	**Supervised tooth brushing % (n)**	**Plaque disclosing agent % (n)**	**Control % (n)**	**P-value**
Plaque score	No plaque present	23.0 (17)	28.9 (22)	29.5 (28)	
	Presence of plaque	77.0 (57)	71.1 (54)	70.5 (67)	0.598
Gingival status	No bleeding gums	41.9 (31)	38.2 (29)	21.1 (20)	
	Presence of bleeding gums	58.1 (43)	61.8 (47)	78.9 (75)	0.008
Tooth brushing skills	Have at least one tooth brushing skills	21.6 (16)	10.5 (8)	14.7 (14)	
	No tooth brushing skills	78.4 (58)	89.5 (68)	85.3 (81)	0.166

Table 6 shows the distribution of participants among the intervention groups (supervised tooth brushing, use of plaque disclosing agent and control groups) in relation to intervention outcome variables. Children with no plaque were distributed as follows; 23% in supervised tooth brushing group, 28.9% in the plaque disclosing agent group and 29.5% in the control group. Regarding bleeding gums; there was a larger proportion of participants without bleeding gums in the supervised tooth brushing group (41.9%) than in the plaque disclosing agent group (38.2%) and control group (21.1%). The difference between the groups was statistically significant (p=0.008). Participants possessing at least one of the studied tooth brushing skills were only 21.6% in the supervised tooth brushing group, 10.5% in the plaque disclosing agent group and 14.7% in the control group. These differences were not statistically significant.

Table 7: Participants' mean score for plaque, gingival bleeding and tooth brushing skills at baseline and at follow up

Variable	**Mean score at baseline**	**Mean score at follow up**	**t-value**	**P-value**
Plaque score	26.0	20.3	11.1	0.001
Gingival bleeding score	5.8	3.4	12.9	0.001
Tooth brushing skills score	0.2	0.7	∞	∞

The mean plaque score of participants at baseline was 26.0 which drop off to 20.3 at follow up (p=0.001). That of gingival bleeding was 5.8 at baseline and 3.4 at follow up (p=0.001). Mean score for tooth brushing skills increased more than three times from 0.2 at baseline to 0.7 at follow up though no statistical value could be computed due to limited range of the scored value (Table 7).

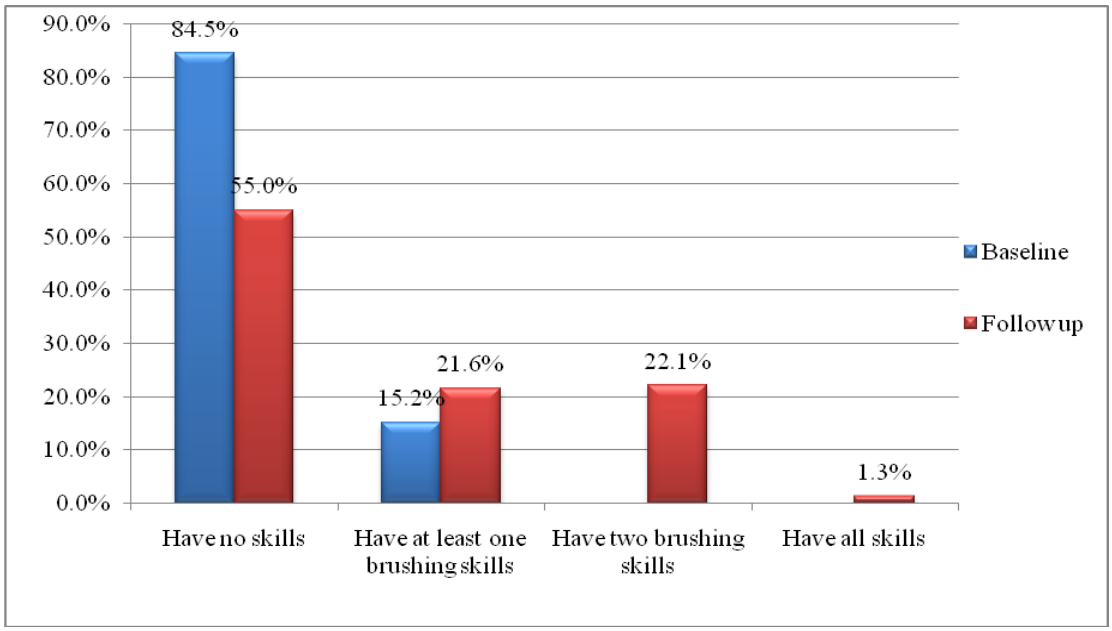


Fig.1: Frequency distribution of participants' tooth brushing skills at baseline and at follow up (n=231)

Figure 1 presents information about the distribution of tooth brushing skills categorized as those having no tooth brushing skills, having at least one tooth brushing skill, have two tooth brushing skills and those who had all three tooth brushing skills among 231 pupils who participated at the follow up. At baseline a large proportion of the participants (84.5%) had no skills and the remaining 15.2% had at least one skill whereas at follow up participants' skills were; having no skills 55%, having at least one skill 21.6%, having two skills 22.1% and those having all skills 1.3%.

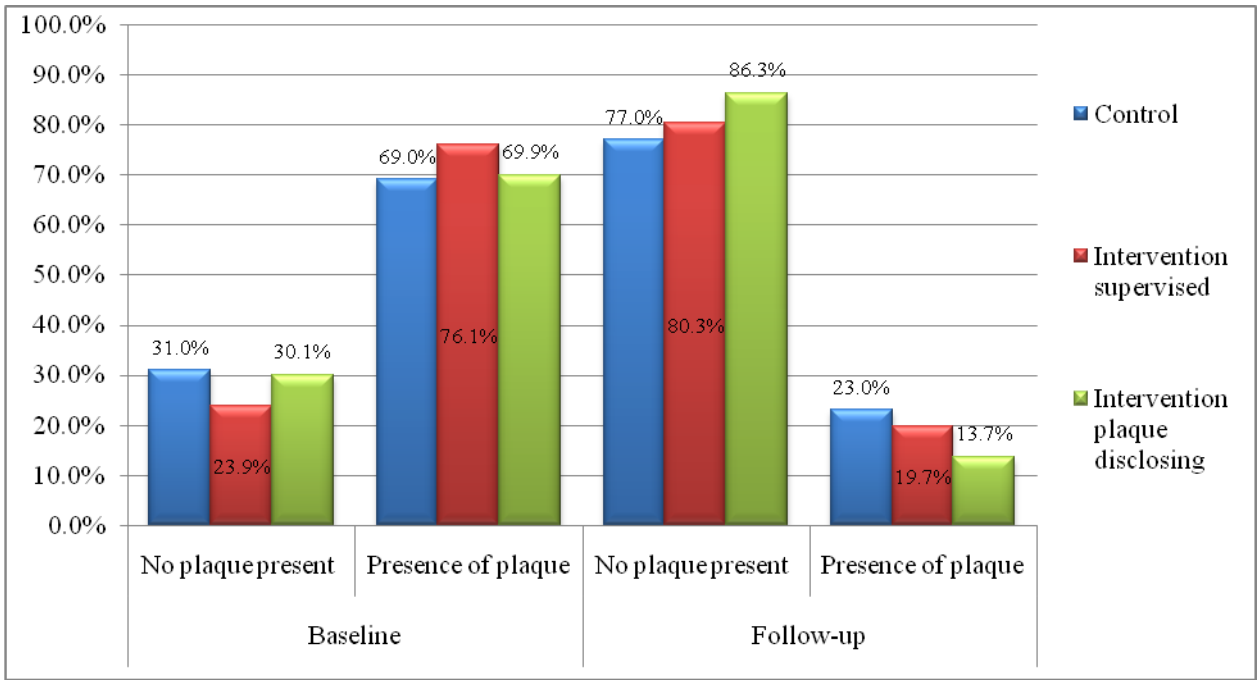


Fig 2: Frequency distribution of participants' oral hygiene status in the three intervention groups at baseline and follow up (n=231)

