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Association Between Water, Sanitation, General Hygiene And Oral Hygiene Practices Of Street-Involved Young People In Southwest Nigeria

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Abstract

Background Oral hygiene practices can be linked to personal hygiene practices, including access to water and other sanitation facilities. The objective of the study was to determine if there is an association between oral hygiene practices and water and sanitation hygiene (WASH) practices among street-involved young people (SIYP).

Methods A cross-sectional study involving SIYP age 10-24 years in two states in Nigeria recruited through respondent-driven sampling was conducted. Interviewer-administered questionnaires were used to collect data on water access, sanitation personal and oral hygiene. The instruments used for collecting the data were standardized tools for measuring the phenomena studied. The association between knowledge and practice of oral hygiene; oral hygiene and water, sanitation and hygiene (WASH), and indicators of good oral hygiene were assessed.

Results We found that the proportion of SIYP with good knowledge of oral hygiene was high (84.9%), but fewer had good oral hygiene practice (8.9%). There were significant associations between knowledge and practice of tooth cleaning, use of fluoride-containing toothpaste, dental flossing, consumption of sugar between meals, and frequency of dental check-ups ($p<0.001$ respectively). Respondents with good water collection and storage (AOR: 2.40; 95% CI: 1.31-4.38; P=0.004) and those residing in Lagos (AOR: 2.61; 95% CI: 1.42-4.80; P=0.002) had higher likelihood of having good oral hygiene.

Conclusion Good oral hygiene practices of SIYP in Nigeria is associated with access to water collection and storage. WASH programs can have impact on health through improved oral hygiene practices.

Background

Access to water is strongly associated with hygiene practices, and hygiene practices are strongly linked to health. For these reasons, one of the 2030 Agenda for Sustainable Development goals is access to safe drinking water. Safe water can be a driver of progress for many of the Sustainable Development goals, including health, nutrition, education and gender equality [1]. Global actions therefore gave rise to the water, sanitation and hygiene (WASH) initiative, with the aim of empowering communities to enhance their access to and use of safe water and sanitation service, and to improve sustainable hygiene practices [2].

Such access should improve oral hygiene practices also as oral hygiene is a part of personal hygiene. Personal hygiene in the context of the WASH initiative does not directly address oral hygiene [3]. Yet, poor oral hygiene contributes to acute and chronic ill-health [4]. When tooth cleaning is not adequate, plaque can accumulate, which increases the risk for caries [5], gingivitis [6], and periodontal diseases [7]. Periodontal disease is associated with increased risk for cardiovascular diseases [8,9], type 2 diabetes [10], preterm birth [11], low birth weight [12] and low sperm count [13]. The risk of end-stage renal disease and cardio-renal mortality increases in people with periodontitis and type-2 diabetes [10]. Oral hygiene is linked to general health [14].

Tooth cleaning habits and practices are established early in life [15]. Bad habits present in adolescence, and are associated with increased risk for diseases in adulthood [16]. Good oral hygiene practices on the other hand, are associated with knowledge of what constitutes good practices [17]. Though the ability to self-regulate improves during adolescence, the motivation to employ self-regulatory abilities for health-related behaviours declines during this period with implications for overall oral health and well-being [18,19]. This decline may be worse for

adolescents and youths who live without parental influence and control, such as street-involved young persons (SIYP).

SIYP are adolescents and young persons who come to the street and engage in the street economy as a source of labour [20]. They also engage in high-risk behaviours [21] and have emergency health needs [22]. In Nigeria, studies indicate that the risk for sexually transmitted infection, HIV infection and sexual exploitation are increased in SIYP [23-26]. The oral health needs of the homeless are also significant, large but often neglected [27-29]; these people reside in slums and poor residential areas [22], which increases their risk for poor sanitation and personal hygiene practices. They are vulnerable to diseases that WASH addresses.

While oral hygiene is part of personal hygiene practices, oral hygiene is at the greatest risk of neglect by children, adolescents and adults when faced with multiple life issues [30]. While personal health care practice to optimize healthcare is prioritized by those in the labour industry, oral health practices are often less prioritized [31]. SIYP who also are working agents are also at risk of deprioritizing their oral hygiene practices in comparison to other personal hygiene practices.

WASH are country-level programs that aim to reduce the risk for diseases by creating environments that support good personal hygiene and sanitation. Little is known about the link between WASH practices and oral health. Yet, with the high prevalence of dental caries in developing countries [32] - the same regions where WASH programs are implemented and expected to have a major impact - incorporating oral hygiene practices into WASH programs may be a cost-effective approach to addressing important health needs at the population level. WASH programs have focused on under-5-year age children to reduce the risk of childhood infectious diseases that result from inadequate access to water and sanitation [33].

