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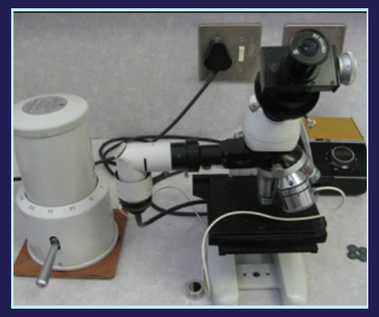

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Infection Control: Level of awareness in Health Care Workers

The prevention and control of the spread of infection in the healthcare set-up is critical. It is aimed at controlling the spread of infection from patient to patient, from patients to staff and from staff to patients or even among staff members. The proper use of appropriate, sterile equipment and clean facilities is important in controlling the spread of infection. Although infection control is an integral part of the infrastructure in health care, it is often poorly supported and underfunded.

The emergence of blood borne viruses in the recent past has brought the issue of infection control under scrutiny worldwide and especially with the Ebola outbreak in West Africa. Some of the areas where focus has been placed in health care facilities are hand hygiene, sterilization of equipment, cleaning of facilities, disinfection of surfaces, floors and the environment in general, personal protective gear and antimicrobial surfaces being used in laboratories and other areas. Vaccination of health care workers and post exposure prophylaxis are areas that have been under supported especially in developing countries.

Surveillance for infection, outbreak investigation and training in infection control of healthcare workers has been under emphasized and the resources allocated are minimal. This is especially so in the developing countries where the limited resources are directed towards curative measures rather than then preventive care. This compromises response in the event of an outbreak and this has been well demonstrated in the number of deaths seen in West Africa as a result of the Ebola outbreak.

The emergence of blood-borne virus and especially the human immunodeficiency virus in the early 80s changed the way dentistry is practiced. Recommendations were made that dentists should treat all blood and body fluids as being infectious since patients maybe asymptomatic or unaware of their status [1,2] when seeking dental treatment.

The dental team including the dentist, dental nurse, assistants, laboratory technicians and the dental patient can be exposed to pathogens such as HIV, herpes simplex virus types 1 and 2, cytomegalovirus (CMV), hepatitis B and C, mycobacterium tuberculosis, staphylococci, streptococci and numerous other viruses and bacteria occupying the oral cavity. This transmission of infection can be through direct contact with blood and bodily fluids, indirect contact with contaminated instruments, equipment or work surfaces, contact of exposed mucosal surfaces like the conjunctiva, nasal and oral cavity with contaminated droplets propelled by sneezing and coughing of an infected person and finally inhalation of microorganisms that are airborne [3]. The mycobacterium tuberculosis micro-organism is airborne and can remain suspended in the air and infective for hours. It is transmitted from persons with pulmonary or laryngeal Tubercle Bacillus or tuberculosis through coughing, sneezing and even singing.

Furthermore, for infection to spread, the following conditions must be present[4]:

- a pathogenic organism of sufficient virulence and in adequate numbers to cause disease
- a reservoir or source that allows the pathogen to survive and multiply (e.g., blood)
- a mode of transmission from the source to the host
- a portal of entry through which the pathogen can enter the host
- a susceptible host (i.e., one who is not immune)

There are detailed guidelines on how to prevent spread of infection but many practicing dental practitioners have not taken the time to familiarize themselves with these guidelines. In this era where new viruses and antibiotic resistant bacteria species are emerging, it is important for all health care workers to be trained in infection control.

In 2010, the Ministry of Medical Services launched the National Infection Prevention and Control Guidelines for Health Care Services in Kenya.[5] This is a very detailed manual on all aspects of infection control in the health care services in the country. It would be interesting to know how many medical and dental practitioners in the country are aware of these National Guidelines. Familiarization with this document by every practicing medical and dental practitioner is paramount.

Professional Associations in conjunction with the Public Health Services should be encouraged to set up training for all health care workers on infection control. These training sessions should be held regularly so as to capture the new and innovative ways of dealing with the new micro-organisms. It is also important that appropriate surveillance is put in place to check any suspected infections within a particular health-care setting and hence control outbreaks in the very early stages.

Prof Evelyn Wagaiyu,BDS (Nrb), MSc (Lond), PhD (Nrb)

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ORIGINAL ARTICLE

Instrument Sterilization Practices and Monitoring in Private and Public Dental Clinics in Eldoret, Nakuru and Kisumu Municipalities in Western Kenya

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Keywords: sterilization,biological indicators, Kenya, sterilization monitoring, dental instruments

Abstract

Introduction: The safety of patients, staff and the public should always be a leading concern for all dental practitioners. It is important to ensure that safety measures are rigorously observed. One important safety practice for dental facilities is the proper sterilization of reusable dental instruments. Ensuringthat sterile instruments are present chair-side for every patient requires following a nine-step procedure (transporting, holding/pre-cleaning, cleaning, drying, corrosion inspection, packaging, sterilization, storage and distribution, monitoring ofinstrument flow). Missing or performing a step improperly jeopardizes the entire sterilization process.

Monitoring sterilization is an essential activity. Monitoring includes a combination of mechanical, chemical and biological techniques designed to evaluate the performance of the sterilization process.

Materials and method: This study was carried outamong dentists practising in three towns in the Western part of Kenya. All the clinics run by qualified dentists were approached to participate in the study. Out of the 31 clinics approached 29(93.5%) agreed to participate.

A self-administered questionnaire was used to collect information on several parameters including; type of practice, personnel, patient load and sterilization practices.

Self-contained biological indicator vials were supplied for each sterilizer in each clinic. These were incubated within eight hours after exposure to the sterilization cycle to determine the effectiveness of sterilization.

Results: There was sterilization failure in 31% of the sterilizers. A majority (93.5%) of the practices use steam autoclaves.Those practices where a qualified nurse was in charge of sterilization were the least likely to have sterilization failure (p=0.046). While majority of the clinics use chemical and mechanical monitoring, only one clinic reported use of biological monitoring.

Conclusion and recommendation: Mandatory sterilization monitoring using Biological Indicators in Dental practices in Kenya to ensure effective sterilization is recommended.

It is also recommended that a wider study covering the whole of Kenya should be carried out to determine the true picture in the country.

Key terms: sterilization, Kenya, dental practice/clinics/office, biological monitoring

Introduction

Sterilization is the complete destruction of all forms of microbial life and is best accomplished in health care facilities through the application of heat. However, a variety of sterilization methods, such as steam under pressure, dry heat, ethylene oxide (ETO) gas, hydrogen peroxide gas plasma and liquid chemicals are used in health care facilities.[1,2]

Untreated or ill-treated contaminated dental instruments could possibly allow for the cross-transmission of pathogenic microorganisms from patient to patient or from patient to practitioner or practitioner to patient. To minimize cross infection, dental facilities must observe stringent rules concerning

instrument sterilization, disinfection and maintenance of equipment.

Methods of sterilization for dental instruments and equipment that are heat stable include steam under pressure (autoclave), unsaturated chemical (formaldehyde) vapour and dry heat.[2-4] Out of these three methods steam under pressure (autoclaving) is the most dependable and efficient.[2-5]

It is imperative that sterilization procedures be monitored using a combination of mechanical, chemical, and biological methods designed to evaluate sterilizing conditions and procedural effectiveness.[2,4-7] Mechanical monitoring of sterilization includes assessing cycle length, operational temperature and pressure and equipment integrity by observing the gauges or displays on the sterilizer. Some tabletop sterilizers have recording devices that print out such parameters. Correct readings do not necessarily ensure sterilization, but incorrect readings could be the first indication that a problem has occurred during the sterilization cycle.

Chemical indicators, internal and external, use special chemicals that change colour or shape when exposed to a certain chemical or specific temperature. Chemical indicators are useful because they give instant end-of-cycle results – change or no change. Chemical indicators such as heat sensitive tape change colour rapidly when a given parameter is reached.

An internal chemical indicator should be placed in every sterilization package to ensure the sterilization agent has penetrated the packaging material and actually reached the instruments inside. An external indicator should also be used when the internal indicator cannot be seen from outside the package.[2]

Single-parameter indicators (class 1-3) provide information on only one sterilization parameter, such as temperature and are available for steam, dry heat, and unsaturated chemical vapour. Multi-parameter indicators are also known as chemical integrators and include classes 4-6.These, and especially Class 5 integrating indicators, are better than other chemical monitors, such as autoclave tape because they are designed to react to all critical variables simultaneously.[8]

Because chemical indicators do not prove sterilization has been achieved, a biological indicator (e.g., spore test) is required.

Biological indicators (BIs) are the most accepted means of monitoring the sterilization process because they directly determine whether the most resistant microorganisms (e.g., Geobacillus or Bacillus species) remained viable after processing. Because spores used in BIs are more resistant and are present in greater numbers than are the common microbial contaminants found on patient care equipment, an inactivated BI indicates that other potential pathogens in the load have also been killed.

Instrument sterilization is a vital component of an effective infection control program; improper sterilizer operation can jeopardize patient safety and health.[2, 6]

Periodic biological monitoring of sterilizer function offers confidence to dentists, staff, and patients that sterilization procedures are providing protection from infectious diseases. The use and functioning of the sterilizer is monitored by mechanical, chemical, and biological means, and records should be kept to document these evaluations.