Oral hygiene status at baseline and follow up assessed as plaque score and categorized as no plaque present and presence of plaque are presented in figure 2. At baseline children without plaque were 31.0% in control group, 23.9% in supervised tooth brushing group and 30.1% in plaque disclosing agent group. The proportions changed at follow up as follows; pupils without plaque were 77.0%, 80.3% and 86.3% in the control group, supervised tooth brushing and plaque disclosing agent groups, respectively.

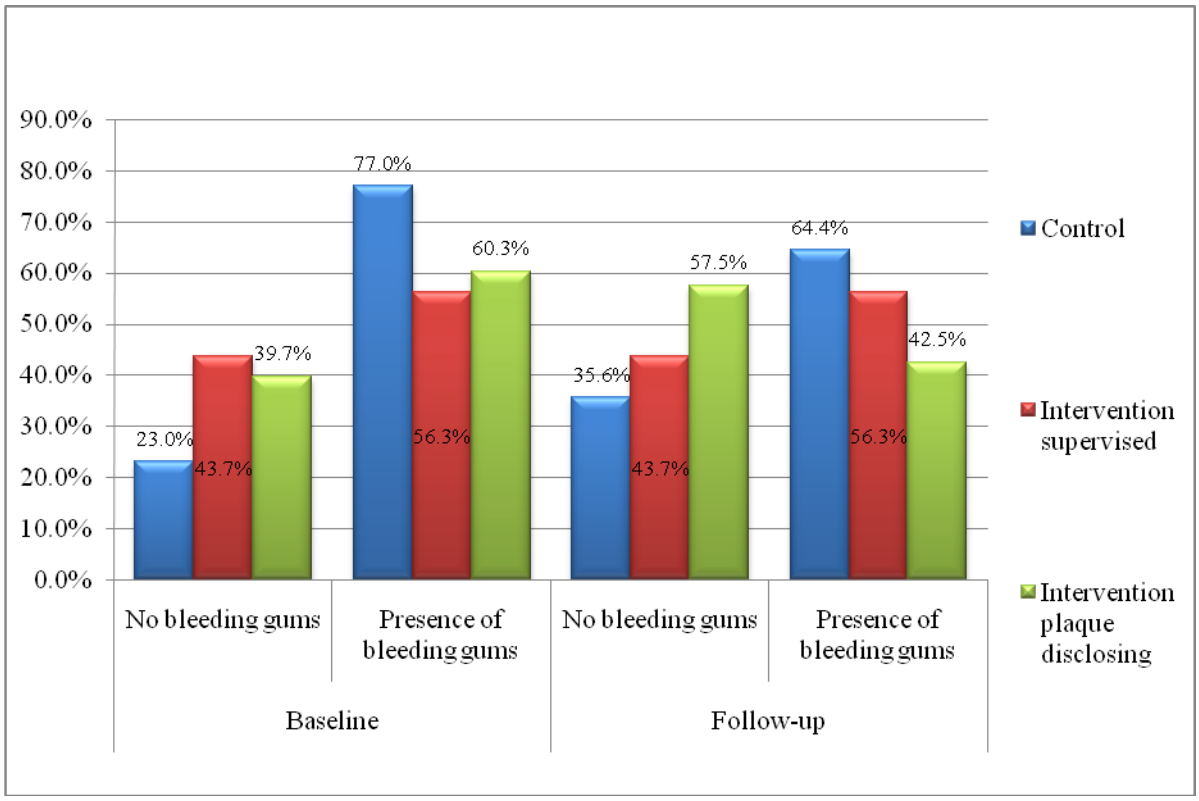


Fig 3: The distribution of participants' gingival health in the three intervention groups at baseline and follow up (n=231)

Figure 3 presents gingival status of the intervention groups at baseline and follow up. At baseline children with no bleeding gums were distributed within the groups as follows; 23.0% in control group, 43.7% in supervised tooth brushing group and 39.7% in plaque disclosing agent group. The proportions at follow up were; pupils without bleeding gums 35.6%, 43.7% and 57.5% in a control group, supervised tooth brushing and plaque disclosing agent groups, respectively. There was a big change in gingival health seen in the plaque disclosing agent group followed by supervised tooth brushing group.

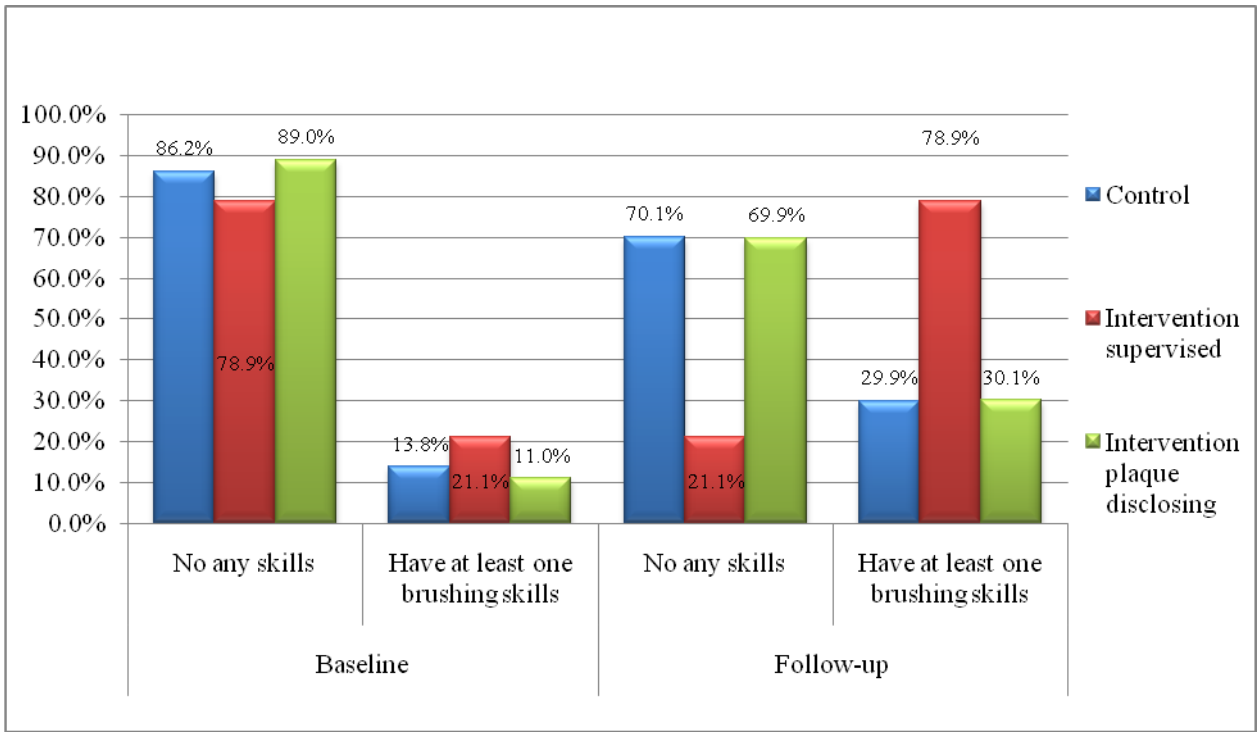


Fig.4: The distribution of participants' tooth brushing skills in the three intervention groups at baseline and follow up (n=231)