Though there is a WASH agenda for Nigeria [34], our literature search yielded no publications on SIYP, WASH or oral health. Oral health as a dynamic process that can be affected by poor access to water, sanitation and personal hygiene enhancing systems and structures, which operate to perpetuate inequality [35]. Oral hygiene practices can be affected by the following conceptual domains that affect health: demographic factors (age, sex, education, and employment), distal factors (access to water and sanitation services), and proximal factors (oral health knowledge and oral health behaviour). This study is an effort to address the gap in understanding about the relationship between WASH and oral hygiene practices of SIYP. It will determine the association between the knowledge and practice of oral hygiene of SIYP in Nigeria; and the association between oral hygiene practices and other personal hygiene practices, including access to water and other sanitation facilities. We hypothesize that poor oral hygiene practices are associated with poor access to water, sanitation and personal hygiene for SIYP. We also hypothesized that oral hygiene practices are strongly associated with other personal hygiene practices. Personal hygiene practices are strongly associated with access to water and access to other sanitation facilities [17]. Thus, oral hygiene practices may also be associated with access to water and access to other sanitation facilities. We have found no literature reporting associations between oral hygiene practices and other personal hygiene practices and access to sanitation facilities.

Methods

Study design and study population: This was a cross-sectional study that explored the knowledge and practices of hygiene among SIYP in southwest, Nigeria. A community engagement program (CEP) on WASH was implemented in December 2018, to access the SIYP community and foster rapport between the research team, field workers and

study participants. This approach was adopted to facilitate and retain participation of SIYP for the one-year project. The WASH CEP consisted of health talks on personal hygiene (hand-washing, sanitation, oral hygiene, and menstrual hygiene) and street hygiene. Data were collected from recruited SIYP before the WASH CEP began. Study participants were adolescents and young people, aged 10 to 24 years, who met the criteria for being SIYP (those who spend most of their time on the street and return home at night, or who continually live and sleep on the street).

Sample size: Sample size determination for the project was guided by Turner [36], who recommended estimates to derive sample size for surveys on orphaned and vulnerable children (OVC) in homeless situations. Considering the unavailability of data to generate prevalence rate of OVC in the proposed study environment, the suggested minimum sample size of 800 to 1000 for this study. A total of 845 (452 males and 393 females) SIYP were interviewed during the WASH CEP.

Study Instruments: The WASH questionnaire had sections on socio-demographic characteristics; personal hygiene (water collection and storage and handwashing); knowledge about hygienic practices; sanitation; waste disposal; oral hygiene; and menstrual hygiene (for girls only). Each section was adopted from validated sources. The tool used to collect information on personal hygiene was adapted from the UNHCR 2018 WASH knowledge, attitude and practice survey questionnaire [37]. The tool used to collect data on oral hygiene has been used in past studies in Nigeria [38]. A content validation was conducted by a national WASH consultant who is a community health expert in sanitarian and public health. A pilot was then conducted to test the questions for ease of understanding and language clarity. The survey took place between the first and third weeks of December 2018.

Socio-demographic data collected were age, sex, marital status, school attendance and state of residence. Age was designated as age at last birthday and was stratified into three groups: 10-14 years, 15-19 years, and 20-24 years. Marital status was designated either married or not married; those living with their spouse were considered married. History of school attendance was designated either ‘yes’ or ‘no;’ a ‘yes’ response indicated that the person had had some level of formal education.

Information on oral hygiene practices was collected with a 5-item questionnaire that sought information on the frequency of tooth cleaning, use of fluoride-containing toothpaste, use of dental floss, consumption of sugar between meals, and frequency of dental check-ups. The responses to the questions ranged from four to seven alternatives. The acceptable responses were brushing more than once a day, use of fluoridated toothpaste always or almost always, flossing at least once a day, eating sugary snacks between main meals less frequently than once a day, and attending a dental check-up within the last year. Only three of the five items was used to measure good oral hygiene practice. The expected practices were: brushing teeth more than once a day, used fluoridated toothpaste always or almost always, and ate sugary snacks between main meals less often than once a day [38]. The responses were given a score of 1 and otherwise 0. A possible score range of oral hygiene practices was 0-3. Respondents were considered to have good oral hygiene practice [34] if they had 2 to 3 of these oral health practices: Those with 0 to 1 practice were considered to have poor oral hygiene practice.