Sterilization failures should be addressed carefully and promptly so that patient safety can be maintained. Studies have shown that failure of sterilization occurs although monitoring by physical observation and/or chemical indicators might indicate otherwise.[8]

Assessment of the effectiveness of autoclaves in dentistry started in Germany in 1976 with a study reporting a 12% overall spore test failure rate.[9] A 1978 study in Minnesota, USA, indicated an autoclave failure rates of 33% for general practice dental practices.[9] Skaug reported autoclave failure rates among Norwegian dentists in 1983 to be 23%.[10] An investigation among American endodontists showed a failure rate of all types of sterilizers to be above 15%.[11] A report from Denmark indicated that 2.3% of autoclaves in public clinics and 5.7% in private practices offices failed spore testing.[12] Studies of 87 American general private practices showed an alarming number of sterilizers (64.7%) were not effective in killing all the spores present. When office personnel were given information for improving sterilizer performance, there was a noticeable reduction in sterilization failures following retesting.[13] A failure rate of 4.4% has been reported when 4,579 sterilizer loads were tested in Canada.[14] A repeat study in Norway by Skaug, Nielsen and Palenikin 1996 produced failure rates of 10.5%.[15] When 840 UK dentists (52% response) were asked to test their practice autoclaves using spore test ampoules, 4.0% of the autoclaves failed to sterilize the ampoules, and only 70% of respondents reported that they checked

their autoclave performance. These results appear to show the need for routine monitoring of sterilizer performance.[16] A comparison of autoclave failure among Norwegian dentists reported a drop from 8.8% in 1985 to just 1.6% in 1996(17).A more in depth study of just one year (1995-1996) in Norway indicated that dry heat was 12 times more likely to fail than did steam autoclaves (19.2% versus 1.6%).[18] A study conducted in Mexico found a failure rate of 7.4%.[19] No such studies have appeared in the literature concerning the effectiveness of autoclaves used in Kenyan dental offices.

Justification

The routine use of spore testing (BIs) is not currently a requirement for dental practitioners in Kenya. A literature review indicated there is no published research done in Kenya concerning biological monitoring of dental practice sterilizers. It is also apparent that there are no well-established ethical or legal requirements to ensure that spore testing is done routinely. This could be part of the requirement for continued registration of public or private dental practices.

Study Aims and Objectives

Study Aim

The overall aim of this study was to determine the effectiveness of sterilization methods used by dental practitioners in the study region. Such information is useful in helping to improve the quality of dental health care being provided to patients.

Specific Objectives

1. To describe the instrument recycling practices of dental clinics in the study region
2. To identify the methods used for monitoring the sterilization process
3. To determine the knowledge of local dental practitioners concerning sterilization monitoring
4. To measure the effectiveness of the sterilization processes performed by local dental clinicians in the study region

Materials and Methods

Study Design

This was a cross-sectional study where every sterilizer present in each dental facility was monitored using BIs.

Study Site

The study was conducted in Nakuru, Eldoret and its environs, and Kisumu, all main towns in Western Kenya.

Sampling and Sample Size

All dental care facilities operated by qualified dentists in the towns listed were approached to participate in the study. Both private and government facilities were included in the study. Participation was voluntary.

At the end of the study 29 out of 31 clinics approached agreed to participate.

Data Collection

A self-administered questionnaire together with a pair of biological indicator vials (S poreview® – SPSmedical Supply Corp. USA) for each sterilizer in each clinic was distributed to the dental clinics participating in the study. A set of instructions on how to use the BI vials and a consent form were given to each clinic. A research assistant delivered these. On an agreed date and time the research assistantwent back to collectthe completed questionnaire and exposed vials. The vials were delivered to the microbiology laboratory of the Moi University School of Medicine(MUSOM).

According to the manufacturer's recommendations, the vials were collected and incubated within 8 hours after exposure. This was possible because all the towns in the study area are within eight hours' drive from Eldoret where the School Of Medicine microbiology laboratory is located.

Laboratory Procedures

Sporeview® BI vials are self-contained Biological indicators containing spores of *Geobacillusstearothermophilusin* a plastic vial inside which there is a glass ampoule containing modified soybean casein digest broth.

In the laboratory crushing the inner glass media ampoule using a vial crusher to mix the media with the spores activated the BIs. The vials were then incubated at 60^{o}C for 24 hours and monitored at eight hourly intervals. An unexposed vial from the same batch of biological indicators was also incubated to act as a control. Any surviving spores will germinate and grow. Sterilization failure (positive outcome) was indicated by a change in colour in the vial from purple to yellow. There was no colour change if the sterilization was effective (the colour remained purple). Inactivated spores in the case of failure feed on the media to produce acid

as one of the by products. This acid lowers the PH and activates a colour sensitive indicator incorporated in the soya bean culture media. When the indicator is exposed to low pH, it turns colour from purple to yellow.

The outcome was considered positive when one or both vials from the same steriliser indicated failure (colour turned from purple to yellow).

Ethical considerations

Alphanumerical codes were used to blind the study. The questionnaires and BI indicators were assigned alphanumerical codes as means of identification by the PI. The research assistant then distributed both the coded questionnaires and BIs. Only the assistant could relate the questionnaire/BIs and the clinic for purposes of distributing/collecting the samples and delivering the results. This information was kept confidential by the assistant and was not known by any other person. At the end of the study the research assistant under supervision destroyed this information.

The assistant collected sealed questionnaires from the clinics to ensure he did not access the information. The sealed questionnaires were delivered to the PI. The results from the laboratory were all sealed before being given to the research assistant for delivery to the various clinics. No names were used on the forms; therefore the laboratory technician could not relate the results to any clinics.

All the results were accompanied by a set of guidelines containing literature on recommended sterilization protocol and how to solve sterilization failure.

Data Management

The data was stored and analysed using the SPSS 17.0 program (SPSS Inc. Released 2008. SPSS Statistics for Windows, Version 17.0. Chicago: SPSS Inc.) for windows program. The questionnaire covered practice demographics, practitioner and staff training backgrounds, professional memberships, continuing education practices and office sterilization procedures. Information coming from the questionnaire was compared using a chi squared analysis comparing the location of offices, patient load, types of sterilizers present, office personnel and spore testing results.

Results

29 out of 31 (93.5 %) of all the practices approached agreed to participate in the study. The majority 65.5% (19) were private clinics, 24.1% (7) were government, 6.8% (2) were private hospitals while, 3.4% (1) were from Non Governmental Organization clinics.

The dental practices participating in the study were from the following towns:

- Eldoret and its environs -18
- Nakuru - 6
- Kisumu - 8

Effectiveness of Sterilization

It was found out that 31.0% (9) of the clinics had sterilization failure while 69.0% (20) were effective.

14.3% of the public hospital clinics had failure compared to 42.1% of the private clinics. This difference was however not statistically significant (χ^2=3.40,*df*=3, *p*=0.34)

Table 1. Type of practice and effectiveness of sterilizer

	Effectiveness		
Type of practice	**Effective**	**Failure**	**Total**
Public	6	1	7
NGO	1	0	1
Private hospital	2	0	2
Private clinic	11	8	19
Total	**20**	**9**	**29**

Methods of sterilization

A large majority (93.1%) (27) of the dental facilities use autoclaves alone or in addition to other methods of sterilization. 34.5% of the clinics also use chemical sterilization, while only one clinic (3.4%) reported use of dry heat sterilization.

Sterilization monitoring

Clinics documenting monitoring of sterilization using chemical methods in addition to other methods were 69% (20). 72.4% (21) reported use of mechanical monitoring alone or in addition to other methods. Only one clinic (3.4%) reported using BIs to monitor sterilization. 10.3 % (3) of the clinics did not perform monitoring at all.

Packaging, Labelling And Post-Sterilization Packaging of Instruments

72.4% (20) of the practices packaged their instruments in one way or another before sterilization. This was done in linen- wrapped instrument trays (37.9%), wrapped perforated instrument trays (17.2%), lockable imperforated instrument trays

(3.4%) and self sealing paper/ plastic peel pouches (24%).

Only 41.4 % of the clinics labelled the packages. A higher percentage of the clinics in public hospitals [71.4%] labelled their packages compared to the private clinics [26.7%] .This difference was statistically significant (p=0.02, df 3).

The information indicated on the labels included date of sterilization by 34.5% of the clinics, procedure (10.3%) and sterilizer identification (6.9%).

Table 2 below shows the methods of storage.

Table 2. Methods of storage

Method of storage	% of clinics
Loose in enclosed cabinets	13.8
Loose in enclosed drawers	27.6
Loose on open areas	13.8
Wrapped in enclosed cabinets	55.2
Wrapped but on open areas	20.7

Frequency of attendance of CPEs (Continuous Professional Education)

A majority of the dentists (89.7%) attend CPEs and there was no association found between this and outcome of sterilization ($\chi2$=0.08, p= 0.928, df 1)

Personnel

Employees directly in charge of sterilization

Table 3. Sterilization failure rates and designation of employee in charge of sterilization

Employee	Frequency of practices (%)	Sterilization failure rate (%)
Nurse	31.0	12.5
In-house trained dental assistant	62	45.5
Receptionist	7	100

The least failure rate was recorded where a nurse was in charge of sterilization

Patient Loads

Table below shows the patients load distribution in the clinics.

Table 4. Weekly patient load

Patient load per week	Frequency N [%]	Portion of Failure rate[%]
Less than 25	8[28.6]	10
26 – 50	11[39.3]	14.2
51-75	4[14.3]	0
More than 75	5[17.9]	3.6
TOTAL	**28[100]**	

The most frequent patient load was 26 to 50 patients per week. Most clinics see 50 patients or less per week.

There was no significant association found between patient loads and sterilization failure [$\chi2$=2.420, p=0.49, df 3]

Practice duration

A majority of the clinics had been operating for 5 years or more (71.4%). No significant association was found between the practice duration and sterilization failure ($\chi2$=0.070, p=.966, df 2).

Liquids used for decontamination (pre-holding)

The liquids most frequently used for pre-holding were sodium hypochlorite (58.6%) and glutaraldehyde (55.2).

Liquids used for cold sterilization

The most commonly used liquid chemicals for cold sterilization were glutaraldehyde (58.6%) followed by sodium hypochlorite(20.7%).

Discussion

Infection control has become of paramount importance in the field of Dentistry in the 21st century. This is because infectious and transmissible diseases, resistance of microorganisms to conventional drugs and emergence of new virulent microbes are on the rise.

Barrier techniques including gloves, hand washing, face masks, protective eye wear/clothes, and limiting contamination must be combined with disinfection and sterilization of equipment and instruments used in the dental clinic.[21]

The percentage of autoclave failure of 31% in this study is significant enough to raise concern on the effectiveness of sterilization in the dental practice reported in this study. This is higher than reported by Chan in 2007,[22] who found failure in 7% of his respondents,2% found in UK [17] and 13% found in Ireland.[25] However the methodologies between this studyand the others mentioned were

Table 5. Types of liquid used for decontamination

Commercial name/name indicated	Chemical name(composition)	Number of clinics	Frequency(%)
Jik	Sodium hypochlorite	17	58.6
Cidex,cidezyme,,glutaraldhyde, totacide	Glutaraldehyde	16	55.2
Spirit	ethanol	4	13.8
Endozyme, aniosyme	Enzymatic cleaner(protease, amylase)	3	10.3
Presept tabs	Sodium dichloroisocyanurate(NaDCC)	3	10.3
Hydrogen peroxide	Hydrogen peroxide	1	3.4
Zeta ultra	Aldehyde free concentrate	1	3.4
Omo	soap	2	6.8
Water	water	2	6.8

Table 6. liquids used for cold sterilization

Name stated	Chemical name/composition	Frequency
Cidex,glutaraldehyde, Totacide, steranios,	Glutaraldehyde	17 [58.6]
Endozyme	Enzymatic cleaner (protease/amylase enzymes)	1 [3.4]
Ultrasnipes		1 [3.4]
Jik	Sodium hypochlorite	6 [20.7]
Presept tablets	Sodium dichloroisocyanurate(NaCC)	1 [3.4]
Zeta ultra	Aldehyde free concentrate	1 [3.4]
Spirit	ethanol	2 [6.8]

different. Studies show varied sterilization failure rates but of importance is that practitioners must be prepared for and investigate this failure.[8,17]

Several factors contribute to failure of sterilization. In this study it was found that 93% respondents use autoclaves while 34% combine it with chemical sterile methods, 10% do not monitor their autoclaves, 72% pre-package their instruments, while 41% label their packaged instruments. These concur with literature documentation showing that safekeeping and proper storage is key to effective sterilization.

Other aspects that contribute to failure are reported as:

- Inadequate preparatory steps
- Poor packaging
- Poor autoclaves procedures
- Poor control in packaging and storage
- Contamination during sterilization and Use of chemicals and procedures not meeting the required standards.[22] These reports are consistent with the findings in this study.

When comparing the percentage of failure amongst the persons working in the clinic, most failure was seen where the receptionist was performing the sterilization (100%) followed by the in-house trained dental assistants (62%) whilst nurses had 12.5% failure. This can be explained by the fact that nurses in Kenya are formally trained in infection control protocol.

The term cold and chemical sterilization are often used interchangeably, and in essence they refer to the same procedure described in this study. The two most commonly used chemicals were gluteraldehyde (55.2%) and sodium hypochlorite (58.6%). Other chemicalsused in the dental practice include alcohols, glycol ethers and ethylene oxide gas.[22]

Although these chemicals are known to be effective and are routinely used in the dental office, caution must be taken in their uses due to their potential health hazards (burns, carcinogenic nature, absorption through the skin and inhalation) and during their waste disposal.[23]

Conclusion and Recommendations

From this study it can be concluded that the failure rate of sterilization posed by dental practices is of concern because sterilization failure was detected in more than 1/3 of the respondents.

This therefore leads to the following recommendations

1. Dental practitioners should use mechanical, chemical and biological infection control

methods at all times to ensure patient safety.
2. Periodic spore testing on all autoclaves used in the dental clinics/hospitals be made mandatory in Kenya.
3. Licensing of Dental practice by the regulatory bodies should be linked with compliance of infection prevention and control as is practiced in other parts of the world.
4. All personnel carrying out sterilization for use in the dental practice must be properly trained
5. A further study to be carried out to encompass the entire dental fraternity should be done as follow to confirm these findings

Limitations of the study

1. Use of self containing biological indicators meant than incubation had to be done within 8 hours of exposure the same day. Therefore this did not enable us to test from areas which were distant from the location of the microbiology labaratory
2. Retesting of the sterilizers where there was failure was not done. This needs to be done in future studies after giving sterilization guidelines to the clinics where there is failure.

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Influence of shade on curing hardness of two nanocomposites

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Abstract

Objectives: This study compared the hardness of three shades each, of two types of restorative nanocomposites, after curing with a high-power light-emitting diode (HP LED) curing light (FreeLight 2, 3M ESPE), at 100% (20 s) of the recommended curing time.
Methods: Two Nano-composites Z350 (shades A1, A3.5, C2) and Filtek Supreme XT (FS XT), shades yellow, clear, grey) were used to prepare 10 samples per experimental condition to a total of 60 samples. The specimens were prepared by packing the composites into 3 mm-diameter holes drilled through the centre of 2 mm-wide opaque PVC discs. Vickers micro hardness measurements were obtained on both sides of the samples and the bottom-to-top hardness ratios were calculated. Data was analysed by 3-way analysis of variance allowing for heterogeneous variances and pairwise comparisons were made to determine which factor combinations differed from others ($p<0.01$).
Results: FS XT showed the highest bottom hardness values, while Z350 showed significantly lower bottom hardness values than FS XT. These differences in bottom hardness values for FS XT and Z350 were ascribed to the translucency of the FS XT shades compared to the opacity of the Z350 shades.
Conclusions: The translucency or opacity of composite materials is an important factor in obtaining adequate cure.

Introduction

Aesthetic resin composite restorative materials are increasingly being used to restore shape and function in posterior teeth. Posterior composite resin restorations, however, are submitted to very large masticatory forces. Therefore the mechanical properties of a resin composite material become even more important in determining a resin composite's long term clinical performance under occlusal forces.

A composite material may be defined as a compound of two or more distinctly different materials, with properties that are superior or intermediate to those of the individual constituents.[1]

Basically, a dental composite is composed of four major components: organic polymer matrix, inorganic filler particles, coupling agent, and the initiator-accelerator system.[2] Several other components are also added to enhance the composite material, for example pigments are added to achieve an acceptable shade and/or opacity.

Developments in filler technology have led to nanoparticles and nanoclusters produced by 3M ESPE for their nanocomposites, Filtek Supreme XT and Filtek Z350. Nanoparticles and nanoclusters are being manufactured using synthetic chemical processes to produce building blocks on a molecular scale. Progressively larger structures are assembled and transformed into suitable nanosized fillers.3 Aqueous colloidal silica sols are being used to synthesize dry powders of nanosized silica particles 20nm and 75nm in diameter. These particles are treated to prevent aggregation. Two types of nanoclusters with a cluster size range of 0.6 – 1.4 microns have also been developed. One type consists of loosely-bounded agglomerated silica particles and is being used in the translucent shades. The other type consists of agglomerated zirconia/silica particles that are radiopaque and is being used in the enamel, body and dentin shades.[3 4]

The most important factors that influence the mechanical properties, are the composition of the composite resin itself and its degree of cure.[5] The composition of light cure resin composites, including the quantity and size of the fillers, the amount and type of photoinitiators, and resin matrix are determined by the manufacturer.[6]

Objectives

1. Measuring and comparing the top and bottom surface hardness of the three different shades of the two nanocomposites.
2. Comparing the bottom to top (B/T) hardness ratio % of all the shades of the nanocomposites.

Materials and methods

Two Elipar FreeLight 2 light units (Serial numbers: 939820005741 and 939820005740) were used in this study. The intensity of the lights was checked randomly throughout the study to ascertain that it did not drop below 80%. The lights were also tested with a handheld radiometer (Cure-Rite, Dentsply/ Caulk Div., Milford, DE, USA) and light emission was always in the range of 940 – 980 mW/cm2.
Three shades of two nano-composites were used to prepare 60 samples (2 types of composite x 3 shades x 1 curing periods x 10 samples) (Table 1).

Table 1. Composition of Filtek Z350 and Filtek Supreme XT.

	Filtek Z350	Filtek Supreme XT
Manufacturer	3M ESPE	3M ESPE
LOT	6BG, 5BC, 5AB	4AN, 5BG, 6AJ
TYPE	Nanocomposite	Nanocomposite
Shade	A1, A3.5, C2	Clear, Yellow, Gray
Filler load	78.5% by weight	72.5% by weight
Filler particle size	Effective particle size = 5-20nm Cluster particle size = 0.6-1.4§m	Particle size = 20- 75 nm Cluster size = 0.6-1.4 m
Recommended curing time	All = 20 secs for 2mm layer	All = 20 secs
Filler type	Zirconia/silica nanocluster and silica particles	Pre-polymerized filler and pyrogenic silica

Opaque PVC discs were overfilled with composite and excess material extruded. Discs were cured at a standard, nonexponential curing mode for 20 seconds. Curing tip was mounted at a fixed distance of 2 mm from the sample. Specimens were kept dry in an incubator at 37 °C for 24 hours.

A Vickers micro-hardness tester (Model M12a, Vickers Ltd, York, England) was used (load = 50 kg X 10 s) to obtain the top and bottom Vickers hardness values of the specimens. (Figure 1).

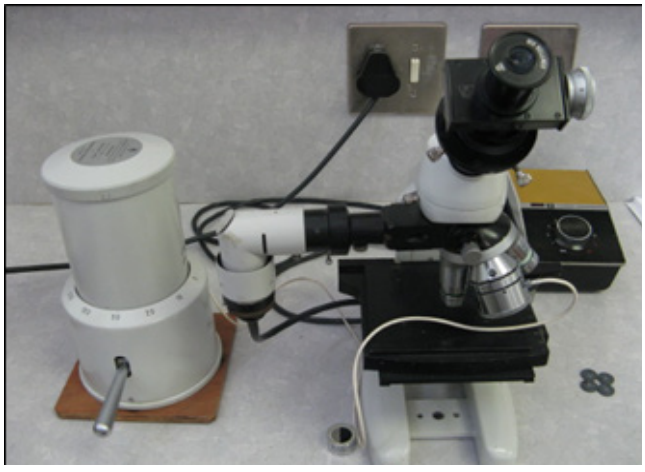

Figure 1: Vickers Microhardness Tester

Three measurements were made on each side of a specimen and a mean hardness value was calculated for each side of each specimen (Figure 2).