Figure 4 presents the findings of tooth brushing skills at baseline and follow up categorized as having no skills and with at least one studied skill among participants in the intervention groups. Children having at least one tooth brushing skill at baseline were 13.8%, 21.1% and 11.0% in control, supervised tooth brushing and plaque disclosing agent groups, respectively. The proportions changed at follow up; those having at least one skill were seen in 29.9%, 78.9% and 30.1%, respectively, in the control, supervised and plaque disclosing agent groups.

Table 8: Participants' mean scores for plaque, gingival bleeding and tooth brushing skills in the three groups at baseline and follow up

	Control	**Supervised tooth brushing**	**Plaque disclosing agent**
Mean plaque score			
At baseline	26.6	25.7	25.5
At follow up	21.8	19.6	19.0
p-value	0.001	0.025	0.001
Mean gingival bleeding score			
At baseline	6.6	4.9	5.6
At follow up	4.0	3.3	2.8
p-value	0.001	0.001	0.001
Mean tooth brushing skills score			
At baseline	0.1	0.2	0.1
At follow up	0.4	1.4	0.4
p-value	0.001	0.001	0.001

The differences in mean plaque score, gingival bleeding score and tooth brushing skills were all statistically significant for all groups at baseline and at follow up (Table 8).

Table 9: Participants' mean difference (95% CI) scores in plaque, gingival bleeding and tooth brushing skills for use of plaque disclosing agent

	Mean difference (95% CI)	**P-value**
Plaque score		
At baseline	1.1 (-2.0,4.1)	1.000
At follow up	2.8 (0.8,4.8)	0.003
Gingival bleeding score		
At baseline	1.0 (-0.05, 2.0)	0.067
At follow up	1.2 (0.4, 2.0)	0.002
Tooth brushing skills score		
At baseline	0.03 (-0.1,0.7)	1.000
At follow up	0.005 (-0.3, 0.3)	1.000

At baseline the mean difference (95% CI) between the groups at baseline were not statistically significant. However, there was statistically significant difference in mean change for the plaque score and gingival bleeding score at follow up in a group that used plaque disclosing agent as compared to the controls. These were; 2.8 (0.8, 4.8) for plaque and gingival bleeding were 1.2 (0.4, 2.0) (Table 9).

Table 10: Participants' mean difference (95% CI) scores in plaque, gingival bleeding and tooth brushing skills for supervised tooth brushing

	Mean difference (95% CI)	**P-value**
Plaque score		
At baseline	0.9 (-2.2,4.0)	1.000
At follow up	2.2 (0.1,4.1)	0.034
Gingival bleeding score		
At baseline	1.7 (0.7,2.8)	0.001
At follow up	0.7 (-0.1,1.6)	0.104
Tooth brushing skills score		
At baseline	-0.7 (-0.2,0.06)	0.606
At follow up	-1.0 (-1.2,-0.6)	0.001

The mean difference (95% CI) in a supervised tooth brushing group when compared with the control group at baseline showed statistically significant difference in gingival bleeding score, 1.7 (0.7,2.8). The mean difference (95% CI) in plaque score and tooth brushing skills at baseline were not statistically significant. At follow up supervised tooth brushing revealed a statistically significant difference in plaque score, 2.2 (0.1, 4.1) and tooth brushing skills, -1.0 (-1.2,-0.6) but not for the gingival bleeding score (Table 10).

Table 11: Participants' mean difference (95% CI) scores in plaque, gingival bleeding and tooth brushing skills for the two interventions

	Mean difference (95% CI)	**P-value**
Plaque score		
At baseline	0.2 (-3.1, 3.4)	1.000
At follow up	0.6 (-1.5, 2.8)	1.000
Gingival bleeding score		
At baseline	-0.7 (-1.8, 0.3)	0.307
At follow up	0.5 (-0.4, 1.3)	0.576
Tooth brushing skills score		
At baseline	0.1 (-0.04, 0.2)	0.271
At follow up	1.0 (0.7, 1.3)	0.001

There was no statistically significant difference in mean scores of three variables at baseline for the supervised tooth brushing as compared to plaque disclosing agent groups. Furthermore, the mean difference between groups at follow up for plaque score; 0.6 (-1.5, 2.8) and gingival bleeding score; 0.5 (-0.4, 1.3) did not differ statistically significantly. The only statistical significant different in mean change was observed for tooth brushing skills score between the supervised tooth brushing and control group at follow up, 1 (0.7, 1.3) (p=0.001) (Table 11).

Table 12: Adjusted results for having good oral hygiene after intervention reported in odds ratio and 95% CI

Intervention group	**OR(95%CI)**	**p-value**
Control group	1	
Plaque disclosing agent group	2.88 (1.05,7.90)	0.040
Control group	1	
Supervised tooth brushing group	1.05 (0.43,2.60)	0.917

Adjusted to socio-demographics (1) and oral hygiene practices (2):

1: Child age, child sex, mothers' education, fathers' education, mothers' occupation and fathers' occupation

2: Tooth brushing frequency and tooth brushing supervision status of children

Table 12 presents the odds of having good oral hygiene among the intervention groups adjusted to socio-demographic characteristics and children's oral hygiene practices. The odds of having no plaque was 2.88 (1.05, 7.90) in plaque disclosing agent group compared to 1.05 (0.43, 2.60) in supervised tooth brushing group and that of control group. In addition, the odds of having no plaque were higher in males OR (95% CI) 3.66 (1.57, 8.57) compared to female. Those whose fathers' were employed and had business were unlikely to have no plaque compared to their counter parts, OR (95% CI) 0.38 (0.16, 0.92). The differences were statistically significant and the p-value for plaque disclosing agent group, male pupils and employed fathers were 0.04, 0.003 and 0.032, respectively.

