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Association of behaviors and asthma control in a sample of Lebanese adolescents with asthma

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Abstract
Background: The relationship between behavioral problems and asthma is bidirectional; while the presence of a chronic disease such as asthma might predispose the person to stress, anxiety, and other behavioral issues, behavioral problems might in turn cause uncontrolled asthma through nonadherence to asthma management strategies. In Lebanon, behavioral problems and uncontrolled asthma could be of significant concern for adolescents. Consequently, we found it necessary to evaluate association between behavioral problems and uncontrolled asthma in a sample of Lebanese adolescents.
Methods: Data for this cross-sectional study were collected using the snowball sampling technique in July 2023. The questionnaire was developed with Google Forms and distributed to participants via social media platforms and messaging applications. The Asthma Control Test (ACT) was used to check for uncontrolled asthma, and the Youth Self-Report (YSR) scale was used to assess behavioral problems. It yields nine subscales (anxious-depressed, withdrawn-depressed, somatic complaints, social problems, thought problems, attention problems, rule-breaking behavior, aggressive behavior, and other problems) and a total score.
Results: When taking each behavior score as an independent variable, older age was associated with lower ACT scores (more controlled asthma); F(15, 186) = 3.66, P = 0.014, and 95% Confidence Interval (CI) [-0.85, -0.10]. Living in a rural area, compared to urban was associated with higher ACT scores, P = 0.018, and 95% Confidence Interval (CI) [0.28, 2.94]. The intake of the COVID-19 vaccine, P = 0.003 and 95% CI [0.73, 3.55]; waterpipe smoking, P = 0.017 and 95% CI [0.38, 3.85]; and having more somatic complaints, P = 0.005 and 95% CI [0.04, 0.25],

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also were significantly associated with higher ACT scores (more uncontrolled asthma). When taking the total behavior score as an independent variable, higher YSR scores were associated with higher ACT scores (more uncontrolled asthma), F(10, 191) = 4.30, P = 0.038, and 95% CI [0.003, 0.10].

Conclusion: Our findings support the inclusion of mental health treatments for better asthma control and point to a link between behavioral issues and uncontrolled asthma. In a developing nation without a clear established strategy for asthma prevention, the findings of this study could help develop potentially beneficial public health treatments.

INTRODUCTION

Asthma is defined as "a chronic airway inflammation, a common and potentially serious chronic disease that can be effectively treated to control symptoms and minimize the risk of exacerbations."[1] Asthma affects around 262 million persons worldwide and is responsible for 455,000 deaths.[2] In 2023, around 27 million people in the United States had asthma, that is, 1 in every 12 persons was asthmatic.[3] In Lebanon, the prevalence of asthma varied between 8.2%[4] and 14.6% in children aged 3–16 years and 6.7% in adults.[4–6] International guidelines state that achieving and maintaining control over asthma, defined as "no daytime symptoms, no limitations on daily activities, no nocturnal symptoms or awakening, no need for reliever treatment, normal or near-normal lung function results,"[7] is the main objective of asthma management in order to lower the risk of exacerbations that could be life-threatening and lead to long-term morbidity.[8] However, in daily practice, a sizable portion of patients still have poorly managed asthma.[9,10] A number of studies have identified the benefits and advantages of effective asthma management on a variety of outcomes, including a decreased loss of work/school days, a normal and even improved quality of life, and a decreased risk of exacerbations.[11] Despite guidelines emphasizing control over asthma, many patients still experience poorly managed asthma.[12,13] Uncontrolled asthma was shown to be associated with decreased daily activity, a decline in cognitive and intellectual abilities,[11] and a lower quality of life in children.[14]

Multiple socioeconomic and environmental factors are associated with uncontrolled asthma, including but not limited to females,[9] lower socioeconomic[15] and educational status,[16,17] and exposure to triggers, such as pesticides, cigarettes,[18] and waterpipe[19] smoking.

In addition to socioeconomic factors, behavioral problems, such as anxious, aggressive, and withdrawal behaviors,[20] somatic complaints, social, thought, and attention problems, and nonadherence to management strategies, contribute to uncontrolled asthma, creating a bidirectional relationship.[21] While the presence of a chronic disease, such as asthma, might predispose the person to stress, anxiety, and other behavioral issues, behavioral problems could in turn cause uncontrolled asthma through nonadherence to asthma management strategies.