Results

Top hardness values (THVs)

No significant differences in top hardness were noted amongst the different shades of composites within each type of composite .The statistically significant differences in Top Hardness Values among some of the experimental groups were quite small and probably not of clinical significance.

Bottom hardness values (BHVs)

The bottom hardness values showed larger differences amongst the various experimental conditions compared to the Top Hardness Values.

For Filtek Supreme XT (FS XT) the shade did not appear to affect the bottom hardness after curing for 20 seconds.

The darkest shade (C2) in Z350 had the lowest hardness (C2 [dark] < A3.5 [universal] < A1 [light]).

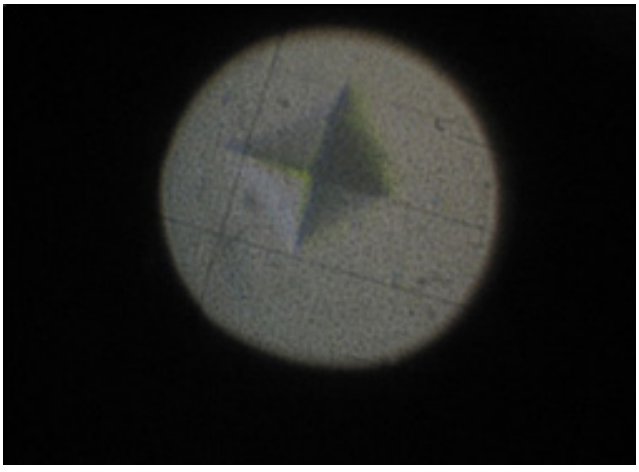

Figure 2 : Correctly aligned Indent

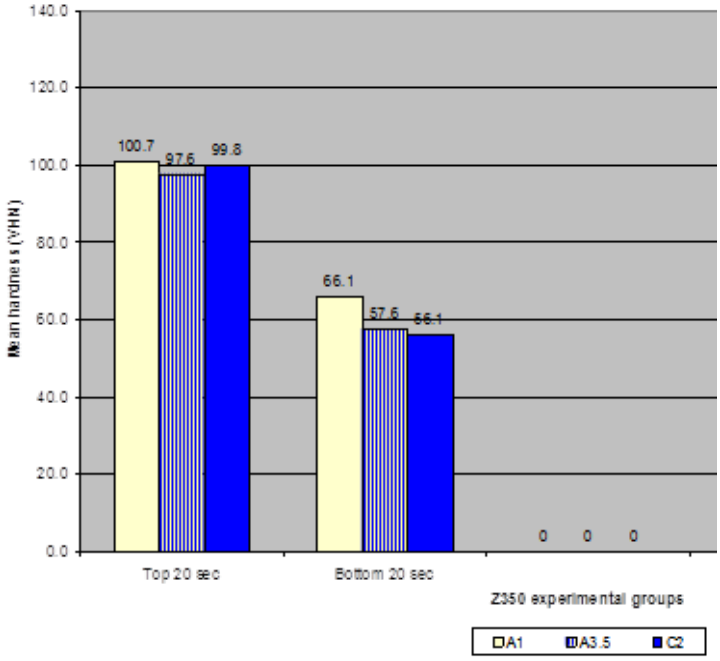

Fig. 3. Top and bottom hardness (VHN) of Z350 irradiated for 20 seconds

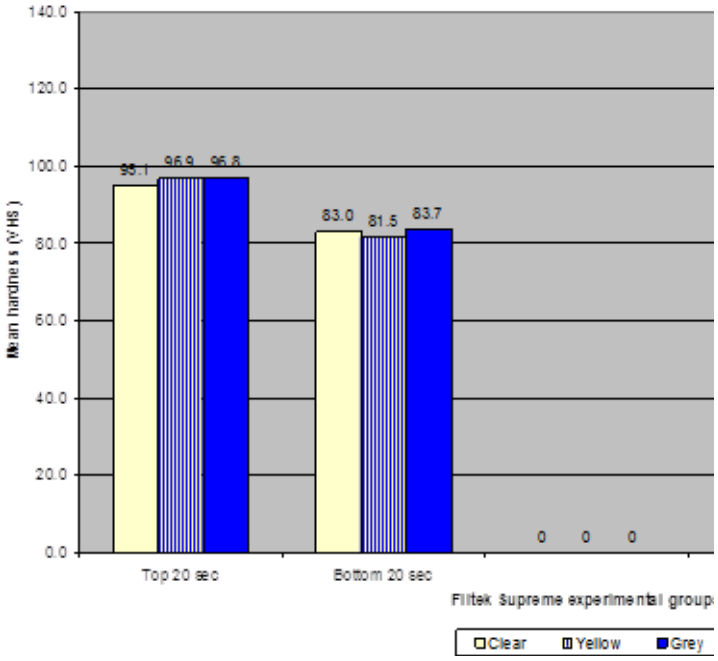

Fig. 4. Top and bottom hardness (VHN) of FS XT irradiated for 20 seconds

The shade A1 was significantly harder than A3.5 and C2.

The curing groups FS XT showed the highest Bottom Hardness Values

Figures 3 and 4, show the Vickers Hardness values for Z350 and Filtek Supreme XT, respectively, when cured for 20 seconds. Both the top and bottom hardness values for each material is represented in one graph to show the differences, not only between the two materials, but also differences within one material of different shades.

Bottom /Top hardness ratios

The hardness ratios for the FS XT yellow shade and grey shade were nearly similar. FS XT was the only composite which had hardness ratios above 80% for all its shades.

Table 2. Vickers hardness means (SD) and B/T hardness ratio means (SD) for the two types of nanocomposites at 20 seconds.

		20 seconds		
Type	**Shade**	**Top**	**Bottom**	**B/T Ratio (%)**
Z350	A1	100.7(3.9)	66.1(7.3)	65.5(5.9)
	A3.5	97.6(5.0)	57.6(2.9)	59.1(3.2)
	C2	99.8(5.0)	56.1(8.5)	56.1(6.6)
FS XT	Clear	95.1(2.0)	83.0(5.7)	87.3(5.4)
	Yellow	96.9(6.6)	81.5(5.9)	84.2(3.6)
	Grey	96.8(5.6)	83.7(8.6)	86.3(6.0)

Discussion

Adequate polymerization is a crucial factor in obtaining optimal physical performance of composite materials and is related to better clinical performance. There are, however, many variables that affect degree of cure; for example, filler type and size, light source intensity, duration of exposure and resin shade.[6] Of these factors filler size and shade have been tested in this study.

The physical and mechanical properties of a composite material are determined by the size, distribution and content per volume of the filler particles in the matrix. Therefore the hardness of a composite will be dependent on these variables; for example, hardness can be increased by using smaller particles and a higher filler content.[7]

At the top surface Z350 had slightly harder top hardness values than FS XT. Such a small variation in top hardness was expected as all of these composites contain a very high filler load. All the composites are also produced by the same manufacturer and have the same proprietary resin matrix.

The slight variation in hardness between the two composites can probably be explained by the small differences in filler load. The filler load of Z350 is 78.5% by weight and of FS XT is 72.5% by weight. The fact that Z350 is closer in hardness to FS XT, may be due to the similar filler particle size distribution to that of FS XT.

Concerning the influence of shade on top hardness, no significant differences in top hardness values were noted amongst the different shades when cured for 20 seconds. For bottom hardness of the Z350 the lighter shade A1 was cured significantly harder than the darker shade C2.

All the translucent shades of Filtek Supreme, however, were cured to the similar hardness. The order of the most influential factors in maximizing cure at the surface of a restoration is filler type, exposure duration and resin shade.[6] This means that shade is only a small contributing factor at the surface of the restoration, and even more so with less extreme shades. Filler type and exposure time are not factors in the analysis above: the different shades being compared fall within the same type of composite and the same exposure group. Therefore, this finding agrees with Rueggeberg[6] and his colleagues that the influence of shade on top surface hardness is very small.

As light passes through the bulk of restorative material, its intensity is decreased due to light absorption and scattering by the composite resin. This may lead to a lower depth of cure value[8] or lower hardness values at the bottom of a specimen[9]. In the present study the bottom surface showed much lower hardness values than the top surface for all of the experimental conditions. FS XT showed the highest bottom hardness values.

There are various factors that could have led to these differences in bottom hardness values. The light reduction that takes place as light passes through composite resin is quite complex. Light scattering is related to filler load, particle size and particle size distribution.[10]

If filler size was a factor, more similar bottom hardness values would have been expected of both the nanocomposites. This, however, was not the case. Transmission of light also depends on the opacity or translucency of a resin composite.[11] Bouschlicher[12] and his associates reported a similar degree of conversion for a microfill than for a hybrid composite. They suggested that this unexpected result was probably due to the microfill composite's higher translucency. The shades used for the FS XT samples had a very high translucency in comparison to the shades used for Z350, which were quite opaque. The filler load of Z350 is also slightly higher than that of FS XT. Filler load can also influence light transmission. Light transmission decreases as filler

load increases.[12] Depth of polymerization is more dependent on the opacity or translucency of a resin composite than on the shade itself.[11] This is confirmed by this study where very small, non-significant differences in bottom hardness values were noted for the translucent FS XT shades (clear, yellow, gray). In contrast to this, a significantly lower bottom hardness value was noted for the dark, more opaque C2 shade of Z350 in comparison to its universal and lighter shades .