Information on oral hygiene knowledge: The questions on oral hygiene practices were adapted to inquire about respondents’ oral hygiene knowledge. Respondents were asked about their knowledge of the frequency of tooth cleaning, use of fluoride-containing toothpaste, use of dental floss, consumption of sugar between meals, and frequency of dental check-ups. Correct responses to the questions were assigned ‘1’ if positive and ‘0’ if otherwise. After that, an index was computed for the variables used to measure oral hygiene knowledge with a possible score

ranging from 0 to 5. The mean score cut-off point was 2. Respondents who answered yes to 3 and more of the 5 questions reflected good oral hygiene knowledge. Responses fewer than these three correct responses were categorized as poor oral hygiene knowledge [39]. The questions on oral hygiene knowledge were asked after the questions on oral hygiene practices.

Information on personal hygiene: Questions on personal hygiene consisted of four: water collection and storage, handwashing, sanitation and waste disposal. The section on water collection and storage had 5-item, closed-ended questions that explored responses about source of drinking water (improved and non-improved) ; source of water for other activities, such as bathing and washing; if had containers for collecting and storing water; frequency of cleaning drinking and storage water containers and how the containers were cleaned. The responses to the questions ranged from 2 to 5. Only those who were positive to have good water collection and storage practice were assigned '1' indicating good water collection and storage practice, while others were assigned '0'.

For handwashing practices, a 4-item close-ended questionnaire was used to elicit information on the frequency of handwashing, washing hands before eating, washing hands after toilet, and frequency of bathing and changing of clothes. Responses to the questions on handwashing practices were coded as no - '0'and yes – '1'. The possible score range was 0 to 4. Only respondents who answered positive to the four questions were assumed to have good handwashing practices.

A 4-item questionnaire was used to elicit information on sanitation. It explored information on the usual place for defecation (improved facility and non-improved facility); access to handwashing facility at a place of defecation and access to water and soap to wash hands after defecation. The responses to the questions on sanitation were coded as '0' – no and '1' – yes and were thereafter merged. Score for good sanitation practice was 4. Any score of less than 4 was categorized as poor sanitation.

A 3-item questionnaire was used to elicit information on the management of waste. It inquired about methods for disposal of waste and the use of bare hands to collect waste. The three questions were scored to arrive at a composite score for good waste disposal practice. The score for good waste disposal was 3. Any score less than 3 was categorized as poor waste management.

Study procedures: The study participants were recruited through respondent-driven sampling [40]. The first seeds for the respondent-driven sampling were identified in areas where SIYP cluster. Clusters were identified through mapping conducted by the research team along with officials of the State Ministry of Health. Two high-volume clusters each in Lagos and Osun States were identified: the cluster sites in Lagos State were Bariga and Ajah; the sites in Osun State were Oke-Baale and Olaiya/Sabo.

Two cards with identification numbers were given to the first ten seeds in these cluster areas after they had been interviewed to recruit friends or peers, which some SIYP accomplished. The recruitment effort of seeds was complemented by direct recruitment by the research team, who also visited the cluster areas.

All recruited study participants gave consent before administration of the questionnaire by research team members. The questionnaire was administered in a place the respondent felt most comfortable to respond to questions. At the end of the interview, participants were given lottery tickets that enabled them to enter a raffle draw during a sideshow at the end of the survey. The values of the draw prize were $0.40 to $2.25.

Variables: The outcome variable for this study was 'oral hygiene practices,' measured as either good or poor. The explanatory variables were good or poor water collection and storage, handwashing, sanitation and waste disposal practices. Other explanatory variables included background information of respondents: sex, age, state of residence, school attendance, and marital status.

Data analysis: Data were collected electronically with open data kit, an online/offline platform for the collection and management of data. After that, data were downloaded from the online server for analysis purposes. The statistical software STATA 15.1 was used for data analysis. Univariate analysis was conducted to describe the proportion of respondents for the outcome, explanatory and background variables. Bivariate analysis was conducted with Pearson chi-square (or Fisher's exact t-test where appropriate) to determine the associations between the outcome variables and the explanatory and background information variables. Inferential analysis was conducted to identify risk indicators of good oral hygiene. Binary logistic regression, guided by two models, was conducted. The first model tested the association between the outcome and explanatory variables, whereas the second model tested the associations between outcome and explanatory variables after adjusting for confounders (background information). Statistical significance was considered a p-value less or equal to 0.05.

