



Clustering of oral and general health risk behaviors among adolescents

Silvia Carréra Austregésilo^{a,*}, Paulo Sávio Angeiras de Goes^b, Manoel Raimundo de Sena Júnior^c,
Carolina Thaiza Costa Pazos^a

^a Federal University of Pernambuco, Postgraduate Program in Child and Adolescent Health of the Federal University of Pernambuco, Recife, PE, Brazil

^b Federal University of Pernambuco, Department of Clinical and Preventive Dentistry of the Federal University of Pernambuco, Recife, PE, Brazil

^c Federal University of Pernambuco, Department of Statistics of the Federal University of Pernambuco, Recife, PE, Brazil

ARTICLE INFO

Keywords:

Oral health
Health behavior
Adolescent
Cluster analysis

ABSTRACT

Since the co-occurrence of several health-risk behaviors is associated with an increase in chronic diseases, the study of clustering is relevant. The aim of this study was to evaluate how seven types of general and oral health-risk behaviors, cluster among adolescents. A cross-sectional analysis was performed with a sample of high school students from state public schools in São Lourenço da Mata, State of Pernambuco, Brazil (n = 1154). Data were obtained using a self-reported questionnaire. To identify cluster solutions of seven general and oral health-risk behaviors, Hierarchical Agglomerative Cluster Analysis (HACA) was performed. Most of the adolescents participating in the study was female (54.3%) and aged < 16 years old (77.1%). HACA indicated two broad stable clusters for the seven health-risk types of behaviors. The first cluster included following behaviors: smoking, drinking and less frequent tooth brushing. The second cluster reveals the combination of high bread, pasta and snack intake; high intake of sweets; high intake of soft drinks; low intake of fruits and vegetables. Results provided by HACA identified two groups of health-risk behaviors. The first cluster mainly shows risk (problematic) behaviors, whereas the second cluster denotes the non-adhesion of preventive behavior (non-healthy diet). Health-compromising behaviors are common among teens and occur in distinct clusters. These findings could be used by schools, health promotion authorities and other stakeholders to design and implement tailored preventive interventions in Pernambuco, Brazil. Therefore, clustering of several types of behavior has important implications for a comprehensive strategy in health promotion policies and practices.

1. Introduction

Adolescence is defined as a transition phase from childhood to adulthood, characterized by many changes. It is highly relevant to emphasize that the concept of adolescence as a different and distinct period of development is a relatively recent phenomenon (Nagaland et al., 2016).

During this period of life, oral health is frequently dispensed and the development of health-compromising behaviors, such as poor nutritional habits, irregular dental hygiene, and low health care, becomes quite significant (Nagaland et al., 2016; Craigie et al., 2011).

The literature shows that attitudes toward risk and common behaviors practiced during adolescence do not occur alone and in isolation, but instead tend to occur in clusters or bundles (Spring et al., 2012). They are distributed among the population according to certain patterns (Singh et al., 2013; Conry et al., 2011). In other words, they are not randomly distributed (Craigie et al., 2011).

The study of clustering of multiple behavioral risk factors is relevant

because the co-occurrence of several health-risk behaviors is associated with a particularly increased disease risk, including certain types of cancer and cardiovascular diseases (Marmot and Allen, 2014). Further, behavior patterns in adulthood are usually built during adolescence (Alzahrani et al., 2014). Consequently, understanding how certain health-related behaviors are adopted by young people has serious implications throughout life (da Silva Brito et al., 2015).

The cluster analysis based on the Hierarchical Cluster Analysis (HACA) is the correct approach to identify health-related behavior groups. It actually provides more stable cluster solutions when compared to nonhierarchical cluster analysis. It also allows the grouping of individuals with similar characteristics in different variables that lead toward empirical homogeneous types (Borgen and Barnett, 1987; Everitt et al., 2011).

Previous discussions investigating the co-occurrence of so-called health-risk behaviors employed different data analysis techniques to find a solution (Singh et al., 2013; da Silva Brito et al., 2015; Park et al., 2010; Azeredo et al., 2016). However, so far, we have found only two

* Correspondent author at: Professor Souto Maior Street, 54, apartment 403, Casa Amarela, Recife, Pernambuco, Brazil.
E-mail addresses: silvinhacarrera87@gmail.com (S.C. Austregésilo), manoel@de.ufpe.br (M.R. de Sena Júnior).

investigations that have examined the clustering of oral health as well as general health behaviors employing a data-driven technique such as the HACA in adolescents (Alzahrani et al., 2014; Jordão et al., 2017).