Darker shades would normally be associated with a lower degree of cure or hardness value since the pigments in darker shades absorb more light, as confirmed by the following studies. Aguiar[9] and his colleagues found the lighter shade to have a higher hardness value than the darker shade. The shades of a microhybrid resin composite Z250 they tested were C2 (darker) and A1 (lighter). Shortall[13] reported lower depths of cure for the darker shades of Z250, for example C2 and D3, than for the lighter shade A1. When Tsai[8] and his colleagues evaluated depth of cure with a few Z250 shades, they also found that the darker shade (C4) had a greater depth of cure than the lighter shade (B1). After direct examination of the C4 shade they suggested that its greater translucency, as well as the underlying optical properties of its fillers and tints, may have contributed to this difference.

This study did not test the whole range of available shades of the composites tested. It is recommended to extend the current work to include all of the shades, especially the more extreme shades of Filtek Supreme (dentin and body shades).

Limitations of the study

The effectiveness of polymerization was assessed using the Vickers microhardness test, the reasons being that hardness tests are cheap and relative simple to perform. They are also popular, therefore making comparisons to other researchers' work possible. More importantly, hardness tests are an accurate indirect method of evaluating the degree of polymerization of different types of composites[11] as they show a positive correlation to degree of conversion[12]. The only disadvantage of conventional microhardness tests is that a direct visual measurement of the indentation length is performed after removal of the load as error may occur due to elastic recuperation. Such error may lead to an overestimate of hardness when the Vickers (or Knoop) microhardness tests are used.[11] If this held true for the present study, it may mean that the actual surface hardnesses of the specimens were even lower than the hardness values reported.

Light intensity decrease with increasing distance from the curing tip, which will result in a softer bottom hardness of a 2-mm specimen.[9,14] Therefore the distance of the light-cure tip from the composite surface was standardized at 2mm. Although some researchers use a 1mm distance 7 15, a 2mm distance was regarded as clinically a more relevant distance.[14,16] Using a 2mm distance instead of a 1mm distance could have provided lower hardness values than those reported in the studies that used a smaller distance, explaining the low hardness achieved. The spin-off, however, is that the results obtained mimic the clinical setup where cusps prevent close positioning of the light tip when a posterior occlusal restoration is cured.

Conclusions

On the basis of the surface microhardness measured at the top and the bottom of 2 mm thick specimens of three shades each of the two nanohybrid composites irradiated at 100% of the recommended exposure time, the following conclusions were reached:

- For all three shades of FS XT, the differences referred to above were quite small and probably not of clinical significance.
- The translucency or opacity of resin composite materials, rather than shade or type of composite, is an important factor to be considered for obtaining adequate polymerization.

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ORIGINAL ARTICLE

Association between knowledge and practices of parents and dental caries among preschool children

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Abstract

Background: Children below five years old depend on parents for the care of their primary teeth.
Objective: To determine the association between knowledge and practices of parents regarding dental health care and dental caries among preschool children.
Design: Cross sectional analytical study.
Setting: Gertrude's Children's Hospital, a leading children's hospital within Nairobi County in Kenya.
Study population: Children 3-5 years old and their parents from high socioeconomic communities residing within Nairobi.
Materials and methods: The study selected 387 respondents by systematic random sampling method. Pretested questionnaire interviews were conducted for parents on demographics, dental knowledge, dental hygiene practices and cariogenic foods consumption. Basic Screening Survey (BSS) done under natural light as per recommendations of World Health Organization described the dental status. Computed data was analyzed by descriptive statistics, Odds Ratio (OR), Confidence Interval (CI), Chi square and Fishers' Exact tests.
Results: The prevalence of caries was 153(39.5%), categorized as 118(77.1%) untreated decayed teeth, 20(13.1%) filled teeth and 15(9.8%) missing teeth due to decay. Bivariate analysis showed significant risk factors for caries that included incorrect knowledge on appropriate time to commence tooth brushing (OR=2.51, p <0.05), dentist's visit by first birth day (OR= 2.24, 95% CI: 1.32-3.81, p < 0.05), high frequency consumption of cariogenic foods (p< 0.05), not ever visited a dentist (OR=2.59, p< 0.05). Significant protective factors for caries included tertiary maternal education (OR= 0.0, 95% CI: 0.0-0.2, p <0.05), assisted tooth brushing (OR=0.2, 95% CI: 0.09-0.40, p <0.05), low frequency consumption of cariogenic foods.
Conclusion: Gaps in knowledge and practices among parents regarding dental health care of preschool children's still exist and contributes to caries occurrence among their children despite high level of maternal formal education. Focused dental health care education for preschool care givers, regulation of cariogenic sticky foods and planned dentist's visits are recommended.

Introduction

Dental caries (tooth decay) is a pathological process of break down and destruction of the tooth structure.[1] Tooth decay among young children (under six years of age), defined by one or more decayed, missing or filled teeth is called early childhood caries (ECC). Globally, few epidemiological oral studies focus on the young children however, the United States of America (USA) categorize caries among the most common chronic disease in children with a prevalence of about five times that of asthma and seven times that of hay fever.[2] Lithuanian in Kaunas had no studies on Early Childhood Caries (ECC) till the year 2010.[3] In Africa, caries in children is higher in low socioeconomic communities. Kenya has no national oral survey but isolated studies among children under five years old have reported high prevalence (59.5%) of caries.[4]

The goal for this study was to assess the knowledge and practices of parents regarding dental

health care of their children's primary teeth and determine the association with caries. Children under five years old depend on their parents for dental health care such that habits learned at that time can be carried on to the future. The multi-factorial nature of caries disease indicate that it is a chronic infectious process that may begin early in childhood (soon after the eruption of the primary teeth) with life-long health implications.[2] The approach is therefore to include care givers of young children in the prevention strategies of those at high risk for decay. Preschool children are vulnerable to caries by their snacking behavior on cariogenic foods common during nursery time.[5] Children attending health care at Gertrude's Children's Hospital are vulnerable for caries due to their high socioeconomic background that exposes them to a lifestyle of consuming sugary sticky foods. Some children's may develop severe caries but be scarcely monitored due to the misconception by their parents that replacement by better permanent teeth will overcome any previous dental diseases. However, dental caries experienced in early childhood can progress to permanent teeth.[6] The American Dental Association recommends teeth cleaning to commence as soon as the first teeth grow and dentist's visit to be at first birthday and regularly every 6 months.[7]

Interaction of three factors responsible for successful dental caries development includes cariogenic microorganisms, especially Streptococcus mutans, fermentable carbohydrates and a susceptible tooth surface (for sufficient time). Initial oral cavity microorganism's colonization is likely from mother to child through shared utensils, food, and close contact as early as at six months.[8] When lactic acid, resulting from foods fermentation lowers the oral PH to < 5.5, the acids erode the enamel and progress to the pain sensitive tissues, the dentine, pulp and cementum, a process that leads to loss of minerals (mainly calcium and phosphates) and cavitations.[9] Tooth decay process is of public health concern since the early stage demineralization (non cavitated lesions), can be reversed by calcium and phosphate, together with fluoride. The de-mineralization and remineralization process occur several times a day leading to damage, repair, and reversal or maintaining the status quo of the tooth.[9] Saliva buffers the acidic environment.

Materials and methods

Study design

The study employed a cross-sectional analytical design that utilized both quantitative and qualitative approach.

Study site

This study was conducted at a Gertrude's Children's Hospital (GCH) that lies in the outskirts of the Central Business District of Nairobi, the capital city of Kenya in East Africa. The GCH is a leading private children's hospital in East and Central Africa, run by a Board of Trustees. It operates as the main branch within Muthaiga estate and [9] satellite clinics fairly distributed within Nairobi. The hospital runs three dental clinics and a busy outpatient.

Study population

The study population consisted of children aged between 3–5 years and their parents sampled from the outpatient pool while attending health care for mixed curative and preventive conditions. The population has accessibility to professional dental health care while seeking care for other ailments at the GCH.

Sample size

Sample size of 389 respondents was determined by the Fischer et al. statistical formula.10

Sampling methods

Systematic random sampling of 387 respondents was done at the interval of the 12th appropriate respondent for questionnaire interview of the parents and dental examination of the children. Identified timing for the interviews were at the laboratory stage while clients waited for their reports or just after clients had completed their primary reason for hospital visit. Variation of the times within the day included morning, afternoon and evening sessions to eliminate the bias of selecting subjects with similar periodicity in timing the hospital visit which ensured adequate randomization. This study was conducted within November 2011 to January 2012.

Data collection procedure

The instruments and tools for data collection included a pretested questionnaire for parents consisting of structured and some unstructured questions in English or Kiswahili language as found appropriate. The variables assessed were the socio demographics of participants, children's characteristics, knowledge of parents regarding dental health care of primary teeth, dental health care practices of children and cariogenic foods consumption. Frequency of snacking on sticky

cariogenic foods was classified as high when (daily), moderate (2-6 per week) low (when consumed during outings only). Basic Screening Survey (BSS) was done as per the WHO recommendations to assess the dental status under natural light. A single Community Oral Health Officer (COHO) performed the dental examination. The COHO and professional dentist inter examiners agreement was good, rated at kappa o.88. Findings were recorded as decayed, missing, and filled teeth (DMFT) scores with fluorosis and teeth lost to trauma or exfoliation excluded

Data analysis

Data cleaning and validation was done. Quantitative data was tabulated for descriptive statistics of the basic variables were used to describe the results. Bivariate analyses were done using the Odds Ratio (OR) to demonstrate the association at 95% Confidence Interval (CI). A measure of statistical significance by Chi square and Fisher's Exact Test was done at p value < 0.05 as significant.

Ethical Consideration

Authorization to carry out the research was sought from Jomo Kenyatta University of Agriculture and Technology (JKUAT) and Kenya Medical Research Institute (KEMRI). The Ethics Review Committees of KEMRI and GCH gave approval, the hospital administration granted permission for data collection and parents of the children signed an informed consent. Parents received oral health education and referrals where necessary. Data collected was stored and confidentiality maintained.