Results

Oral hygiene knowledge: More than half of the respondents had good knowledge about the frequency of tooth cleaning (52.4%) and were aware of the need to use fluoride-containing toothpaste (62.4%). However, only a low proportion of respondents had good knowledge on the frequency of use of dental floss (22.2%), frequency for consumption of sugar between meals (15.5%), and frequency of dental check-ups (31.6%). Two hundred and sixty-four (31.2%) SIYP had good oral hygiene knowledge. Table 1 lists the proportion of respondents for each item of the oral hygiene knowledge assessed.

There were sex, age and state differences in the responses on frequency of dental check-ups. There also were state differences in the responses on frequency of tooth brushing, teeth flossing, and use of fluoride-containing toothpaste, as illustrated in Table 1. Significantly more females than males ($p=0.003$), more 10-14-year-olds ($p=0.03$), and more respondents from Lagos State ($p<0.001$) indicated that dental check-up visits should be every 6-12 months. Also, significantly more respondents from Lagos State knew of the need to brush the teeth twice a day or more ($p=0.02$), floss daily ($p<0.001$), and regularly use fluoride-containing toothpaste for tooth brushing ($p<0.001$).

Oral hygiene practice: Seventy-five (8.88%) respondents had good oral hygiene practices. The majority of the respondents cleaned their teeth less often than twice a day (93.6%), did not use dental floss (95.6%), consumed sugar between meals (85.0%), and did not have an annual dental check-up (94.0%). Table 2 lists the proportion of respondents for each item of oral hygiene practice.

There were residential-location differences in the responses on frequency of tooth brushing, use of fluoride-containing toothpaste, and frequency of dental check-ups. There also were age differences in the responses on use of fluoride-containing toothpaste, as illustrated in Table 3. Significantly more respondents in Lagos than in Osun State gave correct responses on frequency of tooth brushing ($p<0.001$), use of fluoride-containing toothpaste ($p<0.001$), and frequency of dental check-ups ($p=0.002$). Also, more 10-14-year-olds than those 15-24-years-old gave appropriate responses to the use of fluoride-containing toothpaste ($p<0.001$).

Table 3 lists the three factors significantly associated with oral hygiene practices. More respondents in Lagos than in Osun State (13.1% vs 4.6%; p<0.001); more respondents with good than poor oral hygiene knowledge (9.6% vs 0.0%; p<0.01); and more respondents with good than poor water collection and storage (12.4% vs 4.7%; p<0.001) had good oral hygiene practice.

Association between oral hygiene practice and oral hygiene knowledge: Table 4 shows the associations between oral hygiene practice and oral hygiene knowledge. There was a significant association between knowledge and the practices of frequency of tooth cleaning, use of fluoride-containing toothpaste, use of dental floss, consumption of sugar between meals, and frequency of dental check-ups (p<0.001 respectively). There were also significant associations between the knowledge on the frequency of tooth brushing and the consumption of sugar between meals (p=0.01), use of fluoridated toothpaste (p=0.004), and frequency of dental check-ups (p=0.001). The knowledge on frequency of dental check-ups was significantly associated with appropriate practices on the consumption of sugar between meals (p<0.001) and use of fluoridated toothpaste (p<0.001).

Indicators for good oral hygiene practices: Table 5 reports on the outcome of the logistic regression analysis identifying indicators for good oral hygiene practices. Before adjustment of the model, the only indicator for good oral hygiene was good water collection and storage; respondents who had good water collection and storage were more likely to have good oral hygiene practices (OR: 2.01; 95% CI: 1.24-3.24; P<0.01). After adjustment, good water collection and storage retained its significance; SIYP with access to good water collection and storage were more likely to have good oral hygiene practices than those with poor water collection and storage (AOR: 1.78; 95% CI: 1.09-2.92; P=0.02). Also, those residing in Lagos (AOR: 2.85; 95% CI: 1.61-5.06; P=0.001) were more likely to have good oral hygiene than did those residing in Osun State.

Discussion

To the best of our knowledge, this is the first study to highlight the association between WASH variables and oral hygiene; and to describe the oral hygiene knowledge and practices of SIYP in Nigeria. Good water collection and storage was associated with good oral hygiene practices. We identified that although the oral hygiene knowledge of SIYP was better than their oral hygiene practice, and that most respondents had poor oral hygiene practices, oral hygiene knowledge significantly correlated with oral hygiene practices and was an indicator of good oral hygiene practices (no SIYP with poor oral hygiene knowledge had good oral hygiene). Also, the oral hygiene practices of SIYP residing in cosmopolitan Lagos State were better than that of respondents residing in the less urbanized Osun State.