Table 13: Adjusted results for having healthy gingiva after intervention reported in odds ratio and 95% CI

Intervention groups	**OR (95%CI)**	**p-value**
Control group	1	
Plaque disclosing agent group	2.14 (1.05,4.36)	0.036
Control group	1	
Supervised tooth brushing group	1.03 (0.50,2.14)	0.940

Adjusted to socio-demographics (1) and oral hygiene practices (2):

1: Child age, child sex, mothers' education, fathers' education, mothers' occupation and fathers' occupation

2: Tooth brushing frequency and tooth brushing supervision status of children

Table 13 presents the odds of having healthy gingiva among the intervention groups adjusted to socio-demographic characteristics and children's oral hygiene practices. With reference to control group the odds of having healthy gingival was 2.14 (1.05, 4.36) in plaque disclosing agent group (p=0.036) and 1.03 (0.50, 2.14) in supervised tooth brushing group although this difference was not statistically significant. Likewise, the odds of having healthy gingival was 0.531 (0.28, 0.99) in 7 year old pupils and 0.51 (0.27, 0.95) in male pupils; p-values were 0.048 and 0.032, respectively.

Table 14: Adjusted results for having tooth brushing skills after intervention reported in odds ratio and 95% CI

Intervention groups	**OR(95%CI)**	**p-value**
Control group	1	
Plaque disclosing agent group	1.07 (0.50, 2.28)	0.870
Control group	1	
Supervised tooth brushing group	11.87 (4.92,28.68)	0.001

Adjusted to socio-demographics (1) and oral hygiene practices (2):

1: Child age, child sex, mothers' education, fathers' education, mothers' occupation and fathers' occupation

2: Tooth brushing frequency and tooth brushing supervision status of children

Table 14 presents the odds of having tooth brushing skills in the three intervention groups adjusted to socio-demographic characteristic and children's oral hygiene practices. With reference to control group the odds of having the studied tooth brushing skills were 11.87 (4.92, 28.68) in the supervised tooth brushing group (p=0.001) and 1.07 (0.50, 2.28) in plaque disclosing agent group which was not statistically significant. Furthermore pupils whose fathers had secondary education and beyond were unlikely to have tooth brushing skills odds ratio 0.34 (0.16, 0.75) p=0.007 while those with mothers with secondary education or beyond were more unlikely to have tooth brushing skills compared to their counter parts and the odds ratio 0.49 [(0.24, 1.02) p=0.055].

CHAPTER FOUR

4.0 DISCUSSION

This study was a cluster randomized controlled field trial which was done among grade two pupils aged 7 and 8 years from ten primary schools in Kinondoni district; Dar es Salaam. The study tested two interventions namely supervised tooth brushing and use of plaque disclosing agent on oral hygiene status, gingival health and tooth brushing skills. The children were almost equally distributed in age and sex. Substantial proportion of their parents had primary school education or less but with some income generating activities. This suggests that the social economic status of these parents was average and therefore they can afford to buy tooth brushes and tooth paste for their children. The findings are in line with those from a study done in Tanzania by Mashoto et al. (2010).

Children's oral hygiene behavior, brushing twice per day and being supervised during tooth brushing were not favorable; less than ten percent brushed their teeth at least twice a day and only a quarter were supervised during tooth brushing. The findings of this study are in line with those of studies done in Tanzania (Nyandindi et al., 1996) and elsewhere (Al-Omiri et al., 2006; Kinyita et al., 2010; Kuppuswamy et al., 2014; and Manohar et al., 2017).

In the current study large proportion of participants presented with poor oral hygiene at baseline. This reflects their earlier reported practices where almost all brush once a day and a few were supervised during tooth brushing. The findings are in line with that reported by Ndanu et al. (2015) that 95.3% of school children had plaque. Contrary to most findings which reports socio-demographic inclination of oral hygiene status (Varenne et al., 2004; Muwazi et al., 2005; Mbawala et al., 2010), this study did not show such relationships probably because the current participants were socio-demographically equally distributed.

At baseline this study found that, more than half of study participants had unhealthy gingiva in agreement with their poor oral hygiene. This is similar to other studies done in Nigeria (Kolawole et al., 2011) and in Chile (Varas et al., 2011) which reported more than half of the

study population to have gingivitis. However the findings are in contrary to a study done in United Arab Emirates by Gopinath et al. (2015) which reported that more than two thirds of the participants had healthy gingiva.

The 7 years old children had healthy gingiva than the 8 year olds in this study. Probably the younger children are reminded to brush their teeth by their parents than those aged 8 years who may be considered to be independent. This finding is contrary to that of a study among similar ages that was done in Chile by Varas et al. (2011) where gingival health was almost similar. Females had healthier gums than males which may imply that personal hygiene among boys may not be a priority. This is contrary from a finding of a study by Gopinath et al. (2015) which reported boys to have healthier gums.

With respect to the required tooth brushing skills, more than four fifth of the participants in the present study did not have those skills at baseline. This was an expected finding since majority of these children reported not to be supervised during tooth brushing at home. Furthermore, school teachers as the other arena where the required tooth brushing skills could have been imparted to the children have been reported to be insufficient (Frencken et al., 2001). The finding is in line with that of a study done in Tehran by Mahmoodi et al. (2014) who reported that majority of the children did not possess the required tooth brushing skills. This study also found that more male pupils had one or more of the studied tooth brushing skills than females. This suggests that probably girls were shy to demonstrate their skills compared to boys when they were required to do so in front of people who are not familiar to them.

In the current study, following randomization, the proportion of participants with respect to their intervention status revealed a harmonious distribution in oral hygiene and tooth brushing skills but the proportion of controls with unhealthy gingiva was significantly higher than of the two intervention groups. For this reason interpretation of the findings on the effect of the study intervention on the aspect of gingival health might be exaggerated.

The oral hygiene status, gingival health and tooth brushing skills improved dramatically from the situation at baseline to follow up. These findings demonstrate that even simple oral health

education, incentives and means of assessment which required children to demonstrate how they brush their teeth made positive impact to these children regardless of their participation status. These findings are comparable to those of other studies that reported improvement in plaque score (Palenstein et al., 1997; Freitas-Fernandes et al., 2002; Kang et al., 2008; Kallar et al., 2011, Damle et al., 2014 and Borges-Yáñez et al., 2017), in gingival health (Palenstein et al., 1997; Freitas-Fernandes et al., 2002) and in tooth brushing skills (Hawkins et al., 2001; Hartono et al., 2002; Livny et al., 2008) following intervention.

In this study, marked reduction of proportions of participants with plaque and gingiva bleeding was observed from baseline to follow up, for the plaque disclosing agent group as compared to the control group. The mean difference for the change between the two groups was significant at follow up and not at baseline which implies that the change was attributed by the use of plaque disclosing agent to aid tooth brushing. Furthermore, the mean difference for plaque score was large and that of gingival health was small according to Cohen values. This indicates the strength of plaque disclosing agent in achieving cleanliness although if not done routinely may not be sufficient for the gingival health. Similar findings have been reported by Leal et al. (2002) and Chounchaisithi et al. (2014), for the plaque disclosing agent interventions. Though there was slight gain in tooth brushing skills from baseline to follow up in the plaque disclosing agent group as compared to the control the mean difference was insignificant. The observation is in a way expected, since the use of plaque disclosing agent to aid tooth brushing did not specifically emphasize on tooth brushing skills rather it emphasized on clearing of the dyed sections of the mouth.