Results

Demographic characteristics of the participants

From the sampled 387 respondents, this study found 195(50.4%) male and 192(49.6%) female children. Majority of participants 218(56.3%) were from Nairobi County, 164(42.4%) from other Counties within Kenya while 5(1.3%) were from countries outside Kenya. Maternal highest education level attained was university level 230(59.4%), college 114(29.5%), 7.5% had complete and incomplete secondary, 12(3.1%) completed primary and 0.5% did not know. Analysis revealed that tertiary education of mothers was protective of caries among their children, university level (OR= 0.0, 95% CI: 0.0-0.2, p <0.05). A small proportion of families 3(0.8%) lived in a one bed roomed houses while majority 180(46.5%) and 178(46%) lived in three and more than three bed roomed houses, respectively. Majority 284(73.4%) of the families had an average net monthly income of > ksh. 50000, 79(20.4%) earned between ksh. 20000<50000 while 11(2.8%) could not tell their average net monthly income. Association between financial status and caries was not conclusive due to very small numbers in some cells.

Dental caries status

Prevalence of caries was 153(39.5%) and 118(77.1%) of children had untreated decayed teeth. More males than females had filled teeth and no male had missing teeth due to caries. Children with no dental caries were 234(60.5%) as shown in Table 1.

Table 1: Categorization of dental caries status decay missing filled teeth (n = 387)

Dental caries status	Male Count (%)	Female Count (%)	Total Count (%)
Dental caries categories present			
Decay	61(31.3)	57(29.7)	118(30.4%)
Filled due to decay	13(6.6)	7(3.6)	20(5.2%)
Missing due to tooth decay	0.0	15(7.8)	15(3.9%)
Total			**153(39.5%)**
No dental caries present			
Sound teeth	110(56.4)	99(51.6)	209(54.2%)
Trauma	4(2.1)	2(1.0)	6(1.5%)
Exfoliation	4(2.1)	9(4.7)	13(3.3%)
others	3(1.5)	3(1.6)	6(1.5%)
Total			**234(60.5%)**

Knowledge of parents regarding dental health care of preschool children

Majority of parents 210(54.3%) obtain information regarding dental health care of their children from the media (Television, Radio, Newsprints and Magazines). A smaller proportion accessed their information from medical doctors 94(24.4%), well baby clinics when children were taken for vaccinations 40(10.4%) and also from relatives, friends and undisclosed sources.

Table 2 shows that 182(47.0%) of parents were not sure of the definition of dental caries while 61(41.6%) knew the correct defination as tooth decay, 237(61.3%) selected incorrect timings to commence tooth brushing but 98(25.2%) correctly indicated to commence as soon as the first teeth appear, 240(62.1%) knew that tooth decay will not stop when permanent teeth grow, 116(30.1%) indicated that bottle feeding at night can cause tooth decay. When parents were asked if children should only visit the dentist when they have tooth decay or pain, majority 312(80.5%) responded no however, only 139(35.8%) selected that children need dentist's visit at first birthday and regularly.

Dental hygiene practices among the children

Table 3 shows that majority of children 280(72.4%) brushed their teeth at least twice a day, 339(87.6%) were assisted by house members to brush their teeth, 189 (48.8%) used pea size fluoride tooth paste and 290(74.9 %) had their toothbrushes renewed at least once within 6 months.

Dentist's visits practices among the children

Children had ever visited the dentist were 134(34.6%) where 88(65.7%) went for check up while 46(34.3%) needed uprooting loose tooth, fixing a decayed teeth or pain on chewing. Majority 253(65.4%) had never been taken to the dentist and gave various reasons like child had not yet shown any problem requiring dentists visit 221(87.4%), teeth decay will clear when permanent teeth grow 13(5.1%), medical insurance cover does not include dental check up 9(3.6%) and also 10(3.9%) mixed reasons:

- Child is scared
- Ignorance of information
- Never thought it is necessary
- No official information or not among routine checkups
- She/he has good teeth, no caries yet

Table 2: Knowledge assessment parameters from parents (n = 387)

Knowledge parameters assessed	Correct response count (%)	Incorrect response count (%)	Not sure/ no knowledge count (%)
What is dental caries?	161(41.6)	44(11.4)	182(47.0)
Appropriate age children to start tooth brushing	98(25.2)	237(61.3)	52(13.5)
Tooth decay stops when permanent teeth grow	240(62.0)	73(18.9)	74(19.1)
Bottle feeding at night can cause tooth decay	117(30.1)	188(48.6)	82(21.3)
Children should visit dentist by 1st birthday	139(35.8)	130(33.5)	118(30.6)
Dentist's visit should only be when child has tooth decay or pain	312(80.5)	59(15.3)	16(4.2)

Table 3: Dental hygiene practices among the children (n = 387)

Dental hygiene practices	Yes count/%	No count/%	Don't know count/%	Total %
Child brushes teeth at least twice a day	280(72.4)	78(20.1)	29(7.5)	100
Child assisted to brush teeth	339(87.6)	31(8.1)	17(4.3)	100
Child uses pea size fluoride tooth paste	189(48.8)	191(49.3)	7(1.9)	100
Child too young to brush teeth	7(1.8)	380(98.2)	0(0.0)	100
Toothbrush renewed at least once within 6 month	290(74.9)	82(21.1)	15(4.0)	100

When parents were asked whether they discuss dental health care issues of their preschool children when they visit doctors, majority 301(77.8%) reported they did not discuss, 77(20.0%) said they discussed while 11(2.8%) did not know of dental discussions with general doctors.

Bivariate analysis

Knowledge of parents regarding dental health care and caries in children

Children of parents who defined caries as discoloration of teeth had higher prevalence of caries but the relationship was not statistically significant (OR= 2.11, 95% CI: 0.98-4.52, p>0.05). Lack of knowledge of when young children should commence tooth brushing was a significant risk for caries among children, like suggesting at 2 years (OR=2.51, p <0.05) and at 3 years (OR=10.2, p <0.05). Lack of knowledge that children should visit the dentist by their first birth was a significant risk for caries in the children (OR= 2.24, 95% CI: 1.32-3.81, p < 0.05).

Practices of children regarding dental health care and dental caries

Children who reported pain when chewing food had significantly high prevalence of caries (OR= 2.19, 95% CI: 1.23-4.96, P <0.05). Failure to brush teeth twice per day was a risk for caries but not statistically significant (OR=1.27, 95% CI: 0.76-2.1, p > 0.05). Assisted tooth brushing was significantly protective of caries (OR=0.2, 95% CI: 0.09-0.40, p <0.05). No renewal of toothbrush at least once in 6 months was 1.55 times more likely associated with caries but was not statistically significant (p >0.05). Children who had never visited the dentist had a significantly higher prevalence of dental caries compared to those who had ever had a dentist's visit (OR=2.59, 95% CI: 1.64-4.08, p <0.05).

Consumption of cariogenic foods and dental caries

Consumption of biscuits/cookies 2-6x/week was significant risk for caries (OR=3.54, 95% CI: 1.44-9.0, p <0.05) but consumption during outings was protective of caries however not statistically significant (p>0.05). Consumption of sweets/candies 2-6x/week was a significant risk for dental caries (OR=3.24, 95% CI: 1.14-9.29, p <0.05). Taking chewing gum daily, 2-6x/week and once/week were risks for caries but the relationships were not statistically significant (p>0.05) while consumption during outings was protective of caries but not was also statistically significant (OR=0.51, 95% CI: 0.22-1.20, p >0.05). Cheese consumption at both low and high frequency was protective of caries but not statistically significant (p>0.05). Children who consumed chocolates 2-6x/week had higher prevalence of dental caries than those who never took the chocolates (OR = 8.64, 95% CI: 2.63-29.22, p <0.05) as shown in Table 4.

Discussion

Knowledge and practices regarding dental health care

The majority of parents (54.3%) indicated that the media was their commonest source of information on dental health care while health care institutions were the second common source. This is consistent with the report from 77.8% of parents who voluntereed that they did not regularly include discussions on dental health of their preschool children's primary teeth during hospital visits for other health care conditions.

Gaps in knowledge regarding dental health care of the under five years old children was evident. Lack of knowledge on the appropriate time for preschool children to commence tooth brushing and visit a dentist for preventive care was a significant risk of caries. The American Dental Association recommends teeth cleaning to commence as soon as the teeth appear in the mouth (since some children develop caries as early as 6 months of age) besides dentist visit at first birthday and regularly every 6 months.[7] In this study, dental health care hygiene was well practiced as 72.4% of children brushed their teeth twice a day. However it was the assisted tooth brushing which was significantly protective for caries. Similar reports have been found by 11Tinanoff *et al*., 2002 in the USA. Utilization of the dental health care facilities was low since only 34.6% of children had ever visited a dentist for a curative or preventive purpose. Not ever visiting a dental was a significant risk for caries, ad hoc dental visits occurred when there was a need compared to recommeded planned visits for preventive and curative services. High frequency consumption of cariogenic sticky foods like (biscuits/cookies, sweets/candies chocolates) posed significant high risks for caries. Similar findings have been reported by Ngatia *et al*. and Kiwanuka, *et al*. in Nairobi Kenya and Uganda respectively among 3-5 years old nursery school children. [5, 12]

Table 4: Frequency of consumption cariogenic foods versus dental caries (n=387)

