




DEVELOPMENT OF A HEALTHY LIFESTYLE ASSESSMENT INDEX FOR SCHOOL-AGE CHILDREN

DESENVOLVIMENTO DE UM ÍNDICE DE AVALIAÇÃO DE ESTILO DE VIDA SAUDÁVEL DE CRIANÇAS EM IDADE ESCOLAR

A.O.
ARTIGO ORIGINAL

Beatriz Faria¹  ; Marta Pinto da Costa^{2,4}  ; Sofia Vilela^{2,3*} 

¹ Unidade de Saúde Pública do ACeS Grande Porto V – Porto Ocidental, Rua de Saraiva de Carvalho, n.º 130, 4000-520 Porto, Portugal

² EPIUnit - Instituto de Saúde Pública da Universidade do Porto, Rua das Taipas, n.º 135, 4050-600 Porto, Portugal

³ Laboratório para a Investigação Integrativa e Translacional em Saúde Populacional (ITR), Universidade do Porto, Rua das Taipas, n.º 135, 4050-600 Porto, Portugal

⁴ Departamento de Ciências da Saúde Pública e Forenses, e Educação Médica, Faculdade de Medicina da Universidade do Porto, Alameda Prof. Hernâni Monteiro, 4200-319 Porto, Portugal

*Endereço para correspondência:

Sofia Vilela
EPIUnit - Instituto de Saúde Pública da Universidade do Porto,
Rua das Taipas, n.º 135,
4050-600 Porto, Portugal
sofia.vilela@ispup.up.pt

Histórico do artigo:

Recebido a 21 de abril de 2023
Aceite a 31 de março de 2024

ABSTRACT

INTRODUCTION: Assessing children's lifestyles is fundamental for developing policies that prevent the onset of non-communicable diseases.

OBJECTIVES: To develop a short lifestyle index for school-age children (6 to 9 years old) and assess their lifestyle characterization.

METHODOLOGY: The index was developed based on data from the 7-year follow-up of the birth cohort Generation XXI (n=4336 children), grouped into four domains: frequency of food consumption, eating behaviours, physical activity (including sedentary behaviours) and sleep duration. Cronbach alpha coefficient was obtained to assess the index internal consistency. Associations between sociodemographic characteristics, the physical environment of the house, and the index score were evaluated through linear regression models, obtaining beta coefficients and respective 95% confidence interval (95%CI).

RESULTS: The final index included only two domains (food consumption and physical activity) with a Cronbach alpha of 0.52 and a mean score of 3.6 ± 2.8 (range: -5 to 10). Maternal age ($\beta=1.066$; 95%CI=1.045-1.087), years of education ($\beta=1.216$; 95%CI=1.186-1.246), having a house with a garden ($\beta=1.630$; 95%CI=1.304-2.037), internet access ($\beta=1.524$; 95%CI=1.086-2.139) and having a bicycle ($\beta=1.710$; 95%CI=1.086-2.694) were positively associated with a healthier lifestyle of the children.

CONCLUSIONS: The index developed is a short instrument that can be used to evaluate school-age children's overall lifestyle. Better maternal sociodemographic characteristics and a better house physical environment increase the likelihood of children having a healthier lifestyle.

KEYWORDS

Diet, Healthy lifestyle index, Physical activity, School-age children, Sleep patterns

RESUMO

INTRODUÇÃO: Avaliar o estilo de vida das crianças é fundamental para o desenvolvimento de políticas que previnam o surgimento das doenças não transmissíveis.

OBJETIVOS: Desenvolver um índice reduzido de estilo de vida para crianças em idade escolar (6 aos 9 anos de idade) e caracterizar o seu estilo de vida.

METODOLOGIA: O índice foi desenvolvido com base nos dados da avaliação aos 7 anos da coorte de nascimento Geração XXI (n=4336 crianças), agrupados em quatro domínios: frequência do consumo alimentar, comportamentos alimentares, atividade física (incluindo comportamentos sedentários) e duração do sono. O coeficiente alfa de Cronbach foi obtido para avaliar a consistência interna do índice. As associações entre as características sociodemográficas, o ambiente físico da casa e a pontuação do índice foram avaliadas através de modelos de regressão linear, com a obtenção dos coeficientes β e respetivos intervalos de confiança de 95% (IC95%).

RESULTADOS: O índice final incluiu apenas dois domínios (consumo alimentar e atividade física) com um alfa de Cronbach de 0,52 e pontuação média de $3,6 \pm 2,8$ (intervalo: -5 a 10). A idade materna ($\beta=1,066$; IC95%=1,045-1,087), a escolaridade materna ($\beta=1,216$; IC95%=1,186-1,246), ter uma casa com jardim ($\beta=1,630$; IC95%=1,304-2,037), acesso à internet ($\beta=1,524$; IC95%=1,086-2,139) e ter bicicleta ($\beta=1,710$; IC95%=1,086-2,694) associaram-se positivamente a um estilo de vida mais saudável das crianças.

CONCLUSÕES: O índice desenvolvido é um instrumento curto que pode ser usado para avaliar o estilo de vida geral em crianças em idade escolar. Melhores características sociodemográficas maternas e um melhor ambiente físico da casa aumentam a probabilidade de as crianças terem um estilo de vida mais saudável.

PALAVRAS-CHAVE

Alimentação, Índice de estilo de vida saudável, Atividade física, Crianças em idade escolar, Padrões de sono

INTRODUCTION

Individual lifestyles are a common factor influencing the onset of non-communicable diseases, considered the leading cause of morbidity and mortality in developed societies (1). Children's lifestyle assessment is crucial for developing and implementing effective policies that prevent diseases related to eating habits and physical inactivity and, thus, ensure health in the future (2). Also, accurate and valid assessments are essential to quantify problems, monitor changes over time and identify high-risk groups (2). The first years of life, especially between 6 and 9, are an essential phase of growth at all levels, ideal for transmitting important knowledge and creating healthy habits that can last for a lifetime (3). The literature reports the benefits of physical activity (PA) in the physical, mental, cognitive, social and academic performance of children and young people (5-17 years old), associating a higher frequency of PA with a better life quality related to health (4, 5). A healthy diet is recommended to reduce the risk of developing non-communicable diseases (6). The relationship between adequate intake of fruit and vegetables (FV) and prevention of various non-communicable diseases is well established (7). Short sleep duration in children is also associated with a significantly increased risk of obesity (8). