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Factor structure of health and oral health-related behaviors among adolescents in Arusha, northern Tanzania

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Abstract

Objective. This study aimed to evaluate the factor structure of health and oral health-related behaviors and it's invariance across gender and to identify factors associated with behavioral patterns. ***Materials and methods.*** A cross-sectional study included 2412 students attending 20 secondary schools in Arusha. Self-administered questionnaires were completed at school. ***Results.*** Principal component analysis of seven single health and oral health-related behaviors (tooth brushing, hand wash after latrine, hand wash before eating, using soap, intake of sugared mineral water, intake of fast foods and intake of sweets) suggested two factors labeled hygiene behavior and snacking. Confirmatory factor analyses, CFA, provided acceptable fit for the hypothesized two-factor model; CFI = 0.97. Multiple group CFA across gender showed no statistically significant difference in fit between unconstrained and constrained models ($p = 0.203$). Logistic regression revealed ORs for hygiene behaviors of 1.5, 0.5, 1.5, 1.5 and 0.6 if being a girl, current smoker, reporting good relationship with school, access to hygiene facilities and bad life satisfaction, respectively. ORs for snacking were 1.3, 1.4, 0.4 and 0.5 if female, in the least poor household quartile, low family socio-economic status and high perceived control, respectively. ***Conclusion.*** The two factors suggest that behaviors within each might be approached jointly in health promoting programs. A positive relationship with school and access to hygiene facilities might play a role in health promotion. Provision of healthy snacks and improved perceived behavioral control regarding sugar avoidance might restrict snacking during school hours.

Key Words: *Schoolchildren, factorial structure, oral health behavior, health behavior, Tanzania*

Introduction

Investigations of the relationships between health and oral health-related behaviors are important in providing information for the planning and implementation of health and oral health promotion programs [1,2]. A conclusion from earlier studies investigating the internal structure of health-related behaviors is that they reflect several different underlying factors and are best conceptualized as a multidimensional phenomenon [1–4]. Åstrøm [5] and Åstrøm and Rise [6] provided support for the contention that oral health-related behaviors constitute two dimensions in terms of 'health enhancing' and 'health detrimental' behavioral patterns among 15- and 25-year-old Norwegians, respectively. Using confirmatory factor analysis, CFA, Åstrøm [7] found that a three factor structure fitted a set of oral health-related behaviors in Norwegian adults and that this factor structure was invariant across time. Studies investigating the relationship between various health and oral health-related behaviors are generally rare. A study of Japanese adults revealed that tooth brushing was associated with eating breakfast, smoking and alcohol use [8]. Recently, Petersen et al. [2] studied health and oral health-related behaviors among Chinese adolescents and identified three factors in terms of 'risk behaviors', 'health promoting behaviors' and 'help-seeking behaviors'. If health and oral health behavior can be conceived of as totally independent actions, each behavior might need its own explanatory theory as well as intervention strategy. However, if health and

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oral health behavior can be shown to reflect a small number of underlying dimensions, indicating that several individual behaviors are motivated by common underlying processes, a more holistic approach to oral health intervention is called for.

Numerous studies have shown that the Theory of Planned Behavior, TPB, has considerable value in explaining and predicting health and oral health behaviors, including hand washing, tooth brushing, sugar and fast food intake [9–14]. In addition to more proximal cognitive factors as suggested by the TPB, distal socio-environmental factors have been shown to influence health-related behaviors [15–17]. The Theory of Triadic Influences, TTI, states that distal determinants of health behaviors can be divided into three major types; cultural environment, social environment and intrapersonal factors [18]. Cultural factors represent the broad cultural environment. The social situation represents the immediate micro-environment, including family structure, school structure and factors related to the physical environment. Distal personal factors represent stable intrapersonal influences such as personality traits, whereas proximal intrapersonal factors reflect cognitions such as attitudes, self-efficacy and perceived behavioral control. In this way, the TTI framework unifies ultimate, distal and proximal versions of various types of behavioral influences. This theoretical framework has been supported in health behavior research, globally [18].

Within sub-Saharan Africa, little is known about the pattern of health and oral health behaviors in young people. Thus, there seems to be a compelling rationale to assess and evaluate the factorial structure of health and oral health-related behaviors among youth living in non-occidental cultural contexts. Risk factor assessment in oral health is rare and the psycho-social and environmental determinants of adolescents' health behavior patterns are mainly unknown.

Aims

This study uses baseline data from the Arusha part of a multi-site cluster randomized trial, integrating oral health into a health-promoting school program (The Limpopo-Arusha school health project, LASH) [19], to examine the inter-relationship of health and oral health-related behaviors among secondary school students. It was hypothesized that responses to seven health (intake of fast foods such as chips, eggs etc., hand wash after use of latrine, hand wash before eating and use of soap when washing hands) and oral health-related behaviors (i.e. tooth brushing, intake of sugared mineral water, intake of sugared snacks) can be explained by two underlying factors, that each behavior would have a stronger relationship with the factor that it is designed to measure than with the competing factor, that the two factors would be correlated and that the factor structure will be invariant across boys and girls. Guided by the conceptual framework of the TTI, this study set out to identify possible distal and proximal social and intrapersonal factors associated with health and oral health behavioral patterns in Tanzanian school students.

Methods

Sampling procedure

A cross-sectional study was performed in Arusha, northern Tanzania, in 2009. A total of 59 public secondary schools were listed in the area, of which 31 schools fulfilled the inclusion criteria of being a public school and having student enrolment of more than 200 students. As this study included several outcomes, the size of the sample was calculated separately for each of them and the largest sample size required was adopted. A sample size of 2000 students was calculated to be satisfactory; using an absolute precision (d) of 0.02, 95% confidence interval (CI) and a design factor of 2. A one-staged stratified (urban-rural) cluster design was utilized with secondary school as the primary sampling unit. Secondary schools (n = 31) in the Arusha municipality were stratified into rural and urban schools, the latter being those within 10 km from Arusha town centre. A total of 11 urban schools (n = 7533 in form I and II) and 20 rural schools (n = 9141 in form I and II) constituted the sampling frame. In the first stage, 10 schools were selected by simple random sampling from rural (k = 10/20) and urban (k = 10/11) schools using an unequal sampling fraction. All available students in form I and II in the selected urban (n = 1487 out of a total of 4933) and rural (n = 1501 out of a total of 3338) schools were invited to participate in the study. Totals of 1163 and 1249 students in urban and rural schools were subsequently included into the study and completed self-administered questionnaires in the school setting. The total participation rate was 80.7% (2412/2988). Parents and students gave written informed consent to participate. Permission to conduct the study was granted by the school authorities and ministries of Education and Health. Ethical clearance was sought from Muhimbili University of Health and Allied Sciences (MUHAS), National Institute for Medical Research (NIMR) both from Tanzania and REK VEST in Norway.

Questionnaire

The questionnaire was initially constructed in English and translated into Kiswahili, the national language in Tanzania. It was back-translated into English by independent translators qualified in English and Kiswahili. Following a pilot test, some modifications in terms of clarification and simplification of wordings were done.

The questionnaires were completed by students during regular scheduled class time under supervision by trained research assistants.

Outcome measures considered in this study were oral health-related behaviors; tooth brushing (e.g. how 'frequently do you brush your teeth'), intake of sugared mineral water ('how frequently do you take sugared mineral water') and intake of sugared snacks/sweets ('How frequently do you take sweets'). Health-related behaviors were; fast food intake ('During the past 7 days how many days did you eat fast foods such as chips, eggs, etc.'), hand wash after use of latrine, hand wash before eating and use of soap when washing hands (e.g. 'During the past 30 days, how often did you use soap when washing your hands') (Table I).

Independent measures were socio-demographic factors, social distal factors and intrapersonal distal and proximal factors, as organized according to the TTI.

Socio-demographic factors were age, gender, place of residence, father's and mother's education, household socio-economic status, household wealth index and smoking (Table I). Household wealth index was assessed according to a standard approach in equity analysis [20]. Durable household assets indicative of family wealth (i.e. bicycle, motorcycle, car, TV) were recorded as (1) 'available and in working condition' or (0) 'not available and/or not in working condition'. These assets were analyzed using principal component analysis. The first component resulting from this analysis was used to categorize households into four approximate quartiles of wealth ranging from the 1st poorest quartile to the least poor 4th quartile.

Social distal factors were food provision at school, school connection and hygiene facilities at school. Food provision at school was assessed as a sum of two items (having snacks at school, having breakfast at school), range 2–10, $\alpha = 0.83$, dichotomized on a median split: (1) food provided at school, (0) food not provided at school. School connection was measured as a sum score of five items (like going to school, school concerned when I am sick, school concerned about my health, freedom to express myself, feeling safe at school), range 5–25, $\alpha = 0.71$, dichotomized on a median split into (1) good school connection and (0) bad school connection. Hygiene facilities at school were assessed as a sum score of four items (enough toilets at school, toilets and latrines easy to get to, available water for hand wash after toilet, available water for hand wash before meal, range 4–20, $\alpha = 0.7$) and dichotomized on a median split into (1) hygiene facilities available at school and (0) hygiene facilities not available at school.

Intrapersonal distal factors were assessed in terms of Life Satisfaction scale [21] based on a sum score of five items (how do you feel about your life, how do you think about yourself, I often feel sad, sometimes I feel everything is hopeless, sometimes I feel my life is not worthy living, range 5–20, $\alpha = 0.68$) and dichotomized on a median split to (1) strong life satisfaction, (2) weak life satisfaction.

Intrapersonal proximal factors were assessed in terms of perceived behavioral control with respect to avoid eating too many sweets and too many fast foods. A sum score of two items (How easy or hard is it for you to avoid eating too many sweets—eating too many fast foods, range 2–8, $\alpha = 0.60$). The sum score was dichotomized on a median split into (1) Low perceived control and (2) High perceived control. Independent and dependent variables in terms of number of subjects according to categories and missing frequency are summarized in Table I.

Statistical procedure

Data were analyzed using SPSS version 15.0 and AMOS 10.0 [22]. Design effect was controlled using STATA 10.0. Exploratory factor analysis, to explore the factor structure of seven health and oral health-related behaviors was conducted as a pilot with a random sub-sample of 1077 participants using PCA. CFA, using maximum likelihood estimation, was conducted to test the validity of the proposed factor structure. Multiple-group CFA was used to test for factorial invariance (i.e. the extent to which a measure remains invariant) across gender as comparison of structural relations across sub-groups requires equivalence of the measurement structure underlying indicators. Multiple-group CFA with the males and females simultaneously allows increasing levels of equality (four steps) constraints to be imposed on the model when it is applied to a new sample in order to assess invariance. In the present study, the first two steps were employed, thus testing for configural (i.e. the same number of factors and pattern of fixed and free parameters) and metric invariance (i.e. equal factor loadings). This method has been used previously in cross-cultural, gender and time comparison studies [22,23]. The adequacy of the model fit was assessed with the chi-square test statistics, χ^2, the Comparative Fit Index (CFI), the Root Mean Squared Error of Approximation (RMSEA) and the Akaike's information criteria, AIC, with models having lower AIC being more plausible [22–24]. The CFI should exceed 0.95 and the RMSEA should be lower or equal to 0.06 to represent acceptable goodness of fit [24]. The statistical significance of parameter estimates are the critical ratio (CR), which represents the parameter estimates divided by its standard error. Based on a level of 0.05, the test statistics needs to be $> \pm 1.96$ before the hypothesis that the estimates equals 0.0 can be rejected. The relationship between sum scores of health and oral health

Table I. Frequency of socio-demographic, psycho social and health and oral health behaviors of school students in Arusha (n = 2412).