Following supervised tooth brushing in the preset study, evident improvement in tooth brushing skills and oral hygiene status was observed while unexpectedly no improvement was seen on gingival health. The improvement in skills implies that the intervention had positive impact on pupil's tooth brushing skills. However, the mean difference for the change (improvement) was significantly large for the plaque score and medium for the tooth brushing skills. This implies supervision on tooth brushing had limited impact on tooth brushing skills

for these children. Probably, the intervention was so brief hence limited duration of exposure of the training. Furthermore, the children lacked routine practice after the intervention since they reported to brush only once in a day and not being supervised at home. This finding is in line with studies which reported reduction of plaque and improved tooth brushing skills in supervised tooth brushing group as compared to control (Harowitz et al., 1976; Palenstein et al., 1997; Kang et al., 2008; Kallar et al., 2011, Damle et al., 2014 and Borges-Yáñez et al., 2017; Hawkins et al., 2001; Livny et al., 2008). The findings are contrary to those from other studies which reported reduction of bleeding gum in supervised tooth brushing groups, compared to control groups (Harowitz et al., 1976; Palenstein et al., 1997; Leal et al., 2002; Damle et al., 2014 and Borges-Yáñez et al., 2017).

In this study, participants in the plaque disclosing agent group were more likely to have good oral hygiene and healthier gingiva than the tooth brushing skills when the control group was used as a reference. This shows that plaque disclosing agent had a positive impact on oral hygiene and gingival health. These findings imply that participants in plaque disclosing agent group had the best way of learning to brush through visualization of plaque retentive areas which led to oral hygiene effectiveness and therefore reduction of plaque and bleeding gums. This is in line with other studies that combined supervised tooth brushing with plaque disclosing agent as a mean to identify and display plaque which resulted into a reduction of plague and gingivitis (Harowitz et al., 1976 and Leal et al., 2002).

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Majority of the children had poor oral hygiene, unhealthy gingiva and had no tooth brushing skills. Supervised tooth brushing showed positive effect on pupil's tooth brushing skills and oral hygiene status. The use of plaque disclosing agent to aid tooth brushing positively influenced pupils' oral hygiene status and gingival healthy. Most socio-demographics and oral hygiene practices had an insignificant influence on the observed health of an intervention.

5.2 Recommendations

1. Oral health professionals to adopt supervised tooth brushing as an intervention during school visits and educate parents on the importance of supervised tooth brushing at home.
2. The government to consider enhancing school oral health programs on areas of the same social strata and structure.
3. Further studies to be done with a prolonged intervention period to determine the effect of supervised tooth brushing and use of plaque disclosing agent on oral hygiene and dental caries.
4. Further researches with intervention to involve parents on children's supervision on oral hygiene to be done and thereafter assessment of its impact on children's tooth brushing skills and oral hygiene status be evaluated.

CHAPTER SIX

6.0 STUDY LIMITATIONS AND MITIGATION

6.1 Study limitations

1. The intervention was done for three days only which might not have been long enough for children to capture the required tooth brushing skills.
2. The principle investigator was not blinded due to the nature of the intervention which required administration of educational technical materials.
3. Wider CI 95% in mean differences and odds ratios on intervention outcome variables.

6.2 Mitigation

1. The intervention was done for three days thereafter children were followed once a week for two weeks for monitoring. This provided more time for participants to acquire benefit of the intervention.
2. An independent clinical examiner apart from the principal investigator was used to avoid ascertainment bias.
3. Adjusted analysis was conducted and cluster effect was considered in the sample size estimation.

CHAPTER SEVEN

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APPENDIX I: INFORMED CONSENT FORM
ASSESSMENT OF THE EFFECT OF SUPERVISED TOOTH-BRUSHING AND USE OF PLAQUE DISCLOSING AGENT ON ORAL HEALTH STATUS OF PRIMARY SCHOOL PUPILS IN DAR-ES-SALAAM

ID-NO. | | | |

Consent/assent to participate in the study

Dear Parent/ Guardian of ……

Greetings! My name is Dr Mercy A. Maya; a Post graduate student at Muhimbili University of Health And Allied Sciences (MUHAS). I am working on a research with the objective to examine the effect of use of plaque disclosing agent to aid tooth brushing and that of supervised tooth brushing on tooth brushing effectiveness and oral hygiene status of primary school pupils in Dar es Salaam, Tanzania.

Purpose of the study

The study is conducted in partial fulfillment of the requirements for the degree of Master of Dentistry in Paediatric Dentistry Programme of MUHAS.

I am writing to request you to allow your child to participate in this study.

What Participation Involves

If you agree for your child to participate in the study, he/she will be interviewed in order to answer a series of questions prepared for the study and examined for oral health status such as dental caries, periodontal disease and other oral diseases. Your child may be taught to brush or provided with plaque disclosing agent to assist in tooth brushing.

Confidentiality

All information collected through interview and clinical examination will be entered into computers with only the study identification number. Confidentiality will be observed and unauthorized persons will have no access to the data collected. The information will only be used for the stipulated research purposes.

Risks

We do not expect that any harm will happen to your child/children during participation in this study.

Right to Withdraw and Alternatives

Your child participation in this study is completely voluntary. You can stop him/her to participate in this study at any time, even if you have already given your consent. Refusal to participate or withdrawal from the study will not involve any penalty.

Benefits

The outcome of the study will benefit him/her in a way that he/she will be examined for oral diseases which is important for prevention of the progression of the diseases. Together with other children in the class, your child will receive oral health education. Thereafter, the child will be taught on how to perform oral hygiene for him/herself under supervision of a dentist and will be referred for management of the disease if present (Appendix VIII). A great care will be taken in examination of your child with regard to all safety measures.

Who to Contact

If you will have questions about this study, you should contact the Principal Investigator, Dr Mercy A. Maya of Muhimbili University of Health and Allied Sciences, P. O. Box 65001, Dar es Salaam, Mobile: 0714608174.

If you will have questions/worry about your rights as a participant, you may call, The Chairperson of the Senate Research and Publications Committee Prof. Said Aboud, P. O. Box 65001, Telephone: +255 22 2152489 Dar es Salaam and Professor Febronia K. Kahabuka who is the supervisor of this study (Mob: 0715 538 084) and Dr Hawa S. Mbawala who is Co-Supervisor (Mob: 0762361537)

Do you agree?

Participant agrees ……..

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

Signature of parent/guardian ……..... Date of signed consent ……..

Participant does NOT agree …….

KIAMBATANISHO I: FOMU YA RIDHAA
TATHMINI YA ATHARI YA USIMAMIZI WA KUPIGA MSWAKI NA KUTUMIA DAWA YA KUFICHUA UTANDO JUU YA MENO KATIKA HADHI YA USAFI WA KINYWA KWA WANAFUNZI WA SHULE ZA MSINGI DAR ES SALAAM

Namba ya usajili | | | |

Ridhaa ya kushiriki kwenye utafiti

Ndugu mzazi/mlezi wa ……

Habari! Mimi ni Dr Mercy A. Maya mwanafunzi wa shahada ya uzamili katika Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili. Ninafanya utafiti huu wenye lengo la kuangalia athari za kutumia dawa ya kufichua utando juu ya meno wakati mtoto anapopiga mswaki mwenyewe na anaposimamiwa kupiga mswaki juu ya ufanisi wa kupiga mswaki na hali ya usafi wa kinywa kwa wanafunzi wa shule za msingi Dar es Salam, Tanzania.