Frequency consumption	Dental caries present			OR(95% CI)	p value
	Yes Count (%)	No Count (%)	Total Count (%)		
Biscuits/ cookies					
2-6x/ week	43 (57.3)	33 (42.7)	76 (100)	3.54(1.44-9.01)	0.00
Once/ week	57 (62.6)	34 (37.4)	91 (100)	4.42(1.84-11.02)	0.00
During outings	42 (23.3)	138 (76.7)	180 (100)	0.8(0.35-1.94)	0.57
Never takes them	11 (27.5)	29 (72.5)	40 (100)	ref	
Sweets/ candies					
Daily	0 (0.0)	1 (100)	1 (100)	0.0(0.0-95.86)	0.52
Daily/2-6x/ week	19 (57.6)	14 (42.4)	33 (100)	3.24(1.14-9.29)	0.01
Once/ week	48 (68.6)	22 (31.4)	70 (100)	0.52(2.13-12.92)	0.00
During outings	73 (30.5)	166 (69.5)	239 (100)	1.05(0.5- 2.32)	0.89
Never takes them	13 (29.5)	31 (70.5)	44 (100)	ref	
Chewing gum					
Daily	1 (50)	1 (50)	2 (100)	1.07(0.01-89.57)	0.96
2-6x/ week	15 (48.4)	16 (51.6)	31 (100)	1.0(0.32-3.11)	0.99
Once/ week	46 (53.5)	40 (46.5)	86 (100)	1.23(0.49-3.13)	0.62
During outings	77 (32.2)	162 (67.8)	239 (100)	0.51(0.22-1.20)	0.09
Never takes them	14 (48.3)	15 (51.7)	29 (100)	ref	
Cheese					
Daily	2 (66.7)	1(33.3)	3(100)	0.68(0.26-32.5)	0.57
2-6x/ week	8 (30.8)	18 (69.2)	26(100)	0.67(0.27-1.54)	0.32
Once/ week	16 (37.2)	27(62.8)	43(100)	0.69(0.44-1.67)	0.66
During outings	7 (35.0)	13 (65.0)	20(100)	0.68(0.30-2.02)	0.62
Never takes them	120(40.7) 1	75(59.3)	295(100)	ref	

P =0.05, OR – Odds ratios, CI – Confidence Interval, ref= reference group

Recommendations

- There is need to promote awareness campaigns among parents regarding dental caries due to gaps in knowledge/practices on dental health care of children under five years old.
- There is need to sensitize parents regarding utilization of dental health care services for scheduled preventive and preservative purposes of the primary teeth.
- There is need to regulate the consumption of cariogenic sticky foods.
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Conflict of interest

We declare that there is no conflict of interest regarding publication of this work whatsoever.

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Association between oral health awareness, perception and practice among school children in Kibera slums, Nairobi

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Abstract

Aim: Assess association between oral health awareness, perception and oral health practices of schoolchildren in government schools in Kibera slum, Nairobi.
Methodology: Descriptive cross-sectional study.
Setting: Ayany, Kibera and Olympic primary schools. Participants: Two hundred and ninety four children aged 9-12 years; conveniently sampled from classes 4-7.
Methods: Data was collected using self-administered, pre-tested questionnaires. Double data entry was carried out. Logical errors were checked using Epi-Info vs. 5. Data was analyzed using SPSS version 19.0. Descriptive statistics reporting means, percentage scores, standard deviation, and frequency description were obtained. Student t -test and Chi-square test were used to test for significance. Pearson's correlation tests and logistic regression analysis were used to test association between variables.
Results: Majority of children (97.28%) had previously received oral health information. Schools (53.74%) were identified as major source of oral health information. Sixty children (20.41%) correctly identified importance of fluoride to dentition. Two hundred and sixty five children (90.14%) reported brushing daily with 29 children (3.74%) reporting brushing twice daily. Tongue (33.67%) and gum (12.93%) brushing was also practiced among group. Toothbrushes (89.80%) and toothpaste (91.84%) being commonly used brushing aids. Two hundred and fifty six children (87.07%) reported having had oral health problem within the previous year. Of these, 80.95% sought treatment from health professionals. One hundred and six (36.05%) children felt that regular dental visit was necessary in the absence of pain. Children with higher levels of awareness exhibited better oral hygiene practices ($p<0.05$). Females had higher levels of awareness than males ($p<0.05$). There was no difference in oral hygiene practices of males and females ($p>0.05$). Perception was not a predictor of practice ($p>0.05$).
Conclusion: There is a positive association between oral health knowledge, attitude and practice. However, environmental and social-cultural factors may influence actual practice.

Introduction

Oral diseases remain a major public health problem worldwide with much of the diseases remaining active and untreated among a large number of individuals.[1] In many developing countries, the oral disease burden is fast increasing due to interactions between retrogressive cultural, socio-economic and environmental factors which increase the populations' risk to the diseases.[1 2] At present, the distribution and severity of oral diseases vary among different parts of the world and within the same country or region with the greatest burden lying among deprived populations.[3]

Diseases such as dental caries, gingivitis, oral mucosal lesions and oro-dental trauma are serious public-health problems whose impact on individuals and communities is considerable. [2 4] Other conditions such as trauma of teeth and jaws, dental erosion, oral manifestations of HIV/AIDS, developmental defects and oro-pharyngeal cancers are also important and particularly prevalent among children of deprived communities.[1] In Kenya, earlier studies record the prevalence of periodontitis to be between 1 and 10% while the prevalence of ulcerative lesions to be about 0.12%.[5] The mean DMFT of children under 18-year olds in urban populations (more so in Nairobi), ranged between 0.2-1.8 and the DMFT of 12-15 year olds ranged between 1.2-1.9.[5]

In 2002, the Kenya Ministry of Health adopted a National Oral Health Policy to provide a national strategy in improving oral health in Kenya by 2013.[6] Despite the plan, organized data on oral health indicators is still lacking, the cost of existing oral

health care and treatment remains unaffordable to the common citizen, and the number of dental health practitioners available to the population remain low (1:100,000).[7] As a result, the oral health needs of many Kenyans (especially the urban poor) still remain unmet.[6]

Several studies have demonstrated that many oral diseases can be prevented when target population are provided with proper education on causes, risk factors, preventive measures and treatment options available for various types of diseases. Though knowledge alone is not sufficient in promoting behavior change.[8] , improving population awareness on proper oral health care is important especially for cultivating positive culture or perception among the general population and most especially among children.[9] .Schools, as learning centers, therefore remain an important setting, for offering an effective way to reach over 1 billion children worldwide and, through them, families and community members. As learning centers, schools are expected to effectively inform and influence awareness, beliefs, perception and practices.[2] In Kenya, 80% of children attend the free primary education; therefore schools present a suitable place for children, who are at highest risk of dental disease, to have access to health education.

The purpose of this study was to determine the association between level of oral health awareness and perception with practices of 9-12 year old schoolchildren from three government schools in Kibera slum, Nairobi.

Materials and Methods

A cross-sectional study was conducted between February and April, 2013. The study comprised 294 school children, between the ages of 9-12 years old. The schoolchildren were conveniently sampled from three government schools: Ayany, Kibera and Olympic primary schools; the only government schools in Kibera slum. Ethical approval was obtained from the KEMRI ethical review committee. Additional consent was obtained from the Nairobi city council and from the schools' authority. Parental consent was waived since the study presented minimal risk to the minors and they were considered old enough to understand what the research entailed. As such the school authorities was considered as the guardians. Data collection was by means of pre-tested questionnaires. An investigator explained the study objectives and went through the questionnaire to ensure participants clearly understood the questions, how to fill the forms and also addressed any concerns or questions arising. The exercise was supervised by the investigators and class teachers from respective classes. The exercise took an average of 40 minutes to conduct and once completed, all respondents' were requested to resume with the normal school programme.

Double data entry was carried out and logical errors checked using Epi-Info version 5.0. Data was then analyzed using SPSS version 19.0. Descriptive statistics reporting mean, percentage scores, standard deviation, and frequency description were obtained. The Student t-test and Chi-square test were used as test of significance. Pearson's correlation tests and logistic regression analysis were used to test correlation between level of awareness, perception towards oral health care and oral hygiene practices.

Results

A total of 294 children comprising 122 males (41.50%) and 172 females (58.50%) were recruited for the study. The group consisted of 9-12 year old school children with a mean age of 10.27 years (s.d.= +/- 0.85).

Level of oral health awareness

Majority of the children (97.28%) had previously received information or advice on oral hygiene care. The common sources of information indicated by the group include schools (53.74%), television (18.03%), home (11.22%) and radio (10.20%). Twenty children (6.81%) specifically identified their mothers as source of oral health information. Majority of the children (97.28%) were aware of the importance of tooth brushing in preventing dental diseases. Two hundred and twenty children (74.83%) correctly identified the reason for using toothpaste during brushing. One hundred and sixty five children (57.48%) indicated that brushing without toothpaste was just as effective as brushing using toothpaste. Sixty children (20.41%) correctly identified the importance of fluoride to dentition. One hundred and seven children (36.39%) were aware of how often toothbrushes should be changed. Two hundred and twenty children (74.83%) were aware that brushing should occur after every meal and at least twice daily (28.91%).

The children identified sugary foods, such as cakes, biscuits, chocolates, sweets (lollipop), ice cream and juices as the major causes of tooth decay;

and daily teeth brushing, eating hard foods, visiting the dentist, drinking milk, and using toothpaste as some of the ways of preventing tooth decay. On what causes halitosis, children among this group identified failure to brush teeth and poor nutrition as the main causes. Some of the oral health misconceptions highlighted by the group included: Malocclusion (3.1%) and sharing of tooth brushes (1.0%) causes halitosis; Eating meat (3.7%) and sugarcane (7.2%) causes tooth decay; and brushing without toothpaste is as effective as using toothpaste (57.48%). Female children exhibited a higher level of oral health awareness than their male counterparts ($p<0.05$). Figure 1 illustrates the responses of male and female schoolchildren on each of the questions provided to assess oral health awareness. The value shown for each question represents the proportion of children, aggregated by gender, who indicated the appropriate/ correct response.

Two hundred and sixty five children (90.14%) reported brushing their teeth daily with 3.74% reporting brushing twice daily as recommended and 283 (96.26%) brushing once per day. Tooth brushes (89.80%) and toothpastes (91.84%) were the commonly used brushing aids within the group. Other brushing aids included chewing sticks/muswak (10.20%), plain water (5.44%) and salt (2.72%). Tongue (33.67%) and gum (12.93%) brushing was also practiced by the group.