Since the concept of clustering is not yet clearly defined in the literature, different authors have theorised and operationalised this construct in different ways (Singh et al., 2013; da Silva Brito et al., 2015; Azeredo et al., 2016). An important contribution of this study has been to clarify the definition and usability of the most appropriate statistical method of the clustering of health-related behaviors.

Thus, we understand the importance of more research to investigate the subject and elucidate these issues better. Therefore, the current investigation analyzes the manner in which seven health-compromising behaviors cluster together among adolescents between 15 and 19 years old in the municipality of São Lourenço da Mata, Pernambuco, Brazil.

2. Methods

2.1. Study design and sample

The current study analyzes secondary data of an epidemiological transversal survey, called “Association between psychosocial factors and oral health,” undertaken in 2014. The survey, which estimated the prevalence of several results in oral health and its association with psychosocial factors, was applied to 15–19-year-old adolescents attending government-run public schools in São Lourenço da Mata, Brazil.

The city of São Lourenço da Mata was selected as a development center for the Metropolitan Region of Recife, starting with the installation of the Pernambuco Arena Complex and significant real estate investments, which may affect the living conditions of the adolescent population. One of the oldest cities in Brazil, the municipality is located 16 km from the capital of Pernambuco. It has an area of 262 km² and population density above 392 inhabitants/km². Around 92% of its 102,895 inhabitants reside in the urban area. Essential data from São Lourenço da Mata's economy include the growing service and industries sectors, a Gross Domestic Product (GDP) per capita of R\$ 5369.34 and the average Municipal Human Development Index (HDI) of 0.65327.

The decision to work with adolescents from public schools was taken so we could obtain a homogeneous sample from the socio-economic point of view. According to data provided by the Municipal Education Department, during the period of collection, the public education network had 49 municipal schools (between schools and kindergartens) and eight state schools. The number of students enrolled in the 9th, 10th, 11th, and 12th grades of high school totaled 8393 in the public network and 1464 in the private network (INEP, 2014).

The sample size calculation was performed considering the oral health outcomes investigated in a previous study and in the epidemiological survey in which the present study is nested (Bezerra and Goes, 2014; da Rocha Kozmhinsky et al., 2016; Roncalli et al., 2012). Among these outcomes, dental pain had the lowest prevalence, with 20%, which was used as a parameter for sample size calculation. Thus, by statistical definition, every prevalence that was > 20% was represented in this set.

Therefore, to calculate the sample size, in the study as a whole, the two-way comparison formula was used, a ratio of 1:1 between groups, with an expected prevalence of 20% of dental pain in this population, test power of 80%, random error of 2.5% and confidence interval (CI) of 95%. The Epi Info 6 calculation program was used.

Eleven public schools that had students of the age group required by the research participated in the study and consisted of a sample of 1154 students, representing a response rate of 81.5% of the sample calculated initially. Each school provided samples proportional to the number of enrolled adolescents of the same age bracket. A quotient of proportionality was established.

A randomized draw was conducted from the nominal list of students from the first name of the list, alternating a selected adolescent with an

unselected one, excluding the 12th name. Adolescents who had difficulties in understanding the questionnaire were excluded from the study.

2.2. Ethical procedures

The research project was conducted according to the principles of Decree 466 of 2012 by the National Health Council and approved by the Committee for Ethics in Research of the Federal University of Pernambuco (CEP/UFPE), registered at 650.163.

All students were informed that their participation was voluntary and that the forms did not contain personal data. They were also informed that they could quit any time during the collection of data. In the case of students younger than 18 years, a term of consent was sent to parents or tutors asking their permission for the students' participation. Students eighteen years old or older signed their own term of consent to participate in the research.

2.3. Measurements

A questionnaire for the collection of data was administered, comprising valid questions used in other surveys (Vettore et al., 2012; Roncalli et al., 2012). The questionnaire included closed and pre-coded questions on aspects related to social and demographic data involving gender, age, race, schooling, survey of school failures, family structure, number of people per home, time of residence, and the presence of siblings in the research. Questions related to behavior comprised habits of hygiene and eating, intake of alcoholic beverages, smoking, and access to and use of dental services.

Each adolescent was interviewed individually by previously trained and calibrated researchers on the school premises. After explaining the aims and methods of the study, remaining doubts were resolved. The application of the questionnaires was remade after every 10 participants so that quality control of data could be undertaken. Results showed a satisfactory degree for retest analysis ($r > 0.8$).

Eating habits included the following questions: “How many times a week do you usually eat each food below?”: “Bread, pasta, and snacks (chicken patty, biscuits, etc.)”; “Sweets in general (stuffed biscuit, chocolates, candy, chewing gum, homemade candy, etc.)”; “Fizzy drinks, fruit juice, or soft drinks like squash”; “Fruits, vegetables and cereals in general (beans, rice, oats, soy, etc.)”.