In December 2019, a new virus, the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), responsible for coronavirus disease 2019 (COVID-19), was first detected in Wuhan, China, and after a few months was declared a pandemic by the World Health Organization (WHO). At one time, asthma was considered a risk factor for COVID-19, because the virus has an impact on the respiratory system. Theoretically, this is due to the increased bronchial mucus secretion, epithelium injury, airway blockage, and local immunosuppression because of inhaled corticosteroids, which create an environment for the COVID-19 virus in asthmatic patients.[22] Additionally, asthmatics contacting cold viruses, such as coronavirus, run the risk of more severe repercussions.[23] In individuals with severe respiratory conditions, such as severe asthma, the new availability of vaccinations against COVID-19 has the potential to lower the risk of the illness and related exacerbations.[24,25] However, the unknown possible interactions with concurrent biologic therapy could be of some concern over the vaccine's safety in individuals with weakened immune systems.[26,27]

The relation between mental health and asthma control is a sophisticated and bidirectional process. Extensive research points out for a strong correlation between mental health conditions manifested by anxiety, depression, and stress and the severity and the degree of asthma control.[28,29] Furthermore, a study conducted in Lebanon showed high rate of mental health issues in adolescents.[30] Behavioral problems and uncontrolled asthma could be of significant worry for adolescents in Lebanon for multiple reasons: (1) Lebanon is facing various social and environmental challenges that may contribute to behavioral problems in adolescents, such as political instability, economic difficulties, and social pressures, which might influence the choices and behaviors of young people;[31] and (2) multiple behavioral problems were commonly observed in Lebanese adolescents than adolescents of other nationalities,[32] including high proportions of aggressiveness,[30,33] substance abuse,[34] smoking,[35] and risky sexual behavior.[36] Additionally, researchers have made the alarming observation that asthma control is unsatisfactory in Middle Eastern and North African populations,[37] that current levels of asthma control in Lebanon fall far short of goals specified in international guidelines for asthma management,[38] and that even Lebanese general practitioners' practice of asthma management "is not at an acceptable standard."[39] Therefore, conducting this study was of significance to further explore correlates of asthma control in Lebanese adolescents and inform the development of adequate mitigation strategies. For these reasons, we found it necessary to evaluate the association between behavioral

problems and uncontrolled asthma in a sample of Lebanese adolescents.

METHODS

Study design

Data were collected using the snowball sampling technique in July 2023. The questionnaire was developed with Google Forms and distributed to participants via social media platforms and messaging applications. The research team contacted adolescents within their network; those who agreed to take part were requested to share the link with other adolescents in their circles, explaining the snowball sampling technique. Inclusion criteria for participation included being of a resident and citizen of Lebanon, and aged 12–18 years. The introductory paragraph included the objectives of this study as well as a request to adolescents to ask for parental permission before filling the survey. No credits were considered for participation.

Minimum sample calculation

Using the multiple regression option (R^2 deviation from zero) in the G-power software, a minimum sample of 144 patients was considered, based on multiple correlation $R^2 = 0.15$, an alpha (α) error of 5%, power of 80%, and 23 predictors to be entered in the final model.

Questionnaire and variables

The Arabic questionnaire had two parts. In the first part, the first section contained a written consent to confirm adolescent's and parents' approval to fill the questionnaire. The second section evaluated participants' sociodemographic characteristics, such as age, gender, and household crowding index calculated by dividing the number of residents by the number of rooms.[40] Moreover, the following factors known to be associated with asthma were included based on the previous studies conducted in Lebanon: school type, humidity at home, exposure to pesticides, cigarette and waterpipe smoking, and living area (urban/rural).[5,6] Questions about the COVID-19 infection (yes/no) and intake of the COVID-19 vaccine (yes/no) were also included.

The second part of the questionnaire included the following scales:

- *Asthma control questionnaire*: Arabic version of the items was obtained from Professor Elizabeth Juniper. This scale was validated for use in Lebanon for the assessment of asthma control in people aged more than 12 years.[41,42] It comprised five questions (e.g., "During the last seven days, how many times have you woken up at night due to asthma attacks?").[19] Questions were rated from 0 to 6, with 0 reflecting no bothering or no symptoms at all, and 6 reflecting very bothering/severe symptoms. Higher scores reflected more uncontrolled asthma. In this study, the Cronbach's α was 0.88.
- *Youth self-report (YSR) scale*: This scale was used to evaluate behavioral problems, and its Arabic version was obtained from Dr. Wendy D'Andrea. It was designed specifically for use in adolescents aged 11–18 years. It is a widely used measure of behavioral problems in adolescents of this age group, with a high test–retest reliability and is sensitive to change.[43] This scale yields nine subscales (i.e., anxious–depressed, withdrawn–depressed, somatic complaints, social problems, thought problems, attention problems, rule-breaking behaviors, aggressive behavior, and other problems) and a total score; higher scores reflect worse behavior in each domain and the overall behavior. Cronbach's α values in this study were as follows: anxious-depressed ($\alpha = 0.89$), withdrawn–depressed ($\alpha = 0.79$), somatic complaints ($\alpha = 0.85$), social problems ($\alpha = 0.86$), thought problems ($\alpha = 0.87$), attention problems ($\alpha = 0.84$), rule-breaking behaviors ($\alpha = 0.89$), aggressive behavior ($\alpha = 0.89$), and other problems ($\alpha = 0.76$); the total score had $\alpha = 0.97$. Permission to use the scale was granted by Achenbach System of Empirically Based Assessment (ASEBA), Research Center for Children, Youth, and Families, Inc.

Statistical Analysis

The SPSS software v.25 was used for statistical analysis. The ACT score was considered normally distributed since the skewness (0.094) and Kurtosis (-0.395) values varied between –1 and +1.[44] The Student's *t* test was used to compare two mean values, and the Pearson test was used to correlate two continuous variables. Two linear regressions were conducted taking the ACT score as a dependent variable; the first model considered each behavior score as an independent variable whereas the second model considered the total score as an independent variable. Results were adjusted over all factors that showed $P < 0.25$ in bivariate analysis. $P < 0.05$ was deemed statistically significant.

RESULTS

In all, 202 adolescents participated in this study; their mean age was 15.96 ± 1.88 years, with 52.0% females. Other characteristics are summarized in Table 1.

Bivariate analysis

The results of this bivariate analysis are summarized in Table 2. Higher ACT scores were found in the following categories of patients: living in rural areas, compared to urban; studying in public schools, compared to private schools; vaccinated for COVID-19; in patients having a member in family working with pesticides; living in a region sprayed with pesticides; and patients living in humid houses. More anxious behavior ($r = 0.20$; $P = 0.004$), withdrawal behavior ($r = 0.18$; $P = 0.013$), somatic complaints ($r = 0.26$; $P < 0.001$), social problems ($r = 0.15$; $P = 0.037$), attention problems ($r = 0.14$; $P = 0.047$), total behavior score ($r = 0.20$; $P = 0.005$), and household crowding index ($r = 0.19$; $P = 0.008$). It is noteworthy that the ACT score was not associated with thought problems ($r = 0.14$; $P = 0.056$), rule breaking behavior

Table 1 Sociodemographic and other characteristics of participants (N = 202).

Variable	N (%)
Gender	
Female	105 (52.0%)
Male	97 (48.0%)
Place of living	
Urban	101 (50.0%)
Rural	101 (50.0%)
School type	
Public	65 (32.2%)
Private	137 (67.8%)
COVID-19 infection	
No	83 (41.1%)
Yes	119 (58.9%)
COVID-19 vaccine	
No	69 (34.2%)
Yes	133 (65.8%)
Person in the house working with pesticides	
No	103 (51.0%)
Yes	99 (49.0%)
Living in a region sprayed with pesticides	
No	135 (66.8%)
Yes	67 (33.2%)
Humidity at home	
No	127 (62.9%)
Yes	75 (37.1%)
Cigarette smoking	
No	185 (91.6%)
Yes	17 (8.4%)
Waterpipe smoking	
No	164 (81.2%)
Yes	38 (18.8%)
	Mean ± SD
Age (years)	15.96 ± 1.88
Body Mass Index (kg/m^2)	22.39 ± 4.27
Household crowding index (person/room)	1.24 ± 0.55
Number of smokers in the house	1.44 ± 1.16
Anxious behavior	57.84 ± 9.51
Withdrawal behavior	58.70 ± 9.19
Somatic complaints	60.51 ± 10.73
Social problems	57.67 ± 9.69
Thought problems	57.87 ± 9.27
Attention problems	55.31 ± 7.79
Rule-breaking behavior	55.62 ± 8.94
Aggressive behavior	55.64 ± 8.35
Other problems	4.69 ± 3.63
Total Youth Self-Report (YSR) score	50.99 ± 14.29
Asthma Control Test (ACT) score	10.06 ± 4.98

(r = -0.03; P = 0.709), aggressive behavior (r = 0.004; P = .956), other problems (r = 0.08; P = 0.268), age (r = -0.09; P = 0.200), body mass index (r = 0.08; P = 0.283) and the number of smokers in the house (r = 0.04; P = 0.583).