Two hundred and fifty six children (87.07%) reported having had an oral problem within the previous year. Of these children, 238 (80.95%) reported having sought treatment for the problem while 18 (6.12%) children did not. Two hundred and twenty nine (77.88%) children reported having sought treatment from health professionals while 22 (7.48%) cases reported having obtained treatment from home or self-medicated. Common oral problems identified by this group included dental caries, bleeding gums, mouth sores and general mouth pains. There was no difference in practice between the male and female children ($p>0.05$), although, more female than male children practiced tongue brushing ($p<0.05$) while more males practiced gum brushing ($p<0.05$). More female children reported having had oral diseases in the previous one year ($p<0.05$). Similarly, more female children sought treatment than their male counterparts ($p<0.05$).

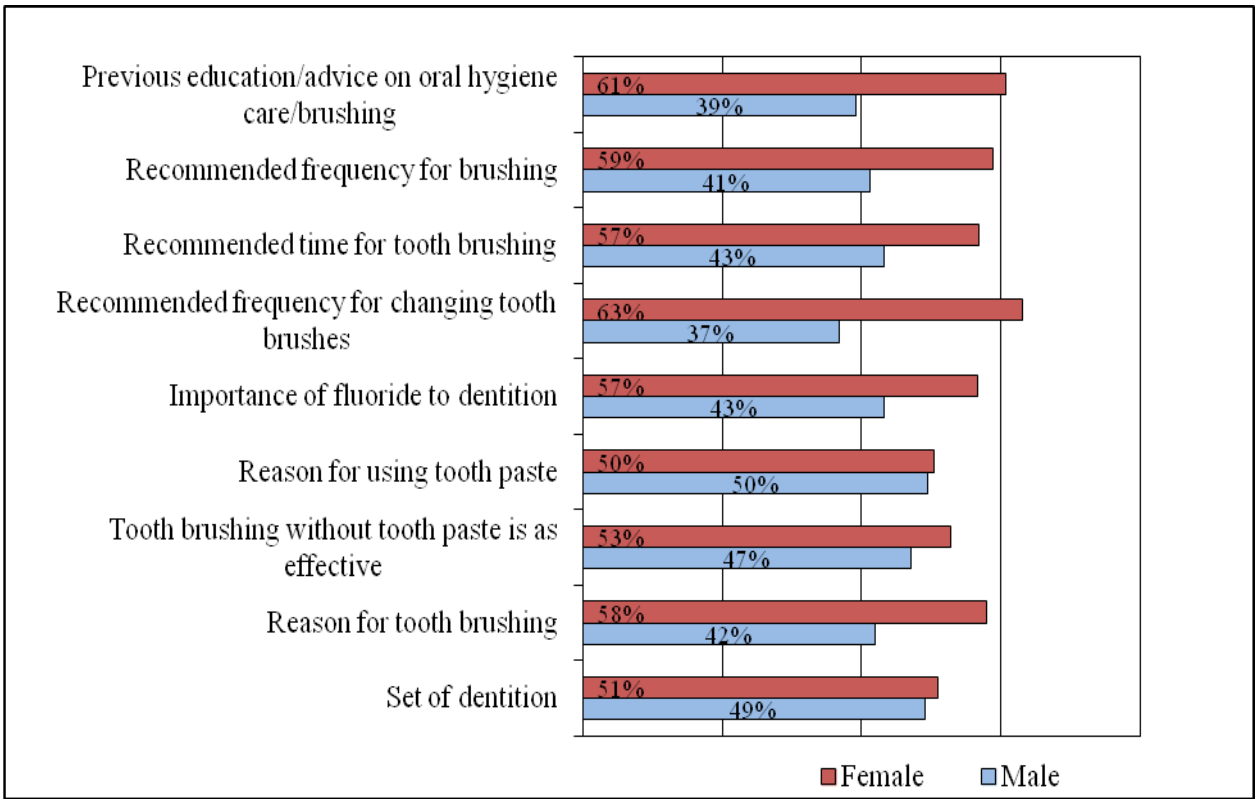

Figure 1: Responses on oral health awareness aggregated by gender

Oral hygiene practices among study participants

Two hundred and sixty five children (90.14%) reported brushing their teeth daily with 3.74% reporting brushing twice daily as recommended and 283 (96.26%) brushing once per day. Tooth brushes (89.80%) and toothpastes (91.84%) were the commonly used brushing aids within the group. Other brushing aids included chewing sticks/muswak (10.20%), plain water (5.44%) and salt (2.72%). Tongue (33.67%) and gum (12.93%) brushing was also practiced by the group.

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Perception towards oral health care

Two hundred and eighty three (96.26%) children perceived oral health to be important to the general well being. One hundred and forty five (49.32%) children identified at least two ways in which oral health affected general health with the most common effects identified by the group including general pain, disease and bad breath which would cause alienation by peers. One hundred and six (36.05%) children felt regular dental visits was necessary in the absence of pain. One hundred and seventy three (58.84%) children considered their mouths healthy mainly because they were not experiencing any pain at the moment. Two hundred and eighty seven (97.62%) children reported that teaching oral health lessons were important in schools. Majority of children (87.76%) of children exhibited a positive perception towards oral health care. There was no difference in perception towards oral health care between male and female children ($p>0.05$).

Association between level of awareness, perception and practice

Logistic regression modeling demonstrates that oral health awareness is a strong predictor of practice among this group of children ($p=0.000$) while perception is not ($p=0.998$). Similarly, using Pearson's correlation analysis, there was a positive correlation between awareness and practice. Children with higher level of oral health awareness exhibited better oral hygiene practices and more positive perception towards oral health care ($p<0.05$). There was no correlation between the children's perception and their practices ($p>0.05$).

Discussion

Majority of children (69.72%) in this group exhibited high levels of oral health awareness contrary to findings from earlier studies which indicated that children in developing world, had limited knowledge on causes and prevention of most common oral diseases.[7,10,11] This may be attributed to increased global oral health promotion initiatives over the decades which aim at increasing awareness and specifically, increased efforts by the Kenya government by introducing health education in the primary schools' curriculum. Majority of the children (97.28%) reported having previously received information on oral hygiene care contrary to figures reported for Nairobi West district (29%) [12] and Mathira West district (40%).[12] This may be attributed to differences in curriculum implementation which may influence ownership of knowledge provided.

School remains the major source of oral health information (53.74%) for this group unlike in North Jordan[13] where parents were identified as the major source of information. According to previous studies, [4,10,11] most children in developing countries grow into adulthood without ever receiving any oral health care advice from their caretakers. Similarly, in Kenya majority of the adult population are unaware of the causes of dental diseases, their preventive measures and pay less attention to their dental health.[7,14] The caregivers therefore, might not promote health education within the household since they also have limited understanding of causes, risk factors and how to prevent oral diseases. As a result, teachers and schools remain as the major sources of information. Fluoride awareness was also low in this group with only 60 children (20.41%) correctly identifying the

importance of fluoride to dentition. All the 9 year old children in this group did not know what fluoride was and its importance to dentition. This is a reflection of a gap in the current health education curriculum in Kenyan primary schools which imparts basic knowledge on teeth, tooth brushing, dietary causes of dental diseases (cavity, decay, bleeding gums and halitosis) and measures for preventing teeth cavity and decay.

Similar to studies in rural India, [8] only 3.74% of children reported brushing their teeth at least twice daily. This was lower than numbers reported for schoolchildren in Nairobi West district (61%) [12] Mathira West district (45%),[12] Khartoum state, Sudan (30%) [15] and in North Jordan (69%).[13] This may be attributed to differences in environmental, socio-economic and education level of caregivers within the different regions. Studies [16,17,19] have demonstrated a correlation between socio-economic factors such as social status, poverty levels and education levels of mothers with high prevalence of oral health problems. These socio-economic factors – limited household resources, lack of access to basic services and amenities – may hinder practice among this group as compared to the populations in above mentioned studies which were mainly drawn from areas considered to be of better socio-economic status. This may also explain why a higher percentage of children (87.07%) among this group reported having experienced oral health problems within the previous year as compared to schoolchildren in Nairobi west (38%),[12] Mathira west (17.5%) [12] and North Jordan (60%).[13] Contact with relevant dental personnel was however confined to treatment and not routine dental check-ups. This may be attributed to financial constraints, high cost of care and caregivers' perception towards oral health care which greatly reflects on the children's health seeking behaviors .[16] Moreover, 63.95% felt that regular dental visits in the absence of pain were unnecessary. Similar to other groups [12,13,16] pain was the motivating factor for seeking oral health care.

Knowledge is a significant factor in forming perception which in-turn moulds behaviour. Studies [13,14] have demonstrated that positive behavior change occurs when adequate information, motivation and practice measures are adopted by individuals. However, the individuals' environment and socio-cultural context may influence actual behavior.[10,20] Smyth [20] observed that daily tooth brushing became more frequent after a community education programme on oral hygiene. In this study, children who had higher levels of awareness exhibited better oral hygiene practices ($p<0.05$). However, though 28.91% were aware that brushing twice daily is recommended, only 3.74% reported brushing twice daily demonstrating the influence of environment and/or socio-cultural context on their practice. Furthermore, there was no difference in oral hygiene practices of male and female children ($p>0.05$) despite the females having had higher levels of awareness than males ($p<0.05$). This group was drawn from a deprived population characterised with limited household resources and high poverty levels. These factors may hinder their practice despite having the relevant knowledge on oral health care.

Perceptions and beliefs also act to influence an individuals' behaviour.[16,17,20] Similarly, an individuals' perception towards oral health may influence uptake and retention of available oral health information and practice. However, perception is as a result of cultural, environmental, educational and socioeconomic factors that modify the association between knowledge, perception and practice.[10,20] Therefore, a positive perception does not necessarily result into practice. 96.26% of children indicated that oral health was important for general well being. However, only 36.05% felt that regular dental visits in the absence of pain were necessary. Although an increase in oral health information is important in promoting healthy practices, the efficacy of such health education campaigns will be limited if key determinants of perception and practice (household resources, cost and quality of care, environment and educational levels) are not taken into account.

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