Variable		% (n)	Missing
Socio-demographic factors			
Age	12–15 years	60.6 (1395)	
	16–21 year	39.4 (907)	4.6 (110)
Sex	Male	47.9 (1154)	
	Female	52.1 (1256)	0.1 (2)
Residence	Urban	48.2 (1163)	
	Rural	51.8 (1249)	—
Mother's education	Low (primary school)	65.0 (1247)	
	High (secondary and above)	35.0 (672)	20.4 (493)
Father's education	Low (primary schools)	54.7 (938)	
	High (secondary and above)	45.3 (778)	28.9 (696)
Wealth index	1st quartile (Most poor)	22.9 (517)	
	2nd quartile	29.2 (661)	
	3rd quartile	23.0 (521)	
	4th quartile (Least poor)	24.9 (562)	6.3 (151)
House SES	High	76.5 (1827)	
	Low	23.5 (560)	1.0 (25)
Smoking	No	94.2 (2261)	
	Yes	5.8 (138)	0.5 (13)
Social distal factors			
Food provision at school	Not provided	55.8 (1313)	
	Provided	44.2 (1041)	2.4 (58)
School connection	Bad connection	43.4 (1012)	
	Good connection	56.6 (1320)	3.3 (80)
Hygiene facilities at school	Not available	50.0 (1172)	
	Available	50.0 (1172)	2.8 (68)
Intrapersonal distal factors			
Life satisfaction	Good	48.8 (1101)	
	Bad	51.2 (1156)	6.4 (155)
Intrapersonal proximal factors			
Perceived control to avoid sweets & fast foods	Low	51.5 (987)	
	High	48.5 (928)	20.6 (497)
Oral health and health-related behaviors			
Tooth brushing—most of the times		93.4 (2236)	0.7 (17)
Hand wash after latrine—always		64.5 (1547)	0.6 (14)
Hand wash before eating—always		65.2 (1562)	0.7 (18)
Hand was using soap—always		43.8 (1048)	0.9 (22)
Intake of mineral water—several times a day		7.6 (182)	1.2 (29)
Intake of fast foods— most of the times/every day		7.7 (183)	1.3 (31)
Intake of sweets—most of the times/every day		23.7 (568)	0.7 (18)

behaviors derived from the factors and distal and proximal socio-psychological factors were assessed by means of cross-tabulation and multiple logistic regression analyses. All independent variables and their corresponding interaction terms were checked in multiple binary logistic regression analysis.

Results

Sample profile

The mean age of the study group (n = 2412) was 15.3 years (SD = 1.3) and 47.9% were boys. As depicted

in Table I, the participants were predominately from rural areas (51.8%), had fathers and mothers with low education (54.7% and 65%), reported high family SES (76.5%) and were non-smokers (94.2%).

Factor structure

In a rotated (varimax and oblique) solution of seven health- and oral health-related behaviors, PCA gave two factors with Eigen value >1, accounting for 45.8% of the variance. Tooth brushing, washing hands before eating, washing hands after latrine and using soap had their highest loadings on the first factor, whilst intake of sugared mineral water, intake of sweets and intake of fast foods loaded highest on factor 2 (results not shown in Table I). On the basis of theoretical conceptualization and results from exploratory factor analysis, CFA was used to test the validity of a hypothesized two-factor model against an alternative one-factor model underlying the seven health- and oral health-related behaviors. Assuming data to be missing at random (MAR), incomplete data was handled using the direct approach by AMOS based on maximum likelihood estimation (ML) [22,23]. As shown in Table II, compared with an alternative one-factor model, the hypothesized two factor model (Figure 1) with cross-loading provided improved fit to the data. This was indicated by substantial decreases in χ^2 and AIC and increases in CFI indices. All factor loadings were in the expected direction and statistically significant at CR > 1.96, ranging from 0.38 (fast food) to 0.57 (sweets) and from 0.18 (tooth brushing) to 0.65 (washing hands after latrine visits). The inter factor correlation was low-to-moderate, amounting to 0.030. This analysis confirmed a 2-factor model in the data. The two factors were labeled hygiene behavior (consisting of tooth brushing, washing hands after latrine use, washing hands before eating, washing hands using soap) and snacking (intake of sweets, sugared mineral water and fast foods). Using multiple-group CFA, the modified two-factor model with cross loadings was tested for factorial invariance across gender. The fit indices for the combined data in the first unconstrained baseline model (no parameters constrained to be equal) was acceptable, providing support for configural invariance across gender, i.e. the patterns of factors and the pattern of indicator—factor loadings were identical for males and females. Compared to the unconstrained model, the model with all factor loadings constrained equal was not statistically significantly different, indicating metric or factorial invariance across males and females.