One strength of this study is the large sample size that made it possible to conduct subgroup analysis. We avoided the use of a summative index to describe oral health practice and WASH because the index may have obscured item-level distinctions and decreased the predictive value of the construct [42]. This decision enabled us to identify how specific WASH items were associated with specific oral hygiene practices. Our study on the association between WASH and oral health is important also because it can help programmers identify ways to leverage the successful and resourced WASH program to improve oral hygiene in developing countries where oral health epidemics are growing [43]. We also add to the growing body of knowledge on WASH [44].

Good oral hygiene practices, such as tooth brushing and the use of toothpaste, requires access to water. When access to water is poor, adolescents may forgo tooth brushing because it presents no immediate risks for their aesthetics. Adolescents prioritize good body image [45], so they may use collected and stored water for other

hygiene purposes other than oral health. Water access is a major problem in Nigeria, with only 26.5% of the population having access to improved drinking water sources [43], a situation that is not improving [46]. Investments in improving water supply and storage may result in improved oral hygiene for SIYP, with the potential of also improving the health and wellbeing of SIYP. Until now, there has been little or no discussions on the impact of WASH on oral health. This study reveals the potential value of WASH programs for oral health and for adolescents and young persons. It also highlights the feasibility of the inclusion of oral health outcomes as an indicator of the success of the programs.

Some WASH indicators have been associated with oral hygiene practices. For example, in the Philippines, handwashing campaigns were run in conjunction with tooth brushing and deworming campaigns for children [47]. We found no significant association between handwashing and oral hygiene practices for SIYP in Nigeria. This may suggest that collaborative WASH and oral health campaigns should focus on different WASH and oral hygiene themes for different populations according to age and culture/norms.

This study also highlights the need to improve the oral hygiene practice of SIYP. This need may not be peculiar to SIYP, as other studies conducted with adolescents in Nigeria show they have comparable oral hygiene practices [48]; dental service utilization is poor [48]; a high proportion of the youths consume refined carbohydrate between meals; and a high proportion brush less than twice a day [46,49]. Associations between oral hygiene knowledge and practices have been reported in other populations [50], and, as in this study, practice is always poorer than knowledge. Better access of Nigerian SIYP to oral hygiene education may significantly improve the proportion of this population that practices good oral hygiene, which may be a simple route to improved quality of life, wellbeing and life expectancy.

Finally, residential location is significantly associated with oral hygiene practices of SIYP. Lagos, in Lagos State, where the study participants were recruited, is a cosmopolitan city. Access to information, oral health care services and improved water collection and storage that affects oral hygiene practices, are more likely accessible in cosmopolitan Lagos State than in hinterland Osun State: in 2015, 82% of urban dwellers and 54% of rural dwellers had access to basic water in Nigeria [51]. The difference in the oral hygiene of SIYP in Lagos and Osun State, and the national profile on water access may be proof of the increased risk of SIYP residing in hinterlands in Nigeria, to poorer oral health than their peers residing in cosmopolitan areas. This hypothesis, however, is unproven and needs investigation.

This study has some limitations. First, is the inherent limitation of the cross-sectional design of the study. We were unable to establish a cause-effect relationship between WASH and poor oral hygiene practices. Second, there may be multiple confounders that were not identified and controlled for; our ability to identify these confounders is limited since almost no studies have been conducted on the subject matter. We, however, controlled for some possible confounders, using logistic regression. Third, the study may suffer from social desirability response bias when questioned on oral health practices [52]. However, we felt this impact was minimal as there was a large difference in the responses to oral hygiene knowledge and oral hygiene practices. Fourth, we did not distinguish between participants who make a living on the street but live in a home and have family contact, from those whose permanent place of residence is the street and have no other contacts or are completely abandoned [53]. The study data was collected from cities in Southwest Nigeria limiting its generalizability to Nigeria in view of the differences in the social contexts of the lives of people in northern and eastern Nigeria which may impact the variables being studied. Despite these limitations, the study provided useful new information and helped generate new study hypotheses that can be pursued through primary data collection.