Dhumuni la utafiti

Utafiti huu unafanyika katika kutimiza sehemu ya matakwa ya shahada ya uzamili ya matibabu ya meno kwa watoto katika Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili. Ninaandika kukuomba umruhusu mtoto wako kushiriki katika utafiti huu.

Ushiriki unahusisha nini?

Endapo utaridhia mwanao kushiriki karika utafiti huu, ataulizwa maswali yaliyopo katika fomu iliyoandaliwa mahsusi kwa ajili ya utafiti huu na kuchunguzwa hadhi ya kinywa na meno kama vile kutoboka kwa meno, magonjwa ya fizi na magonjwa mengine na kinywa na meno. Mwanao anaweza kufundishwa kupiga mswaki au kupewadawa inayofichua utando unaokuwa kwenye meno itakayomsaidia kupiga mswaki.

Usiri

Taarifa zote zitakazoainishwa kwenye fomu ya uchunguzi zitaingizwa kwenye kompyuta kwa kutumia namba za utambulisho. Kutakuwa na usiri na mtu yeyote asiyehusika hatapata taarifa zilizokusanywa. Taarifa hizo zitatumika kwa dhumuni la utafiti tu na si vinginevyo.

Athari

Haitegemewi madhara yoyote kutokea kwa mwanao kutokana na ushiriki wake katika utafiti huu.

Uhuru wa kushiriki na haki ya kujitoa

Ushiriki wa mwanao kwenye utafiti huu ni wa hiari. Anaweza kujitoa kwenye utafiti huu wakati wowote hata kama umeshajaza fomu ya ridhaa ya kushiriki kwenye utafiti. Kukataa kushiriki au kujitoa kwenye utafiti hakutaambatana na masharti yoyote, wala kukosa huduma iliyopangwa kufanyika.

Faida

Matokeo ya utafiti huu yatakuwa na manufaa kwa mwanao. Mtoto atafanyiwa uchunguzi wa magonjwa ya kinywa na meno ambao ni wa muhimu kwa kinga ya muendelezo wa magonjwa hayo. Pamoja na wanafunzi wengine katika darasa lake, atapatiwa elimu ya afya ya kinywa na meno na baadae atafundishwa kupiga mswaki akisimamiwa na daktari wa kinywa na meno. Mwanao akikutwa na tatizo la afya ya kinywa au meno utashauriwa kumpeleka hospitali kwa matibabu (Kiambatanisho VIII). Uangalifu mkubwa utafuatwa katika kuchunguza watoto hawa, kwa kuzingatia kila tahadhari ya usafi.

Nani wa kuwasiliana naye

Kama una maswali kuhusiana na utafiti huu, wasiliana na mkuu wa utafiti huu; Dr Mercy A. Maya Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili, S. L. P. 65001, Dar es Salaam. Simu: 0714608174

Kama una swali kuhusu uhalali wa utafiti huu wasiliana na Prof. Said Aboud Mwenyekiti wa kamati ya Utafiti na Uchapishaji, S.L.P 65001, Simu: 255 22 2152489 Dar es Salaam au wasimamizi wa utafiti huu Profesa Febronia K. Kahabuka ambaye ni msimamizi mkuu wa utafiti huu (Namba: 0715 538 084) na Dr Hawa S. Mbawala ambaye ni msimamizi mwenza(Mob: 0762361537)

Je unakubali kushiriki?

Mshiriki amekubali ….....….....

Mimi ..... nimesoma maelezo ya fomu hii.

Maswali yangu yamejibiwa.Nakubali mtoto wangu ashiriki katika utafiti huu.

Sahihi ya mzazi/mlezi……..... Tarehe ya kutia sahihi ya idhini ya kushiriki……

Mshiriki hajakubali .....…….....

APPENDIX II: TOOTH BRUSHING SUPERVISION PROCEDURE

This will entail group training, demonstration and coaching on proper tooth brushing procedures appropriate for child population.

Children will be trained in form of oral instructions and demonstration using a mouth mankin and tooth brush models. They will be instructed on sequential tooth brushing, teeth surfaces to be brushed, horizontal movements of short strokes and recommended duration of tooth brushing.

- *Sequential tooth brushing:* children will be instructed to start brushing on upper right side of the jaw then anterior part of the upper jaw followed by the upper left side of the upper jaw. Then the child will have to brush the lower jaw left side, the anterior part/segment and finally brush the lower jaw right side.
- *Teeth surfaces to be brushed:* children will be instructed to brush the outer surfaces of the teeth, inner surfaces and then the chewing surfaces.
- *Horizontal movements of short strokes*: children will be instructed to brush back and forth brush movements with short overlapping steps.
- *Duration of tooth brushing:* children will be instructed to count up to ten for each side and surfaces to be brushed making a total of about 120 counts approximating the recommended two minutes.

APPENDIX III A: THE USE OF PLAQUE DISCLOSING AGENT INTERVENTION PROTOCOL

After basic oral health education

Give Plaque Disclosing Agent tablet to chew in a group of five

Give the face mirror to the child to see where the dye

Children have to brush their teeth on their own way

Children should rinse water

Give another plaque disclosing agent

Children should brush/clean all the remain stained areas

Let the child rinse with clean water

Do this procedure to all children in the particular school participating in the study for three days

APPENDIX III B: SUPERVISED TOOTH BRUSHING FOLLOWING BASIC ORAL HEALTH EDUCATION INTERVENTION PROTOCAL

A: Group training.

- Oral instructions
  - *Sequential tooth brushing:* children are instructed to start brushing on upper right side of the jaw then anterior part of the upper jaw followed by the upper left side of the upper jaw. Then the child will have to brush the lower jaw left side, the anterior part/segment and finally brush the lower jaw right side.
  - *Teeth surfaces to be brushed:* children are instructed to brush the outer surfaces of the teeth, inner surfaces and then the chewing surfaces.
  - *Horizontal movements of short strokes*: children are instructed to brush back and forth brush movements with short overlapping steps.
  - *Duration of tooth brushing:* children are instructed to count up to ten for each side and surfaces to be brushed making a total of about 120 counts approximating the recommended two minutes.

B. Demonstration

- Using mouth mankin and tooth brush model children observes and try in tooth brushing and let sample of children try to brush on mankin model to demonstrate strokes and surfaces.