Intake of fruits, vegetables, and cereals was dichotomized into *once a day* or *three to five times a day* versus *at least twice a week* or *never*; intake of food rich in carbohydrates was dichotomized into *less than three times a week* or *never* versus *three to five times a day* or *once a day*; intake of sweets was dichotomized into *at least twice a week* or *never* versus *once* or *three to five times a day*; intake of soft drinks was separated dichotomized into *less than three times a week* or *never* versus *three to five times a day* or *once a day*.

Frequency of tooth brushing was classified into three categories: *Yes. I brush my teeth every day*; *No. I do not brush my teeth every day*; *No. Adolescents were asked about the material used for oral hygiene, which comprised: dental brush; dental cream; dental floss; toothpick; oral solution for mouth rinsing; I am not in the habit of brushing my teeth.*

Smoking was reported as follows: *I do not smoke*; *I smoke once a day*; *I smoke twice to four times a day*; *I smoke five times a day*; *I smoke more than five times a day*. Drinking was similarly reported: *I do not drink*; *I drink once a week*; *I drink twice to four times a week*; *I drink five times a week*; *I drink more than five times a week*. Answers were computerized and formed a quantitative variable that, after counting, was grouped into non-smoker and current smoker (at least once per week), and non-drinking and current drinking.

Oral health practice was separated into *brushing one's teeth daily* versus *not brushing one's teeth every day* or *not brushing one's teeth*. Smoking was clustered into *non-smoking* and *smoking* (at least once a week). Similarly, the intake of alcoholic beverages was clustered into

drinking (at least once a week) and *nondrinking*.

The seven health behaviors under analysis were listed under different categories, varying between 2 and 5. So that they could be comparable, they were analyzed as binary variables (0 = healthy behaviour and 1 = health-risk behaviour), based on public health recommendations and previous investigations (Jordao et al., 2017; Jordão et al., 2018; Alzahrani et al., 2014).

The following were considered behaviors risky to health: less frequent tooth brushing (not every day or never brushes teeth); low intake of fruits and vegetables (at least twice a week or never); high intake of sweets (once or more daily); high intake of soft drinks (once or more daily); high intake of carbohydrate-rich food (once or more daily); intake of alcoholic beverages; and smoking.

The above factors were chosen a priori because they were related to one's lifestyle. Although they could be modified, they are closely associated with non-transmissible chronic diseases.

2.4. Statistical analysis

Descriptive statistical analyses were performed for category variables through simple frequency; in the case of continuous variables, measurements of main trend and variability were performed. Pairwise correlations using Phi test for binary were used.

Hierarchical Cluster Analysis (HACA) was applied to detect patterns and clustering. The method provides more stable cluster solutions than the non-hierarchical cluster analysis does.

At first, the researchers were not aware of cluster association and frequently did not know the number of clusters. A cluster analysis of variables is similar to the factorial analysis, because both procedures identify groups related to variables. Clustering is an excellent tool for the analysis of exploratory data when the researcher suspects that the sample is not homogeneous. HACA was applied to detect patterns and clusters within data (Santha et al., 2016).

According to Clatworthy et al. (2005), the establishment of clusters may be confirmed by replicating HACA in different sub-samples randomly designed from the study's sample. Verifying identified clusters' stability is basic for its validity. Coefficients of relationships between different types of behavior of each cluster were also calculated. It is another approach to validate the structures of the identified clusters (Everitt et al., 2011). Although the method was used in current research in an exploratory way, it has been widely employed in other research fields (Clatworthy et al., 2005).

HACA was employed to identify solutions to stable clusters of several risky behaviors by means of an algorithm of medium bond between groups that identified homogeneous subgroups within a heterogeneous sample. Squared Euclidean distance was employed as a proximity measure due to its usefulness for binary variables (Everitt et al., 2011). At first, the number of identifiable clusters was unknown. SPSS 23.0 was employed for statistical analysis at 5% significance.

3. Results

Table 1 shows that most respondents were female (54.3%), younger than 16 years old (77.1%), brown-colored (56.2%), at years seven and nine (69.8%). Further, 40.7% of the adolescents reported that their mothers' schooling was shorter than eight years.

Concerning oral health behavioral factors, we found that most students brush their teeth every day (96.6%), and about the oral hygiene, the principal used items were toothbrush (96.5%), followed by toothpaste (83.5%) and dental floss (50.8%). However, it is noted that most students do not smoke (98.7%) and those who do smoke, do so only once a day (40.0%), just as among the 6.4% who use alcohol, contact occurs only once a week (88.1%).