List Of Abbreviations

AOR – adjusted odds ratio

CEP – community engagement programme

CI – confidence interval

OR – odds ratio

OVC - orphaned and vulnerable children

SIYP – street-involved young people

UNHCR - United Nations High Commission for Refugees

WASH – water, sanitation and hygiene

Declarations

Ethics approval and consent to participate: Ethics approval for the study was obtained from the Institute of Public Health Research Ethics Committee, Obafemi Awolowo University Ile-Ife (IPHOAU/12/1133), and from Ministry of Health Research Ethics Committees of the Lagos State (LSMH2695/11/260/T) and Osun State (OSHREC/PRS/569T/154). The study was conducted in line with the requirements of the Declaration of Helsinki. Written consent was obtained from all study participants. Parental consent was waived for children below 18 years from all the ethics committees. This was because the study was non-invasive and the children were street kids with associated challenges of locating parents for study approval purposes. The funding agencies were not involved with the design of the study, the collection, analysis, and interpretation of data and in writing the manuscript.

Consent to publish: Not applicable.

Availability of data and materials: The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests: MOF is a Sectional Editor with the BMC Oral Health. All other authors declare that they have no competing interests.

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Authors' contributions: MOF and MOO designed the study. MOO and AOO collected the data. MOO conducted the data analysis. MOF developed the first draft of the manuscript. MOO and AOO contributed to the development of the full manuscript. MOF, MOO and AOO agreed to the final version of the manuscript and its submission for publication. All authors have read and approved the manuscript.

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Tables

Table 1: Oral hygiene knowledge of SIYP in Lagos and Osun State, Nigeria (N=845)

Variables	**Sex**		**Age**			**States**		**Total**
	Male (n = 452)	Female (n = 393)	10-14 years (n = 229)	15-19 years (n = 372)	20-24 years (n = 244)	Osun (n = 417)	Lagos (n = 428)	**N= 845**
Sugar intake in-between meals								
Rarely/never eat between meals	71 (15.7%)	60 (15.3%)	28 (12.2%)	66 (17.7%)	37 (15.2%)	68 (16.3%)	63 (14.7%)	131 (15.5%)
Other responses	381 (84.3%)	333 (84.7%)	201 (87.8%)	306 (82.3%)	207 (84.8%)	349 (83.7%)	365 (85.3%)	714 (84.5%)
X^2; p value	*0.031; 0.86*		*0.19*		*3.32;*	*0.41; 0.52*		
Frequency of teeth brushing								
≥ 2ce a day	216 (47.8%)	227 (57.8%)	110 (48.0%)	195 (52.4%)	138 (56.6%)	201 (48.2%)	242 (56.5%)	443 (52.4%)
< 2ce a day	236 (52.2%)	166 (42.2%)	119 (52.0%)	177 (47.6%)	106 (43.4%)	216 (51.8%)	186 (43.5%)	402 (47.6%)
X^2; p value	*8.38; 0.004*			*3.44; 0.18*		*5.89; 0.02*		
Frequency of teeth flossing								
≥ 2ce a day	92 (20.4%)	96 (24.4%)	49 (21.4%)	78 (21.0%)	61 (25.0%)	68 (16.3%)	120 (28.0%)	188 (22.2%)
< 2ce a day	360 (79.7%)	297 (75.6%)	180 (78.6%)	294 (79.0%)	183 (75.0%)	349 (83.7%)	308 (72.0%)	657 (77.8%)
X^2; p value	*2.02; 0.16*			*1.52;0.47*		*16.80; <0.001*		
Use of fluoride containing toothpaste								
Always	246 (62.2%)	246 (62.6%)	129 (56.3%)	236 (63.4%)	162 (66.4%)	233 (55.9%)	294 (68.7)	527 (62.4%)
Others	171 (37.8%)	147 (37.4%)	100 (43.7%)	136 (36.6%)	82 (33.6%)	184 (44.1%)	134 (31.3)	318 (37.6%)
X^2; p value	*0.02; 0.90*			*5.42; 0.07*		*14.78; <0.001*		
Frequency of dental check-ups								
6-12 monthly	123 (27.2%)	144 (36.6%)	87 (38.0%)	114 (30.7%)	66 (27.1%)	84 (20.1)	183 (42.8%)	267 (31.6%)
Others	329 (72.8%)	249 (63.4%)	142 (62.0%)	258 (69.4%)	178 (73.0%)	333 (79.9)	245 (57.2%)	578 (68.4%)
X^2; p value	*8.65; 0.003*			*6.82; 0.03*		*49.97; <0.001*		