Snacking and hygiene behavior by socio-demographics, social and intra-personal factors

Based on the two factors depicted in Figure 1, summary scores of snacking and hygiene behavior were constructed for further analysis. The sum scores were dichotomized on median splits. Snacking and good hygiene behavior was confirmed by 47.5% and 59.4%, respectively. Table III depicts the distribution of snacking and hygiene behavior by socio-demographics, social and intrapersonal risk and protective factors. Good hygiene behavior was most frequently reported by females, non-smokers, students having a good school connection, accesses to hygiene facilities at school and high life satisfaction ($p < 0.001$). Snacking was most frequently reported by the youngest students, females, those having parents with high education, belonging to the least poor wealth category and having high family SES. Snacking occurred most frequently in students who received food at school, had access to hygiene facilities at school and reported high life satisfaction and low perceived behavioral control with respect to avoid snacking ($p < 0.001$). All variables that were statistically significantly associated with hygiene behavior and snacking in unadjusted bivariate analyses were entered into multiple binary regression models. As shown in Table IV, the ORs of performing good hygiene behavior were 1.5, 0.5, 1.5, 1.5 and 0.6 if being female, a smoker, having good school connection, access to hygiene facilities at school and low life satisfaction, respectively. The ORs of snacking was 1.3, 1.4, 1.9, 0.4, 1.3 and 0.5 if being female, having fathers with high education, being in the least poor wealth category, having low family SES, receiving food at school and having high self-efficacy

Table II. Goodness-of-fit for a one factor and two-factor model of health and oral health behaviors and for the constancy of the two factor model across gender using CFA and multiple groups CFA ($n = 2412$).

Models tested	χ^2/df	CFI	RMSEA	AIC	Diff χ^2	df	p
Within sample tests of alternative models							
One factor model	30.507	0.67	0.11	455.1			
Modified 2 factor model	3.628	0.97	0.03	73.9			
Multi-group test of two-factor model across gender							
Unconstrained	1.759	0.98	0.018	106.7			
Constrained	1.686	0.98	0.017	103.2	8.517	6	0.203