Table 2 shows the prevalence of individual health-risk behaviors.

Fig. 1 shows a dendrogram that illustrates the process, and the partitions produced at each stage of hierarchical clustering analysis of

Table 1

Socio-demographic characteristics of the study sample. São Lourenço da Mata, Pernambuco, Brazil, 2014.

	n	%
Gender		
Female	627	54.3
Male	525	45.5
Age		
≤ 16	890	77.1
> 16	264	22.9
Race		
White	258	22.4
Black	156	13.5
Brown ^a	649	56.2
Yellow (Asiatic origin)	38	3.3
Indigenous (Native)	52	4.5
Schooling		
1–5 year of basic schooling	4	0.3
6–9 year of basic schooling	332	28.8
10–13 year	805	69.8
Occupation		
Yes	83	7.2
No	1062	92.8
Mothers' schooling		
≤ 8 years	466	40.7
9–11 years	166	14.5
≥ 12 years	231	20.2
Never frequented school	16	1.4
Do not know	265	23.2

^a It is a term that describes people who have a skin darker than Whites and lighter than Blacks, but not necessarily implies a White-Black mixture.

Table 2

Prevalence of individual health-risk behaviors among adolescents (n = 1154). São Lourenço da Mata, Pernambuco, Brazil, 2014.

	n	%
Hygiene habits		
Less frequent tooth brushing (not every day or never brushes teeth)	39	3.4
Food habits		
Low intake of fruits and vegetables (less than three days a week or never)	1052	91.2
High intake of sweets (once or more daily)	945	82.8
High intake of soft drinks and similar products (once or more daily)	860	75.4
High intake of carbohydrate-rich food (once or more daily)	871	75.5
Smoking		
Yes (at least, once a day)	15	1.3
Drinking		
Yes (at least, once a day)	74	6.4

behaviors related to health, employed in the current research. The dendrogram provides a visualization of the distance at which clusters are bonded (Everitt et al., 2011).

The height in this diagram represents the distance at which each fusion is made. The nodes of the dendrogram represent clusters, and the lengths of the stems (heights) represent the distances at which clusters are joined. The stems may be drawn so that they do not extend to the zero line of the diagram, in order to indicate the order in which objects first join clusters (Everitt et al., 2011).

The closeness of coefficients showed that smoking (S), drinking (A) and less frequent tooth brushing (B) combined in one group to form a cluster (Cluster 1). The second stage revealed that high intake of sweets (C) plus high consumption of bread, pasta, and snacks (P) formed another cluster. The third stage showed that high intake of soft drinks (R) was linked to P and C. The fourth stage showed that low intake of fruits and vegetables (F) combined with P, C, and R to form a new cluster (Cluster 2). The fifth stage demonstrated the formation of two clusters significantly distanced one from the other (cluster coefficients), which

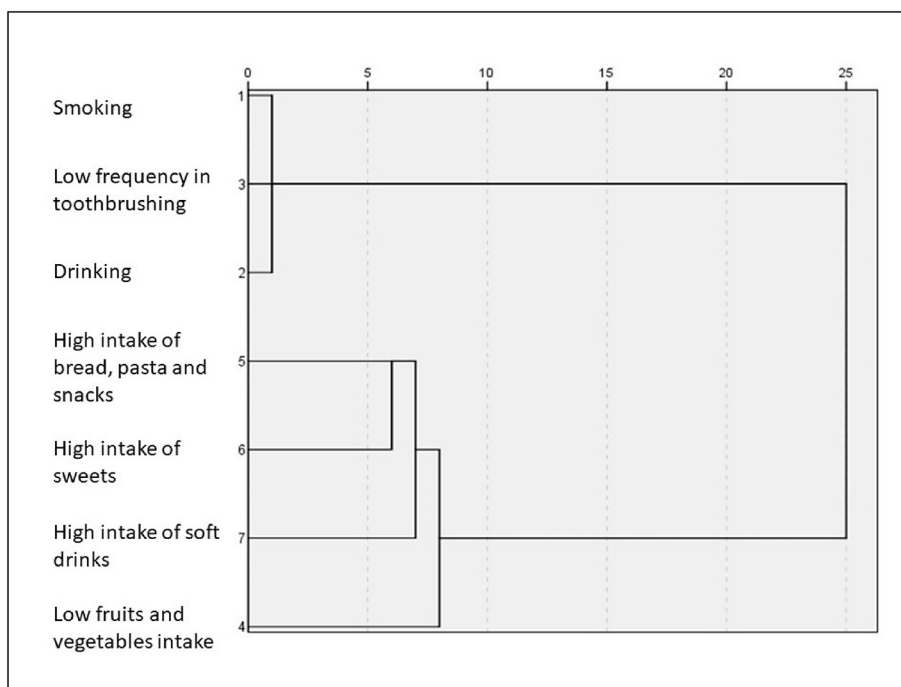


Fig. 1. Dendrogram of the hierarchical cluster analysis of general and oral health-risk behaviors. The distances (agglomeration coefficients) displayed in the top of the dendrogram are rescaled (by default) to fall into a range of 1–25.

provided a better solution to the population under analysis. The two distinct clusters with different health-compromising behavior patterns collectively comprised the seven types of behavior related to health analyzed in the current research.