Multivariable analyses

When taking each behavior score as an independent variable (Model 1, Table 3), the model explained 22.8% of variability of ACT score (R^2 = 0.228). Older age was associated with lower ACT scores (more controlled asthma), F(15, 186) = 3.66, P = 0.014, 95% Confidence Interval (CI) [-0.85, -0.10]. Living in a rural area, compared to urban, was associated with higher ACT scores, P = 0.018, 95% CI [0.28, 2.94]; vaccinated for COVID-19, P = 0.003, 95% CI [0.73, 3.55]; waterpipe smoking, P = 0.017, 95% CI [0.38, 3.85]; and having more somatic complaints, P = 0.005, 95% CI [0.04, 0.25] were significantly associated with higher ACT scores (more uncontrolled asthma).

When taking the total behavior score as an independent variable (Model 2, Table 3), the model explained 18.4% of variability of ACT score (R^2 = 0.184). Higher YSR scores were associated with higher ACT scores (more uncontrolled asthma), F(10, 191) = 4.30, P = 0.038, 95% CI [0.003, 0.10].

Table 2 Bivariate analysis of categorical factors associated with ACT score.

	Mean ± SD	t	df	P
Gender		0.74	200	0.460
Female	10.31 ± 4.77			
Male	9.79 ± 5.22			
Place of living		-2.98	200	**0.003**
Urban	9.04 ± 4.69			
Rural	11.09 ± 5.08			
School type		2.38	200	**0.018**
Public	11.26 ± 5.47			
Private	9.50 ± 4.65			
COVID-19 infection		-0.41	200	0.682
No	9.89 ± 5.09			
Yes	10.18 ± 4.93			
COVID-19 vaccine		-2.58	200	**0.011**
No	8.83 ± 5.04			
Yes	10.71 ± 4.85			
Person in the house working with pesticides		-2.01	200	**0.046**
No	9.38 ± 4.89			
Yes	10.78 ± 5.01			
Living in a region sprayed with pesticides		-2.23	200	**0.027**
No	9.52 ± 4.98			
Yes	11.16 ± 4.84			
Humidity at home		-1.98	200	**0.049**
No	9.54 ± 5.20			
Yes	10.96 ± 4.48			
Cigarette smoking		-1.06	200	0.289
No	9.95 ± 5.02			
Yes	11.29 ± 4.51			
Waterpipe smoking		-1.87	200	0.062
No	9.75 ± 4.90			
Yes	11.42 ± 5.16			

Numbers in bold indicate significant P values.
df= Degree of freedom; t= ratio of mean difference and standard error

DISCUSSION

To the best of our knowledge, this is the first study to tackle the association between behaviors and asthma control in Lebanese adolescents. Our results showed that the

Table 3 Multivariable analyses.