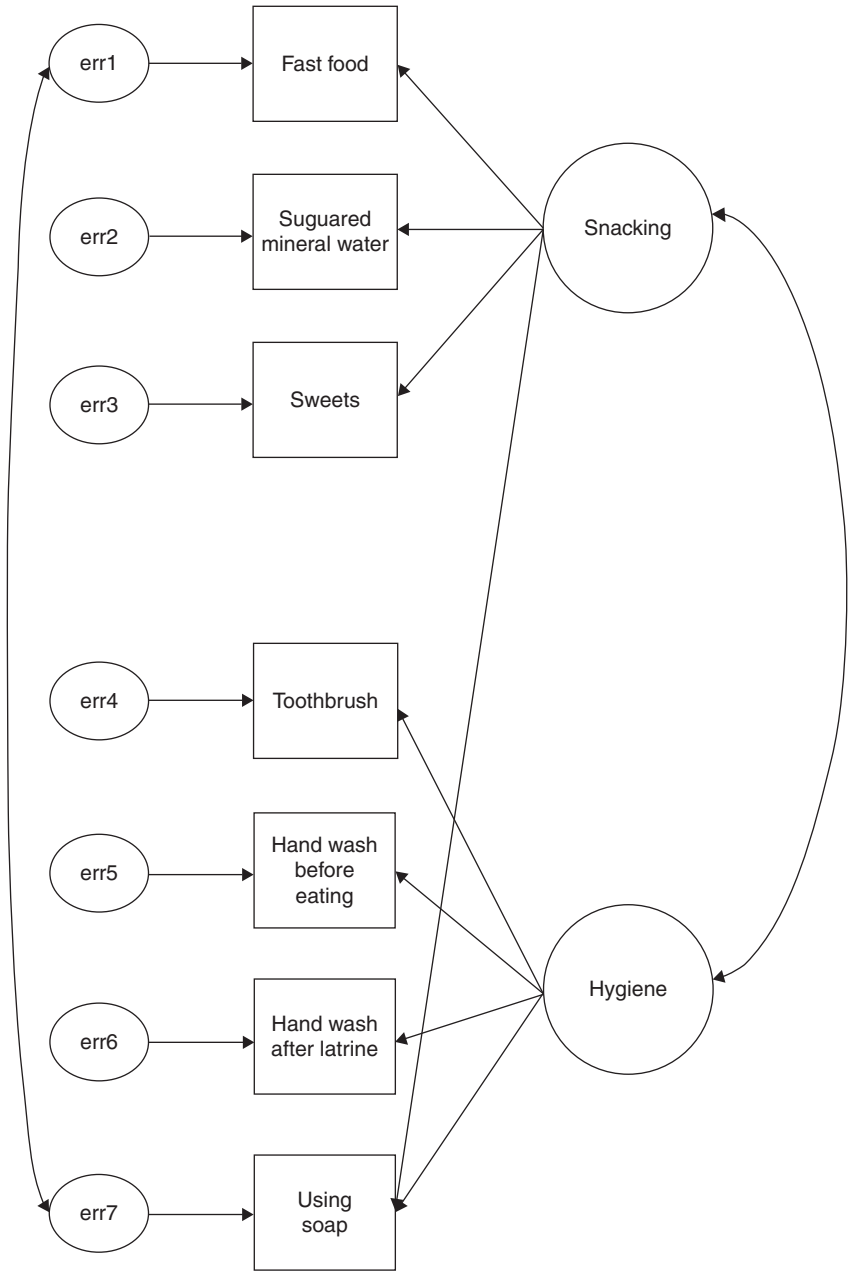

Figure 1. Modified two-factor model of seven health and oral health behaviors based on CFA.

with respect to snack avoidance, respectively. Two-way interactions were statistically significant for gender and availability of hygiene facilities on hygiene behavior, gender and place of residence on snacking and gender and wealth index on snacking. ORs for engaging in hygiene behavior if having access to hygiene facility at school were 1.1 (95% CI 0.8–1.6) in males and 1.8 (95% CI 1.3–2.4) in females. In males and females, the ORs for snacking if belonging to the least poor wealth category were 2.7 (95% CI 1.1–2.8) and 1.4 (95% CI 0.7–2.7), respectively. In males and females, the OR of snacking if being an urban resident were 1.7 (1.1–2.8) and 0.6 (0.4–1.0), respectively.

Discussion

This study identified patterns of health- and oral health behaviors among Tanzanian adolescents and the socio-demographic, social and intrapersonal risk- and protective factors associated with membership in the behavioral patterns. Thus, this study is the first to evaluate the validity of the factorial structure in health and oral health-related behaviors and to test for population homogeneity of the factor structure across gender in a sample of school-going adolescents from Northern Tanzania. Using CFA, the present results confirmed, within boys and girls, the hypothesis that seven health and oral health-related behaviors

Table III. Hygiene and snacking behavior by socio-demographic, social and intrapersonal risk and protective factors, percentages of those confirming good hygiene and snacking.

Variable		Hygiene behavior, % (*n*)	Snacking, % (*n*)
Socio-demographics			
Age	12–15 years	60.4 (824)	52.2 (711)
	16–21 years	57.5 (511)	40.8 (359)**
Sex	Male	55.7 (623)	40.7 (456)
	Female	62.8 (777)**	53.7 (659)**
Place of residence	Urban	58.5 (665)	50.3 (567)
	Rural	60.2 (736)	44.9 (549)**
Mother's education	Low	60.9 (741)	41.7 (507)
	High	59.8 (393)	59.5 (388)**
Father's education	Low	60.1 (550)	42.7 (395)
	High	60.4 (460)	57.0 (426)**
Wealth index	1st quartile (most poor)	57.2 (290)	30.3 (154)
	2nd quartile	62.8 (404)	44.5 (285)
	3rd quartile	60.4 (304)	51.3 (260)
	4th quartile (least poor)	57.6 (322)	62.9 (346)**
Smoking	No	60.4 (1337)	
	Yes	44.1 (60)**	
House SES	High	60.6 (1983)	54.9 (976)
	Low	56.0 (306)	23.3 (128)**
Social distal			
Food at school—not provided	58.4 (747)	42.7 (549)	
Food at school—provided	60.4 (617)	53.5 (541)**	
School connection—good	66.3 (858)	49.1 (633)	
School connection—bad	51.1 (506)**	45.7 (449)	
Hygiene facility: Avaliable	66.8 (768)	49.8 (570)	
Hygiene facility: Not available	52.8 (606)**	44.8 (511)*	
Intrapersonal distal			
Life satisfaction: Good	64.6 (702)	51.7 (552)	
Life satisfaction: Bad	55.3 (626)**	43.6 (494)**	
Intrapersonal proximal			
Perceived control avoiding sweets and fried foods: low	59.7 (574)	53.6 (514)	
Perceived control avoiding sweets and fried foods: high	61.4 (559)	42.8 (388)**	