In the first cluster, at the top of the dendrogram, the following behaviors appeared: smoking, alcoholic beverage consumption, and less frequent tooth brushing. The second cluster revealed the combination of high bread, pasta, and snack intake; high intake of sweets; high intake of soft drinks; and low intake of fruits and vegetables.

Because behavior clustering was similar for males and females, the following analysis was performed for the entire samples and adjusted by gender.

Clusters' stability and validity were confirmed by HACA replication in different randomly designed sub-samples from the samples under analysis. Further, significant associations between variables of each cluster validated cluster structure (Table 3).

4. Discussion

Results provided by HACA identified two groups of health-risk behaviors. The first group comprised smoking, alcoholic beverage intake,

and less frequent tooth brushing. The second group included high intake of bread, pasta, and snacks; high intake of sweets; high soft drink intake; and low consumption of fruits and vegetables.

It has to be underscored that behaviors grouped in the two clusters are different. The first cluster mainly shows risk (problematic) behaviors, whereas the second cluster denotes nonadherence to preventive behavior (unhealthy diet). The difference between the two risky behavior patterns may lie at the social acceptance level (Azereido et al., 2016).

According to the literature, such behaviors as the consumption of illicit drugs, alcoholic beverages, and smoking are socially less acceptable among adolescents and connote problematic behavior patterns. On the other hand, an unhealthy diet represents health damage that is not unacceptable by the community (da Silva Brito et al., 2015; León et al., 2010).

Risky behaviors may be important for adolescents. In the psychosocial model of risk behavior factors among adolescents, Jessor (1991) emphasized the theoretical and practical importance of establishing whether risky behaviors occur alone or are interrelated. For instance, the so-called problematic behaviors, such as the use of illicit drugs, delinquency, abuse of alcoholic drinks, and sexual proclivity, have a

Table 3
Pairwise correlations between of health-risk behaviors. São Lourenço da Mata Pernambuco, Brazil, 2014.

	High bread, pasta and snack intake	High intake of sugar	Low intake of fruits and vegetables	High intake of soft drinks	Low frequency of toothbrushing	Smoking	Drinking
High bread, pasta and snack intake	1	0.339**	0.002	0.311**	0.25	-0.045	0.027
High intake of sugar		1	0.013	0.311**	0.009	-0.009	0.015
Low intake of fruits and vegetables			1	0.065*	-0.111**	-0.046	-0.044
High intake of soft drinks				1	0.052	0.013	0.050
Low frequency of toothbrushing					1	0.105**	0.110**
Smoking						1	0.347**
Drinking							1

The asterisk means that this value shows Phi correlation was significant when $p < 0.001$.

** Phi correlation was significant at $p < 0.001$.

very strong relationship with risky behavior (Jessor, 1991; Van Nieuwenhuijzen et al., 2009). These may be perceived in the first cluster, which includes both smoking and the intake of alcoholic beverages.

In the case of the first cluster, previous studies with several techniques for data analysis also demonstrated a similar grouping pattern, which comprised smoking, drinking, and less frequent tooth brushing (risky/problematic behavior) among adolescents (Singh et al., 2013; Park et al., 2010; Azeredo et al., 2016; Irigoyen-Camacho et al., 2014; Chiolero et al., 2006).

Smoking is an important variable that may be strongly associated with risk-behavior clustering. A study by Chiolero et al. (2006) emphasized that the consistent association with risky behaviors, regardless of age, schooling, nationality, and dose-dependent relation of cigarettes with risk-behavior grouping, strongly suggested that smoking may be the most relevant factor in the accumulation of unhealthy behavior. The author, however, did not infer that smoking caused other risky behaviors, mainly because of methodological reasons (transversal design).

This fact supports the understanding that the first cluster indicates a strong link between smoking and drinking and, less frequent tooth brushing. Further, as reported in the literature, lifestyle habits, such as smoking and drinking, may also lead to bad behavior in oral health (Vettore et al., 2012).