				95% CI		
	Unstandardized β	Standardized β	*p*	Lower bound	Upper bound	VIF
Model 1: Each behavior score as an independent variable (R^2 = 0.228)						
Age	-0.48	0.18	**0.014**	-0.85	-0.10	1.28
Household crowding index	1.17	0.13	0.070	-0.09	2.43	1.20
Place of living (rural vs. urban*)	1.61	0.16	**0.018**	0.28	2.94	1.11
School type (private vs. public*)	-0.33	-0.03	0.659	-1.82	1.15	1.20
COVID-19 vaccine intake (yes vs. no*)	2.14	0.20	**0.003**	0.73	3.55	1.12
Person in the house working with pesticides (yes vs. no*)	0.50	0.05	0.477	-0.89	1.90	1.22
Living in a region sprayed with pesticides (yes vs. no*)	0.30	0.03	0.699	-1.22	1.82	1.28
Humidity in the house (yes vs. no*)	0.58	0.06	0.427	-0.85	2.00	1.19
Waterpipe smoking (yes vs. no*)	2.12	0.17	**0.017**	0.38	3.85	1.15
Anxious behavior	0.02	0.03	0.825	-0.12	0.15	4.20
Withdrawal behavior	0.02	0.03	0.793	-0.11	0.14	3.10
Somatic complaints	0.15	0.31	**0.005**	0.04	0.25	3.00
Social problems	0.004	0.01	0.959	-0.14	0.14	4.62
Thought problems	-0.12	-0.22	0.092	-0.25	0.02	3.96
Attention problems	0.04	0.06	0.576	-0.10	0.17	2.65
Model 2: Total behavior score as an independent variable (R^2 = 0.184)						
Age	-0.32	-0.12	0.085	-0.68	0.04	1.11
Household crowding index	1.47	0.16	**0.021**	0.22	2.71	1.14
Place of living (rural vs. urban*)	1.75	0.18	**0.011**	0.41	3.09	1.09
School type (private vs. public*)	-0.14	-0.01	0.858	-1.64	1.37	1.20
COVID-19 vaccine intake (yes vs. no*)	2.06	0.20	**0.004**	0.66	3.47	1.09
Person in the house working with pesticides (yes vs. no*)	0.42	0.04	0.554	-0.98	1.83	1.20
Living in a region sprayed with pesticides (yes vs. no*)	0.52	0.05	0.499	-0.99	2.03	1.23
Humidity in the house (yes vs. no*)	0.63	0.06	0.382	-0.79	2.04	1.13
Waterpipe smoking (yes vs. no*)	1.84	0.15	**0.038**	0.10	3.58	1.13
Behavioral problems total score	0.05	0.15	**0.038**	0.003	0.10	1.13

*Reference group; numbers in bold indicate significant *p* values.
VIF = Variance Inflation Factor.

COVID-19 vaccine, waterpipe smoking, and having more somatic complaints were significantly associated with higher ACT scores (more uncontrolled asthma). Higher total YSR scores were associated with higher ACT scores (more uncontrolled asthma).

This study results suggested that higher somatic complaints were associated with more uncontrolled asthma, similar to the results of a previous study suggesting that severe asthma manifestations may be credited to psychosomatic signs and behaviors, especially when the diagnostic tests are inconclusive and the treatment response is unreliable.[45]

Previous studies have also looked into association between somatic symptoms and asthma as well as the effects of asthma on children's behavioral issues and quality of life.[46,47] Our results showed that higher behavioral problems were significantly associated with more uncontrolled asthma, corroborating previous findings that uncontrolled asthma was frequently associated with depression and anxiety.[48] Mental health issues, such as depression and anxiety, are relevant comorbidities in severe asthma.[49] In fact, children with higher behavioral problems have lower adherence to treatment,[50,51] more days of wheezing per year,[51] and increased frequency and duration of hospitalization.[50,51] Consequently, it is important to emphasize the need of taking into account how behavioral problems in general and somatic symptoms in particular affect general health and well-being as well as the requirement for thorough evaluation and treatment of these manifestations in asthmatics. In order to create efficient strategies to treat these manifestations in teenage asthmatics, more studies are required to better understand the mechanisms behind the association between behavioral problems and asthma.

Similar to other types of coronavirus infections,[52] SARS-CoV-2 (COVID-19) infection was incriminated in the worsening of respiratory chronic conditions, including asthma.[53] Therefore, asthma patients are advised to have the COVID-19 vaccine, with no unique adverse events being reported for this population.[24,25] The impact of the COVID-19 vaccination on asthma is not yet known and has not been explored; however, Colaneri et al. showed a case of COVID-19 vaccination and asthma exacerbation.[54] This might be explained by the fact that *messenger RNA* (mRNA) vaccines probably induce the production of type-I Interferon (IFN),[55,56] which

is less produced in the bronchial epithelium of asthmatics following a viral infection.[57] Our results could open door for the future studies aiming at explaining the possible mechanisms behind this association.

Our results showed that waterpipe smoking was associated with more uncontrolled asthma in adolescents, in agreement with previous findings.[19] This could be explained by the fact that tobacco smoke constituents can cause loss of cilia and hypertrophy of the mucus gland in the upper airways, leading to inflammation, epithelial changes, fibrosis, and secretory congestion in the peripheral airways. This could result in the destruction of the alveoli, loss of gas exchange surface area, and airways flexibility as well as vascular changes to the small blood vessels of the bronchioles and alveoli.[58]

Adolescents are increasingly turning to waterpipe smoking despite its high risk of dependence,[59,60] with Lebanon having the highest prevalence worldwide (36.9%).[61] This might be due to the waterpipe's social acceptability, compared to cigarette and the misconception of it being less harmful than cigarettes.[62,63] Waterpipe smoking in adolescents is a major public health issue globally, with effective prevention and control strategies still required to address this growing epidemic. However, these findings should be interpreted with caution, as this study did not assess waterpipe dependence in adolescents, number of waterpipes smoked per week, and the duration of each smoking session.