**$p < 0.001$; *$p < 0.05$.

consisted of two factors labeled 'hygiene behavior' and 'snacking', respectively. According to the fit indices applied, the modified two-factor model presented in Figure 1 provided the best description of the data when compared to a one-factor model. Although a small statistically significant p-value obtained for the χ^2 statistics indicated poor fit, all supplementary fit indices employed fulfilled the criteria of 'good fitting' for the two-factor model [22–24]. Moreover, adequate factor loadings in the expected direction were demonstrated and the inter-factor correlations were below the threshold of 0.80, which is the cut-off set to indicate poor discriminant validity [22–24]. Comparing the modified two-factor structure between genders provided evidence of factorial invariance indicating that seven single health- and oral health behaviors have similar relationship to one another in boys and girls. The results from multiple group CFA conform to the guidelines for measurement invariance, requesting that the number of factors, their pattern and the factor loadings should be equivalent across groups [22]. Measurement equivalence renders the interpretation of gender differences on the measured behavioral patterns appropriate and unbiased. The present results agree with previously reported findings but are at odds with others, probably due to real differences between

Table IV. Hygiene behavior and sugar snacking regressed on socio-demographics and school-related contextual factors odds ratios (OR) and 95% Confidence Intervals (CI).

		Hygiene behavior	Snacking
Variable		OR (95% CI)	OR (95% CI)
Age	12–15 years	1	1
	16–21 years	0.9 (0.8–1.2)	0.8 (0.6–1.1)
Sex	Male	1	1
	Female	1.5 (1.2–1.8)	1.3 (1.1–1.8)
Place of residence	Urban	—	1
	Rural	—	1.1 (0.7–1.4)
Mother's education	Low	—	1
	High	—	1.0 (0.7–1.4)
Father's education	Low	—	1
	High	—	1.4 (1.0–2.0)
Wealth index	1st quartile (most poor)	—	1
	2nd quartile	—	1.5 (1.1–2.2)
	3rd quartile	—	1.8 (1.3–2.7)
	4th quartile (least poor)	—	1.9 (1.1–3.0)
Smoking	No	1	1
	yes	0.5 (0.3–0.9)	0.8 (0.4–1.6)
House SES	High	—	1
	Low	—	0.4 (0.2–0.5)
Social distal factors			
Food at school: Seldom	—	1	
Food at school: Often	—	1.3 (0.9–1.7)	
School connection: Bad	1	—	
School connection: Good	1.5 (1.2–1.8)	—	
Hygiene facility: No	1	1	
Hygiene facility: Yes	1.5 (1.2–1.8)	1.0 (0.7–1.3)	
Intrapersonal distal factors			
Life satisfaction: Good	1	1	
Life satisfaction: Bad	0.6 (0.5–0.8)	1.0 (0.7–1.3)	
Intra personal proximal factors			
Self-efficacy avoid sugar: low	1	1	
Self-efficacy avoid sugar: high	1.0 (0.8–1.2)	0.5 (0.4–0.7)	

—, Variable not entered in the logistic model due to lack of statistically significant bivariate association.

countries, cultures and population sub-groups, differences in selected variables examined and in the statistical techniques employed. The factor labeled 'snacking' corroborates the unhealthy diet factor and sugar snacking factor identified elsewhere [5,7]. The factor labeled 'hygiene behavior' has received less empirical support, although it corresponds to the 'health enhancing' and 'active health oriented' behavior identified in Norwegian and Finnish adults [7,25]. A significant relationship between tooth brushing frequency and most general health behavior items have been reported in Japanese adults, suggesting that awareness of the importance of health might influence both oral and general health behaviors [8]. In accordance with the present results, Petersen et al. [2] found oral hygiene and general hygiene practices to load on the same factor in Chinese adolescents.

Surveys carried out in industrialized countries have shown that adolescents' health and oral health behaviors are influenced by the socio-economic status of their parents [26]. Similar findings have been reported from developing countries such as China, Tanzania and Uganda [2,19,26]. According to the present results, adolescents having a family background of higher parental education and income were more likely than their counterparts in the

opposite groups to score high on snacking, whereas smokers were less likely than non-smokers to score high on both hygiene and snacking behavior. In contrast to the findings among Chinese adolescents, socio economic status was not associated with hygiene behavior patterns in the present study [2]. Evidently, poor oral hygiene in the general Tanzanian population aged 15 years and above is very common [27]. Similar findings have also been reported from other sub-Saharan African countries [28].