C. Children brushing

- Individual child be given a toothbrush with toothpaste and be let to brush his/her own teeth

D. Coaching on proper tooth brushing procedures.

- In a group of five children are supervised on brushing and direct them according to protocol

Do the procedures to all participating children in that particular school

APPENDIX IV: ORAL HEALTH EDUCATION

- Oral health education is important for every child
    - It enable us to eat
    - It enable us to speak properly
    - It enable us to laugh and smile
    - It enable us to socialize freely with our friends example when someone has halitosis
- Some of diseases which affect oral health:
    - Dental caries
    - Gum diseases
- Causes of these oral health diseases:
    - Frequent eating of sugary added foods example cakes, sugar, juice, biscuits, chocolate, ice cream, etc.
    - Failure to do proper tooth brushing
- The following should be done to avoid the mentioned oral health diseases
    - Avoid eating of sugary added foods frequently
    - Brush your teeth properly
    - Brush your teeth by using fluoridated tooth paste e.g. Colgate
    - Brush your teeth everyday at least twice a day

KIAMBATANISHO IV: ELIMU YA AFYA YA KINYWA NA MENO

- Afya ya kinywa na meno ni muhimu kwa afya ya kila mtoto
    - Kutuwezesha kula
    - Kutuwezesha kuongea vizuri
    - Kuonyesha hali ya furaha mf. kucheka
    - Kutuwezesha kukaa na wenzetu bila kuona aibu mfano mdomo ukiwa unanuka n.k
- Magonjwa yanayoathiri kinywa na meno ni:
    - Kutoboka kwa meno
    - Magojwa ya fizi
- Vitu vinavyosababisha magonjwa hayo ya kinywa na meno ni:
    - Ulaji wa vyakula vya sukari mfano pipi,keki,sukari, juisi, biskuti, chokoleti, ice cream, lambalamba, ubuyu, na vingine vingivinavyowekwa sukari
    - Kutokupiga mswaki kwa ufasaha
- Ili kuepuka magonjwa hayo inatupasa kufanya yafuatayo:
    - Kuepuka ulaji wa vyakula vya sukari mara kwa mara
    - Kupiga mswaki kwa ufasaha
    - Kupiga mswaki kwa kutumia dawa ya meno yenye madini ya floraidi mf. Colgate
    - Kupiga mswaki kila siku walau mara mbili kwa siku.

APPENDIX V: QUESTIONNAIRE FOR PARENTS/GUARDIAN

ASSESSMENT OF THE EFFECT OF SUPERVISED TOOTH-BRUSHING AND USE OF PLAQUE DISCLOSING AGENT ON ORAL HEALTH STATUS OF PRIMARY SCHOOL PUPILS IN DAR-ES-SALAAM

ID No: | | | |

DD MM YY

Childs' date of birth | | | | | | | Age of your child | | |

1. When did you start to brush your child's teeth
   a. $1^1/_2$ – 2 year
   b. 2 – 3 years
   c. 4 – 5 years
   d. More than 5 years
2. Currently who perform tooth brushing for your child?
   a. Mother
   b. Father
   c. Mother and father alternately
   d. House maid
   e. Other member of the family
   f. Brushes alone

If the answer is (f) 'Brushes alone'for question number 2 continue with question number. 6

3. When did he/she started to perform tooth brushing alone?
   a. 2 -3 years
   b. 4 – 5 years
   c. 6 – 7 years
   d. More than 7 years
4. If he/she brushes alone is he/she supervised?
   a. Yes
   b. No

If the answer for question number 4 is 'No' go to question number. 6

5. Who does the supervision of your child at home?
   a. Mother
   b. Father

c. Mother and father alternately
d. House maid
e. Other member of the family

6. What type of toothpaste do you use for your child?
   a. Whitedent
   b. Colgate
   c. Aqua-fresh
   d. Forever living
   e. Others; specify .....
7. Father's level of education
   a. No formal education
   b. Primary education
   c. Secondary education
   d. College/University
8. Mother's level of education
   a. No formal education
   b. Primary education
   c. Secondary education
   d. College/University
9. Father's occupation
   a. Small scale business
   b. Day worker
   c. Employed
   d. Business man
   e. Self employed
10. Mother's occupation
   a. House wife
   b. Small scale business
   c. Day worker
   d. Employed
   e. Business woman
   f. Self employed

Thank you for your time to answer this questionnaire

KIAMBATANISHO V: DODOSO KWA MZAZI/MLEZI
TATHMINI YA ATHARI YA USIMAMIZI WA KUPIGA MSWAKI NA KUTUMIA DAWA YA KUFICHUA UTANDO JUU YA MENO KATIKA HADHI YA USAFI WA KINYWA KWA WANAFUNZI WA SHULE ZA MSINGI DAR ES SALAAM

Namba ya utambulisho: | | | | | | |

Ndugu mzazi naomba ujibu dodoso hili kuhusiana na mtoto aliyekuletea

Tarehe ya mtoto ya kuzaliwa | | | | | | | Siku Mwezi Mwaka

Umri wa mtoto | | |

Weka herufi husika kwenye kisanduku pembeni ya swali

1. Mtoto wako huyu alianza kupiga mswaki akiwa na umri gani?
    a. Miaka $1^1/_2$ – 2
    b. Miaka 2 - 3
    c. Miaka 4 – 5
    d. Miaka 5 na zaidi
2. Nani anayempiga mtoto mswaki kwa sasa?
    a. Mama
    b. Baba
    c. Mama na baba kwa kupokezana
    d. Dada/ msaidizi wa kazi nyumbani
    e. Mtu mwingine katika familia
    f. Anapiga mwenyewe

    Kama jibu ni (f) anapiga mwenyewe endelea swali la 2, kwa majibu mengine endelea swali la 6
3. Alianza kupiga mswaki mwenyewe akiwa na umri gani?
    a. Miaka 2 -3
    b. Miaka 4 – 5
    c. Miaka 6 – 7
    d. Miaka 7 na zaidi
4. Kama anapiga mswaki mwenyewe anasiamamiwa?
    a. Ndiyo
    b. Hapana

Kama jibu ni "ndiyo" endelea swali la 4, kama jibu ni "hapana" endelea swali la 6

5. Nani anayemsimamia wakati wa kupiga mswaki?
    a. Mama
    b. Baba
    c. Mama na baba kwa kupokezana
    d. Dada/ msaidizi wa kazi nyumbani
    e. Mtu mwingine katika familia
6. Mnatumia dawa gani ya meno kupiga mswaki nyumbani au kwa ajili ya mtoto?
    a. Whitedent
    b. Colgate
    c. Aqua-fresh
    d. Forever living
    e. Nyinginezo; taja .....
7. Elimu ya baba
    a. Hajamaliza elimu ya msingi
    b. Elimu ya msingi
    c. Elimu ya sekondari
    d. Chuo
8. Elimu ya mama
    a. Hajamaliza elimu ya msingi
    b. Elimu ya msingi
    c. Elimu ya sekondari
    d. Chuo
9. Kazi ya baba
    a. Biashara ndogondogo
    b. Kibarua
    c. Mwajiriwa
    d. Mfanya biashara
    e. Amejiajiri (Taja .....)
10. Kazi ya mama
    a. Mama wa nyumbani
    b. Biashara ndogondogo
    c. Kibarua
    d. Mwajiriwa
    e. Mfanya biashara
    f. Amejiajiri (Taja .....)

Asante sana kwa kutumia muda wako kujibu dodoso hili.

APPENDIX VI: QUESTIONNAIRE FOR PRIMARY SCHOOL PUPILS
ASSESSMENT OF THE EFFECT OF SUPERVISED TOOTH-BRUSHING AND USE OF PLAQUE DISCLOSING AGENT ON ORAL HEALTH STATUS OF PRIMARY SCHOOL PUPILS IN DAR-ES-SALAAM

ID-NO. [ ][ ][ ]

Name of the school: ..... Class: [ ]

Age: [ ][ ]

Sex: [ ] (M=1, F=2)

Oral hygiene practise

1. Do you brush your teeth? [ ]
    a. Yes
    b. No

If yes, continue with question number 2.