Finally, the current results observed a lack of significant association between behavioral problems (i.e., rule breaking and aggressive behavior) and more uncontrolled asthma in the past week, which is in contrast with earlier findings. Indeed, prior research drew attention to a statistically significant link between the occurrence of asthma symptoms and the presence of behavioral problems in children.[64] Previous studies also indicated that children with behavioral problems exhibit more severe asthma, with 18 more days of wheezing annually.[51] In addition, it was found that greater levels of behavioral problems are associated with indicators of inadequately controlled asthma, including increased frequency/duration of hospitalization and lower adherence to treatment.[50,51] In an attempt to explain these relationships, Feitosa et al. suggested that asthmatics who live with behavioral problems could have difficulties in managing their symptoms and treatment, thus increasing severity of the disease.[64] However, the majority of existing research was conducted in developed countries, and were not replicated in the present sample from Lebanon. Our findings could be in part explained by sociocultural influences on asthma morbidity, quality of care, self-management, and family management.[65,66] The future studies are required to investigate and further elucidate these under-researched associations in the Arab developing countries.

Living in a region sprayed with pesticides and having a member in the family who works with pesticides were not significantly associated with asthma control in the multivariable analysis; the association between pesticides and asthma exacerbation is debatable; while some findings found a positive association between those two variables,[67,68] (pesticides and asthma exacerbation), other findings showed no association between those two variables.[69] Our results might be explained by the small sample size and the fact that other variables, such as behavioral problems, would have a more important effect on uncontrolled asthma than use of pesticides. The Future studies must clarify and explain this association.

Clinical implications

It is important to address both physical and emotional aspects of asthma management in adolescents. This involves ensuring proper asthma control through medications, self-management techniques, and regular check-ups with healthcare professionals. Additionally, addressing the underlying mental health fears and providing support and education on coping strategies can help mitigate behavioral problems in asthmatic adolescents. Addressing behavioral problems requires a multi-faceted approach, which involves various stakeholders (parents, schools, and healthcare professionals). It is important to promote awareness, education, and support systems to help adolescents make healthier choices and prevent or address behavioral problems.

Limitations

This study had a cross-sectional design, so no causality could be inferred. A selection bias was present because of the snowball sampling technique followed to recruit participants and the unknown response rate. Information and social desirability biases could be considered because participants might not be totally honest when answering the questions. Residual bias was also plausible because the results were not adjusted over possible other factors known to be associated with asthma. The YSR scale is not validated in Arabic yet. These limitations could have affected our results to be generalized to the population. The future studies should aim at validating the Arabic YSR, select a random sample for better representativeness, and add more factors that could influence the association behavioral problems–asthma control in adolescents.

Conclusion

Our findings support the inclusion of mental health treatments for better asthma control and point to a link between behavioral issues and uncontrolled asthma. In a developing nation without a clear established strategy aiming at asthma prevention, the findings of this study could help develop potentially beneficial public health treatments.

Ethics approval and consent to participate

The study protocol was approved by the ethics committee of the School of Pharmacy at the Lebanese International University (Reference #2023RC-018-LIUSOP). Participants were asked to have approval of their parents before filling the survey; an electronically informed consent was considered from each participant when submitting the online

form. All methods were carried out in accordance with relevant guidelines and regulations.

Availability of data

All data generated or analyzed in this study are not available publicly due the restrictions from the ethics committee. Reasonable requests could be addressed to the corresponding author (Souheil Hallit).

Competing interests

The authors have nothing to disclose.

Author contributions

Vanessa Azzi, Michel Soufia, and Souheil Hallit designed the study. Vanessa Azzi collected the data and drafted the manuscript. Souheil Hallit carried out the analysis and interpreted the results. Vanessa Azzi, Fouad Sakr, and Mariam Dabbous collected the data. Diana Malaeb and Sami El Khatib reviewed the paper for intellectual content. All authors reviewed the final manuscript and gave their consent for publication.

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