Among adolescents, it is possible to believe that the social, cultural, and economic context may be an important observation variable regarding the perception and adoption of health risk behavior (Leão et al., 2017). Silva et al. (2016), observed that the consumption of tobacco and physical inactivity have higher prevalence in young people, especially in those with lower incomes in southern Brazil.

Similar results could be detected in the case of the second cluster. There was an association between low consumption of fruits and vegetables and low frequency of physical activities and between tooth brushing and eating habits (Santha et al., 2016; Pengpid and Peltzer, 2011; Ottevaere et al., 2011; Pearson et al., 2009). However, these studies merely reported associations between two types of behavior at a single time; they did not analyze the grouping patterns of multiple health-related behaviors.

In this study, there was a high prevalence of inappropriate consumption of fruits and vegetables among adolescents from Sao Lourenço da Mata. Only 8.8% of the young people responded to the recommendations on the daily consumption of these foods. This result is consistent with previous studies, which also revealed inadequate consumption of fruits and vegetables among adolescents.

In the study of Pearson et al. (2009), only 6% of the adolescents achieved the recommendations for being physically active and for a daily consumption of fruits and vegetables and breakfast. Also, in a survey conducted by Silva et al. (2016), it was found that the prevalence of inadequate consumption of fruits and vegetables was high (88.6%), and only 11.4% achieved the recommendations. These results are similar to those found in this study.

Another study that examined the prevalence and clustering of physical activity, sedentary and dietary patterns among European adolescents, found five stable and meaningful clusters. Males were highly presented in the cluster with high levels of moderate to vigorous physical activity (MVPA) and low-quality diets. Adolescents with low educated parents had diets of lower quality and spent more time in sedentary activities (Ottevaere et al., 2011).

Two studies (Alzahrani et al., 2014; Jordão et al., 2017) were similar to the current one. The former was performed in Saudi Arabia and was restricted to male adolescents; the latter was applied to both genders, in Brazil. However, the two studies employed the HACA method for their analyses. Alzahrani et al. (2014) found two distinct clusters. One cluster included low fruit consumption, less frequent tooth brushing, and low frequency of physical activities. The second cluster involved high intake of sweets and smoking and involvement in physical fighting. Cluster differences in Alzahrani et al. (2014) may have

occurred due to the absence of females and to cultural factors peculiar to each country.

Jordão, Malta, and Freire (2017) also provided two different clusters for 17 oral and general health-risk behaviors. The first cluster comprised a combination of non-preventive behaviors (less frequent hygiene practices, unsafe sex, lack of breakfast, absence of visits to the dentist) and risky behavior (smoking, consumption of illicit drugs, absence of helmet and safety belt, high intake of sweets, physical fighting, and intake of alcoholic beverages). The second cluster comprised an unhealthy lifestyle (sedentary habits, insufficient physical exercise, eating or studying while watching TV, diet poor in fruits).

Results in the current study complement and corroborate those in the abovementioned research works insofar as they discuss risky behavior specific to oral health (tooth brushing) and behavior risky to general health (drinking and smoking, unhealthy diet) among male and female adolescents. In fact, the study detected a similar behavior pattern for males and females, underscoring the need for in-depth knowledge in this field of studies.

The current results should be interpreted by taking into account certain limitations in the research. This is a school-based investigation, and care must be taken when interpreting the results. Because it was conducted in government-run schools, the population studied was relatively homogeneous, and it was based on self-reported behaviors of a single group of respondents. Data provided by the subjects under analysis may have been distorted, which could result in information bias, with overestimation of health-promoting behaviors and underestimation of health-risky behaviors. Further, the transversal feature of the study limits a casual interpretation of results.

Within the perspective of public health, the results have highly important implications. Risky behaviors affect not merely oral health but also overall health. In fact, there is a trend of accumulation in the same persons. Therefore, the results foreground the subjacent theory on coping with common risk factors and on dealing with the clustering of several types of behavior.

On the other hand, this requires the integration of oral and overall health through a comprehensive strategy in health promotion. Within the approach to common risk factors, the main issues of oral health are associated with the same risk factors as for other chronic diseases (Sheiham and Watt, 2000).

One important public health strategy is the development of health recommendations, which could be a helpful assistance to populations to reduce the occurrence of multiple risky health behaviors, commonly lifestyle-related. Therefore, monitoring population compliance with health recommendations could be an important aspect of public health planning (Hardy et al., 2017).

Clustering of risk factors among individuals and groups, especially those at the lowest levels of the social ladder, suggests that preventive approaches should be directed toward sets of risk factors common to a series of diseases and social classes. Consequently, data retrieved from the current research justifies interventions focused on prevention and the concomitant reduction of the main behavioral risk factors for non-transmissible diseases in the general population.