Table 2: Oral hygiene practices of SIYP in Lagos and Osun State, Nigeria (N=845)

es	Sex		Age			Residential location		Total
	Male (n = 452)	Female (n = 393)	10-14 years (n = 229)	15-19 years (n = 372	20-24 years (n = 244)	Lagos (n = 428)	Osun (n = 417)	**N = 845**
ntake in- ı meals								
never eat ı meals	68 (15.0%)	63 (16.0%)	26 (11.4%)	67 (18.0%)	38 (15.6%)	70 (16.4%)	61 (14.6%)	131 (15.5%)
esponses	384 (85.0%)	330 (84.0%)	203 (88.7%)	305 (82.0%)	206 (84.4%)	358 (83.6%)	356 (85.4%)	714 (84.5%)
X^2; p value	*0.16; 0.69*		*3.32; 0.19*			*0.48;0.49*		
ıcy of teeth g								
day day	29 (6.4%)	31 (7.9%)	21 (9.2%)	20 (5.4%)	19 (7.8%)	49 (11.5%)	11 (2.6%)	60 (7.1%)
	423 (93.6%)	362 (92.1%)	208 (90.8%)	352 (94.6%)	225 (92.2%)	379 (88.6%)	406 (97.4%)	785 (92.9%)
X^2; p value	*0.69; 0.41*		*3.44; 0.18*			*24.86; <0.001*		
ıcy of teeth								
day day	20 (4.4%)	15 (3.8%)	8 (3.5%)	15 (4.0%)	12 (4.9%)	22 (5.1%)	13 (3.1%)	35 (4.1%)
	432 (95.6%)	378 (96.2%)	221 (96.5%)	357 (96.0%)	232 (95.1%)	406 (94.9%)	404 (96.9)	810 (95.9%)
X^2; p value	*0.20; 0.66*		*0.62; 0.73*			*2.17; 0.14*		
luoride ing ste								
	134 (29.6%)	108 (27.5%)	104 (45.4%)	95 (25.5%)	43 (17.6%)	175 (40.9%)	67 (16.1%)	242 (28.6%)
	318 (70.4 %)	285 (72.5%)	125 (54.6%)	277 (74.5%)	201 (82.4%)	253 (59.1%)	350 (83.9%)	603 (71.4%)
X^2; p value	*0.48; 0.49*		*47.77; <0.001*			*63.67; <0.001*		
ıcy of heck-up								
ınthly	27 (5.9%)	36 (9.2%)	24 (10.5%)	23 (6.2%)	16 (6.6%)	44 (10.3%)	19 (4.6%)	63 (7.5%)
	425 (94.0%)	357 (90.8%)	205 (89.5%)	349 (93.8%)	228 (93.4%)	384 (89.7%)	398 (95.4%)	782 (92.5%)
X^2; p value	*3.09; 0.08*		*4.20; 0.12*			*10.03; <0.002*		

ıble 3: Factors associated with oral hygiene practices among SIYP in Osun and Lagos States, Nigeria (N=845)

Variables	Good oral hygiene practices (n = 75)	Poor oral hygiene practices (n = 770)	X^2	p value	Total (N =845)
Sex					
Male	36 (8.0%)	416 (92.0%)	1.00	0.32	452 (53.5%)
Female	39 (9.9%)	354 (90.1%)			393 (46.5%)
Age					
10-14 years	27 (11.8%)	202 (88.2%)			229 (27.1%)
15-19 years	31 (8.3%)	341 (91.7%)	3.64	0.16	372 (44.0%)
20-24 years	17 (7.0%)	227 (93.0%)			244 (28.9%)
Residence					
Osun	19 (4.6 %)	398(95.4%)	19.0	<0.001	417 (49.3%)
Lagos	56 (13.1%)	1372 (86.9%)			428 (50.7%)
Ever attended school					
No	8 (12.3%)	57 (87.7%)	1.03	0.31	65 (7.7%)
Yes	67 (8.6%)	713 (91.4%)			780 (92.3%)
Marital status					
Single	69 (9.0%)	702 (91.1%)	0.06	0.81	771 (91.2%)
Married	6 (8.1%)	68 (91.9%)			74 (8.8%)
Oral hygiene knowledge	22 (3.8%)	559 (96.2%)	59.55	<0.001	581 (68.8%)
Poor	53 (20.1%)	211 (79.9%)			264 (31.2%)
Good					
Water collection and storage	36 (6.7%)	501 (93.3%)	8.59	<0.003	537 (63.6%)
Poor	39 (12.7%)	269 (87.3%)			308 (36.4%)
Good					
Handwashing					
Poor	54 (8.5%)	581 (91.5%)	0.44	0.51	635 (75.1%)
Good	21 (10.0%)	189 (90.0%)			210 (24.9%)
Sanitation					
Poor	44 (8.0%)	506 (92.0%)	1.49	0.22	550 (65.1%)
Good	31 (10.5%)	264 (89.5%)			295 (34.9%)
Waste disposal					
Poor	41 (8.8%)	424 (91.2%)	0.04	0.94	465 (55.0%)
Good	34 (9.0%)	346 (91.0%)			