Based on the framework of the TTI, the present study identified numerous social and intrapersonal factors associated with snacking and hygiene behavior in Tanzanian adolescents. Of the 13 independent variables considered, five and six were significantly associated with hygiene and snacking behavior, respectively. Within the distal intrapersonal domain, life-dissatisfaction was associated with smaller odds of practicing hygiene behavior, whereas high perceived control towards sugar avoidance was associated with lower odds of snacking. Depression as an indication of life dissatisfaction has been found to be associated with risk behaviors in adolescents, such as for instance alcohol use which, in turn, has been found to correlate with other health detrimental behaviors for instance sugar consumption [5]. Life dissatisfaction has also been shown to be associated with deterioration in oral health-related quality-of-life, the latter being closely related with sugar consumption [29]. The validity of perceived behavioral control regarding sugar avoidance in predicting limited snacking has been confirmed previously in studies in industrialized as well as in non-industrialized countries [10,14,30].

Within the social domain, contextual school-related factors were associated with hygiene and snacking behaviors. Thus, having a good relationship with school and having access to hygiene facilities at school were both identified as protective factors in that they associated with greater odds of hygiene behavior. Accordingly, a recent European survey of adolescents' health revealed that good school experience was associated with lower risk of health detrimental behaviors [31]. Good school performance has been consistently and positively associated with oral health enhancing behaviors such as tooth brushing and negatively associated with oral health detrimental behavior such as sugar snacking [5]. Petersen et al. [2] reported on positive relationships between good school performance, regular dental visits and a high score on general hygiene performance among Chinese adolescents. Mealtime routines are likely to reduce snacking and consumption of sugary foods, the latter being linked to increased incidence of dental caries, increased body weight and other health problems [31]. Unexpectedly, food provided at school associated positively with snacking. This suggests that the foods offered at school are probably high in fat and sugary products. Studies from industrialized countries have shown that when school stores are available, 85% of inventory items are high in fat and sugars [32]. Subsequent studies should add other contextual factors to the model to better understand the social influences of health and oral health behavior patterns in Tanzanian adolescents.

Some limitations of the present study should be noted. Due to its cross-sectional design, causal inferences cannot be drawn. As the data were all self-reports they are prone to social desirability and recall bias. Attempts were made to minimize those biases by informing students that their responses were confidential and that no one could link names to responses. The questions on health and oral health-related behavior have been successfully applied in previous studies in Tanzania, many of them being adopted from the Tanzanian Global School Based health survey report [33]. Despite its limitations, this study has implications in terms of advancing the understanding of health and oral health-related behaviors among school students in Tanzania. Understanding the factors that influence snacking and hygiene behavioral patterns should enable researchers to design interventions programs. The present results, suggesting two behavioral clusters, indicate that changing tooth brushing might affect hand hygiene practices and vice versa. In the same way, changing sugar intake might influence on food snacking in general. Since the immediate behavioral causes of oral diseases, in terms of diet and hygiene practices, are common to other chronic diseases, changing hygiene behavior and snacking might have implications for oral health as well as general health. Evidence that child and adolescents health-related behaviors are likely to become their adult health-related behaviors and that behaviors are malleable among young people justifies early health and oral health promoting programs focusing on children and adolescents.

Conclusions

This study confirmed that seven health- and oral health-related behaviors reflect two domains or factors among Tanzanian school students, suggesting that behaviors within each domain might be approached jointly in health promoting programs. Equivalence in the factorial structure and in factor loadings across gender suggests measurement equivalence, rendering the interpretation of gender differences on behavioral patterns appropriate and unbiased. The results indicate that oral health promotion programs should address broader patterns of behavior rather than focusing on single individual actions. Gender and socio-economic class differences in the behavioral patterns might facilitate identification of vulnerable groups likely to benefit from health promotion programs. Positive relationship with school and access to hygiene facilities in school environments might play a role in promoting hygiene

behavior. Provision of healthy snacks and improved behavioral control for sugar avoidance might restrict snacking during school hours.

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