References

- Alzahrani, S.G., Watt, R.G., Sheiham, A., et al., 2014. Patterns of clustering of six health-compromising behaviours in Saudi adolescents. *BMC Public Health* 14 (1), 1215–1220. <http://www.biomedcentral.com/1471-2458/14/1215>.
- Azeredo, C.M., Levy, R.B., Peres, M.F.T., et al., 2016. Patterns of health-related behaviours among adolescents: a cross-sectional study based on the National Survey of School Health Brazil. *BMJ Open* 1–9. <https://doi.org/10.1136/bmjopen-2016-011571>.
- Bezerra, I.A., Goes, P.S.A., 2014. Associação entre capital social, condições e comportamentos de saúde bucal. *Cien Saude Colet* 19 (6), 1943–1950. <https://doi.org/10.1590/1413-81232014196.06242013>.
- Borgen, F.H., Barnett, D.V., 1987. Applying cluster analysis in counseling psychology research. *J. Couns. Psychol.* 34 (4), 456–468. <https://doi.org/10.1037/0022-0167.34.4.456>.
- Chiolero, A., Wietlisbach, V., Ruffieux, C., et al., 2006. Clustering of risk behaviors with

- cigarette consumption: a population-based survey. *Prev. Med.* 42 (5), 348–353. <https://doi.org/10.1016/j.ypmed.2006.01.011>.
- Clatworthy, J., Buick, D., Hankins, M., et al., 2005. The use and reporting of cluster analysis in health psychology: a review. *Br. J. Health Psychol.* 10 (3), 329–358. <https://doi.org/10.1348/135910705X25697>.
- Conry, M.C., Morgan, K., Curry, P., et al., 2011. The clustering of health behaviors in Ireland and their relationship with mental health, self-rated health and quality of life. *BMC Public Health* 11 (1), 692–702. <https://doi.org/10.1186/1471-2458-11-692>.
- Craigie, A.M., Lake, A.A., Kelly, S.A., et al., 2011. Tracking of obesity-related behaviours from childhood to adulthood: a systematic review. *Maturitas* 70 (3), 266–284. <https://doi.org/10.1016/j.maturitas.2011.08.005>.
- da Rocha Kozmshinsky, V.M., Heimer, M., Goes, P.S.A., 2016. Sociodemographic factors and oral health conditions related to the impact on the quality of life of adolescents. *Pesqui Bras Odontopediatria Clin Integr* 16 (1), 35–42.
- da Silva Brito, A.L., Hardman, C.M., de Barros, M.V.G., 2015. Prevalência e fatores associados à simultaneidade de comportamentos de risco à saúde em adolescentes. *Rev Paul Pediatr* 33 (4), 423–430. <https://doi.org/10.1016/j.rpped.2015.02.002>.
- Everitt, B.S., Landau, S., Leese, M., 2011. *Cluster Analysis, fifth ed.* Wiley, London.
- Hardy, L.L., Mihrshahi, S., Bellew, W., Bauman, A., Ding, D., 2017. Children's adherence to health behavior recommendations associated with reducing risk of non-communicable disease. *Prev. Med. Rep.* 8, 279–285. <https://doi.org/10.1016/j.pmedr.2017.10.006>.
- Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (INEP), 2014. Sinopse estatística da educação básica. INEP, Brasília. <http://portal.inep.gov.br/sinopses-estatisticas-da-educacao-basica>, Accessed date: 5 January 2018.
- Irigoyen-Camacho, M.E., Sanchez-Perez, L., Molina-Frecherro, N., et al., 2014. The relationship between body mass index and body fat percentage and periodontal status in Mexican adolescents. *Acta Odontol. Scand.* 72 (1), 48–57. <https://doi.org/10.3109/00016357.2013.797100>.
- Jessor, R., 1991. Risk behavior in adolescence: a psychosocial framework for understanding and action. *J. Adolesc. Health* 12 (8), 597–605. [https://doi.org/10.1016/1054-139X\(91\)90007-K](https://doi.org/10.1016/1054-139X(91)90007-K).
- Jordão, L.M.R., Malta, D.C., Freire, M.D.C.M., 2017. Clustering patterns of oral and general health-risk behaviours in Brazilian adolescents: Findings from a national survey. *Community Dent Oral Epidemiol* 1–9. <https://doi.org/10.1111/cdoe.12354>.