2. How many times do you brush your teeth? [ ]
    a. Once a day
    b. Twice a day
    c. Three times a day
    d. More than three times a day
3. What type of tooth brush do you use? [ ]
    a. Plastic
    b. Mswaki
4. Does anyone supervise you to brush your teeth at home? [ ]
    a. Yes
    b. No

    If yes go to question number 5

    If no go to question number 6
5. Who supervises you to brush your teeth? [ ]
    a. Mother
    b. Father
    c. Mother and father alternately
    d. House maid
    e. Other member of the family

6. Do you use toothpaste during brushing?
    a. Yes
    b. No
7. What brand of tooth paste do you use?
    a. Whitedent
    b. Colgate
    c. Aqua-fresh
    d. Forever living
    e. Others; specify .....

Knowledge on oral hygiene practice

8. Do you know tooth brushing is important for oral health?
    a. Yes
    b. No
    c. I don't know
9. Tooth brushing more than two times a day prevent dental caries and periodontal diseases
    a. Yes
    b. No
    c. I don't know
10. Tooth brushing with fluoridated toothpaste prevent dental caries
    a. Yes
    b. No
    c. I don't know

KIAMBATANISHO VI: DODOSO KWA WATOTO WA SHULE YA MSINGI TATHMINI YA ATHARI YA USIMAMIZI WA KUPIGA MSWAKI NA KUTUMIA DAWA YA KUFICHUA UTANDO JUU YA MENO KATIKA HADHI YA USAFI WA KINYWA KWA WANAFUNZI WA SHULE ZA MSINGI DAR ES SALAAM

Namba ya utambulisho: | | | | | | | | | |

Umri : | | |

Jina la shule : ..... Darasa: |

Jinsi: | (M=1, F=2)

Usafi wa kinywa na meno

1. Je unasafisha meno yako kwa kutumia mswaki?
    a. Ndio
    b. Hapana

    Kama ndio endelea swali namba 2. |

2. Unapiga mswaki mara ngapi kwa siku?
    a. Moja kwa siku
    b. Mbili kwa siku
    c. Tatu kwa siku
    d. Zaidi ya mara tatu kwa siku |

3. Unatumia aina gani ya mswaki
    a. Plastiki
    b. Mswaki wa mti |

5. Je unasimaniwa kupiga mswaki nyumbani?
    c. Ndio
    d. Hapana |

Kama jibu lako ni ndio endelea swali la 5

Kama jibu lako ni hapana endelea swali la 6

6. Nani nanayemsimamia kupiga mswaki nyumbani?
    a. Mama
    b. Baba
    c. Mama na baba kwa kupokezana
    d. Dada/ msaidizi wa kazi nyumbani
    e. Mtu mwingine katika familia |

7. Unatumia dawa ya meno unapopiga mswaki?
    a. Ndio
    b. Hapana

7. Unatumia aina gani ya dawa ya meno?
    a. Whitedent
    b. Colgate
    c. Aqua-fresh
    d. Forever living
    e. Nyinginezo; Taja .....

Ufahamu juu ya usafishaji wa meno

8. Je unajua kupiga mswaki ni muhimu kwa afya ya meno?
    a. Ndio
    b. Hapana
    c. Sifahamu
9. Kupiga mswaki mara mbili au zaidi kupelekea kuzuia kutoboka kwa meno na magonjwa ya fizi
    a. Ndio
    b. Hapana
    c. Sifahamu
10. Kupiga mswaki kwa kutumia dawa yenye fluoride ni muhimu kwa afya ya meno
    a. Ndio
    b. Hapana
    c. Sifahamu

APPENDIX VII: DENTAL CLINICAL EXAMINATION FORM FOR PRIMARY SCHOOL PUPILS

ASSESSMENT OF THE EFFECT OF SUPERVISED TOOTH-BRUSHING AND USE OF PLAQUE DISCLOSING AGENT ON ORAL HEALTH STATUS OF PRIMARY SCHOOL PUPILS IN DAR-ES-SALAAM

Date: ...../...../..... ID-NO. | | | |

PLAQUE SCORE

16(M,O,L)			11(M,O,L)			64(M,O,L)		
84(M,O,L)			32(M,O,L)			36(M,O,L)		

0 = No plaque

1 = A film of plaque adhering to the free gingival margin and adjacent area of the tooth, which cannot be seen with the naked eye. But only by using disclosing solution or by using probe.

2 = Moderate accumulation of deposits within the gingival pocket, on the gingival margin and/ or adjacent tooth surface, which can be seen with the naked eye.

3 = Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin

GINGIVAL BLEEDING SCORE

16	11	64
84	32	36

0 = No inflammation.

1 = Mild inflammation, slight change in color, slight edema, no bleeding on probing.

2 = Moderate inflammation, moderate glazing, redness, bleeding on probing.

3 = Severe inflammation, marked redness and hypertrophy, ulceration, tendency to spontaneous bleeding.

TOOTH BRUSHING EFFECTIVENESS

Sequence	Surfaces	Strokes	Time (min)

Sequence

Child follows the following sequence: max right – central – left then mandibular left –central and lastly right

0= No 1= Yes

Surfaces

Teeth surfaces for a child to brush: buccal, palatal/lingual and occlusal

0= No 1= Yes

***Strok*es**

The child perform short steps, back and forth motion on tooth brushing

0= No 1= Yes

Time

Time spent on tooth brushing

0= Less than 2 minutes 1= Two minutes and above

OTHER ORAL HEALTH CONDITIONS

Orthodontic	Swelling	Retained & mobile teeth	Injuries	Cleft lip and/ palate	Others

0= Absent 1= Present

Name of examinaer ..... Signature .....

Date:.....

APPENDIX VIII: REFERRAL FORM

NAME OF THE PUPIL: …….
SEX: …… SCHOOL: ……..
The above named pupil has been examined on oral health at school during a study aimed at assessing the effect of supervised tooth brushing and use of plaque disclosing agent on children's oral hygiene status.
During examination he/she was found with the following oral health diseases:
1. ……..
3. ……..
3. ……..
4. ……..
5. ……..
I refer this child to you for further management in the nearby hospital

KIAMBATANISHO VIII: FOMU YA RUFAA

JINA LA MWANAFUNZI: …….

JINSI: …… SHULE: ……..

Mwanafunzi mtajwa hapo juu amefanyiwa uchunguzi wa kinywa na meno shuleni wakati wa utafiti uliolenga kutathmini athari zinazotokana na usimamizi wa kupiga mswaki na utumiaji wa dawa ya kufichua utado kwenye meno katika hali usafi wa kinywa.

Wakati wa uchinguzi, mtoto alikutwa na magonjwa yafuatayo:

1. ……..
3. ……..
3. ……..
4. ……..
5. ……..

Mtoto huyu amepewa rufaa kufika kwa ajili ya matibabu katika hospitali iliyo karibu na makazi yake