	380 (45.0%)

*estimates derived from Fisher’s exact test

Table 4: Association between oral hygiene knowledge and oral hygiene practices of SIYP in Lagos and Osun State, Nigeria (N=845)

al ene edge	Variables	Oral Hygiene Practices							
		Sugar intake in-between meals		**Frequency of teeth cleaning**		**Use of fluoride containing toothpaste**		**Frequency of check-ups**	
		Rarely or never eat between meals	Other responses	≥ 2ce a day	<2ce a day	Always	Others	Every 6-12 months	Others
	Sugar intake in-between meals								
	Rarely or never eat between meals	109 (83.2%)	22 (16.8%)	7 (5.3%)	124 (94.7%)	36 (27.5%)	95 (72.5%)	7 (5.3%)	124 (94.7%)
	Other responses	22 (3.1%)	692 (96.9 %)	53 (7.4%)	661 (92.6%)	206 (28.9%)	508 (71.1%)	56 (7.8%)	658 (92.2%)
	X^2; p value	*542.49; <0.001*		*0.73; 0.39*		*0.11; 0.08*		*1.00; 0.32*	
	Frequency of teeth cleaning								
	≥ 2ce a day	83 (18.7%)	360 (81.3%)	50 (11.3%)	393 (88.7%)	146 (33.0%)	297 (67.0%)	46 (10.4%)	397 (89.6%)
	<2ce a day	48 (11.9%)	354 (88.1%)	10 (2.5%)	392 (97.5%)	96 (23.9%)	306 (76.1%)	17 (4.2%)	385 (95.8%)
	X^2; p value	*7.43; 0.01*		*24.74; <0.001*		*8.50; 0.004*		*11.57; 0.001*	
	Frequency of use of fluoride containing toothpaste								
	Always	84 (15.9%)	443 (84.1%)	42 (7.9%)	485 (92.0%)	231 (43.8%)	296 (56.2%)	45 (8.5%)	482 (91.5%)
	Others	47 (14.8%)	271 (85.2%)	18 (5.7%)	300 (94.3%)	11 (3.5%)	307 (96.5%)	18 (5.7%)	300 (94.3%)
	X^2; p value	*0.20; 0.65*		*1.60; 0.21*		*158.18; <0.001*		*2.38; 0.12*	
	Frequency of dental check-ups								
	Every 6-12 months	67 (25.1%)	200 (74.9%)	23 (8.6%)	244 (91.4%)	97 (36.3%)	170 (63.7%)	60 (22.5%)	207 (77.5%)
	Others	64 (11.1%)	514 (88.9%)	37 (6.4%)	541 (93.6%)	145 (25.1%)	433 (74.9%)	3 (0.5%)	575 (99.5%)
	X^2; p value	*27.41; <0.001*		*1.36; 0.24*		*11.30; 0.001*		*127.57; <0.001*	

Table 5: Indicators for good oral hygiene among SIYP in Osun and Lagos States, Nigeria (N=845)

iables	Model 1			Model 2		
	OR	95% Confidence interval	P value	AOR	95% Confidence interval	P value
ter collection and						
rage	1.00	1.00	---	1.00	1.00	---
r	2.01	1.24 – 3.24	<0.005	1.78	1.09 – 2.92	0.022
d						
ndwashing						
r	1.00	1.00	---	1.00	1.00	---
d	1.10	0.64 – 1.89	0.73	1.04	0.59 – 1.82	0.89
itation						
r	1.00	1.00	---	1.00	1.00	---
d	1.30	0.79– 2.14	0.30	1.06	0.49 – 2.30	0.88
ste disposal						
r	1.00	1.00	---	1.00	1.00	---
d	1.91	0.56 – 1.49	0.72	1.51	0.90 – 2.53	0.11
e				1.00	1.00	---
nale				1.12	0.68 – 1.85	0.66
14 years				1.00	1.00	---
19 years				0.84	0.47 –1.47	0.54
24 years				0.65	0.32 – 1.30	0.22
idence						
n				1.00	1.00	
os				2.85	1.61 – 5.06	0.001
r attended school						
				1.00	1.00	---
				0.88	0.37 – 2.09	0.78
rital status						
gle				1.00	1.00	---
rried				1.03	0.38 – 2.80	0.95

Supplementary Files

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