- Jordão, L.M.R., Malta, D.C., Freire, M.D.C.M., 2018. Clustering patterns of oral and general health-risk behaviours in Brazilian adolescents: findings from a national survey. *Community Dent. Oral Epidemiol.* 46 (2), 194–202. <https://doi.org/10.1111/cdoe.12354>. (Epub 2017 Nov 23).
- Leão, A.S., Soares, M., Michelle, N., Gonçalves, E.C.D.A., Silva, D.A.S., Silva, R.J.D.S., Thomazzi, S.M., 2017. Simultaneous health risk behaviors in adolescents associated with higher economic class in the Northeast of Brazil. *The Scientific World Journal*, 2017 2017.
- León, J.C., Carmona, J., García, P., 2010. Health-risk behaviors in adolescents as indicators of unconventional lifestyles. *J. Adolesc.* 33 (5), 663–671. <https://doi.org/10.1016/j.adolescence.2009.11.004>.
- Marmot, M., Allen, J., 2014. Social determinants of health equity. *Am. J. Public Health* 104 (s4), s517–s519. <https://doi.org/10.2105/AJPH.2014.302200>.
- Nagaland, T., Kadanakuppe, S., Raju, R., 2016. Adolescent's oral health—a review. *Int J Health Sci Res* 6 (9), 420–425.
- Ottevaere, C., Huybrechts, I., Benser, J., et al., 2011. Clustering patterns of physical activity, sedentary and dietary behavior among European adolescents: the HELENA study. *BMC Public Health* 11 (1). <https://doi.org/10.1186/1471-2458-11-328>. 328.
- Park, Y.D., Patton, L.L., Kim, H.Y., 2010. Clustering of Oral and general health risk behaviors in Korean adolescents: a National Representative Sample. *J. Adolesc. Health* 47 (3), 277–281. <https://doi.org/10.1016/j.jadohealth.2010.02.003>.
- Pearson, N., Atkin, A., Biddle, S., et al., 2009. Patterns of adolescent physical activity and dietary behaviours. *Int. J. Behav. Nutr. Phys. Act.* 6 (1), 45. <https://doi.org/10.1186/1479-5868-6-45>.
- Pengpid, S., Peltzer, K., 2011. Hygiene behaviour and associated factors among in-school adolescents in nine African countries. *Int. J. Behav. Med.* 18, 150–159. <https://doi.org/10.1007/s12529-010-9109-6>.
- Roncalli, A.G., da Silva, N.N., Nascimento, A.C., et al., 2012. Aspectos metodológicos do Projeto SBBrasil 2010 de interesse para inquéritos nacionais de saúde. *Cad. Saúde Pública*. 28 (Suppl), S40–S57. <https://doi.org/10.1590/S0102-311X2012001300006>.
- Santha, B., Sudheer, H., Saxena, V., et al., 2016. The impact of body mass index on oral hygiene practices of adolescents in Bhopal City, India. *J. Coll. Physicians Surg. Pak.* 26 (2), 125–129 (DOI: 02.2016/JCPSP.125129).
- Sheiham, A., Watt, R.G., 2000. The Common Risk Factor Approach: a rational basis for promoting oral health. *Community Dent. Oral Epidemiol.* 28 (60), 399–406. <https://doi.org/10.1034/j.1600-0528.2000.028006399.x>.
- Silva, F.M., Smith-Menezes, A., Duarte M de, F., 2016. Consumption of fruits and vegetables associated with other risk behaviors among adolescents in Northeast Brazil. *Rev Paul Pediatr* 34 (3), 309–315.
- Singh, A., Rouxel, P., Watt, R.G., et al., 2013. Social inequalities in clustering of oral health related behaviors in a national sample of British adults. *Prev. Med.* 57 (2), 102–106. <https://doi.org/10.1016/j.ypmed.2013.04.018>.
- Spring, B., Moller, A.C., Coons, M.J., 2012. Multiple health behaviours: overview and implications. *J Public Health (Oxf)* 34 (Suppl. 1), i3–i10. <https://doi.org/10.1093/pubmed/fdr111>.
- Van Nieuwenhuijzen, M., Junger, M., Velderman, M.K., et al., 2009. Clustering of health-compromising behavior and delinquency in adolescents and adults in the Dutch population. *Prev. Med.* 48 (6), 572–578. <https://doi.org/10.1016/j.ypmed.2009.04.008>.
- Vettore, M.V., Moysés, S.J., Sardinha, L.M.V., et al., 2012. Condição socioeconômica, frequência de escovação dentária e comportamentos em saúde em adolescentes brasileiros: uma análise a partir da Pesquisa Nacional de Ensino Escolar (Pense). *Cad Saude Publica* 28 (Suppl), S101–S113. <https://doi.org/10.1590/S0102-311X2012001300011>.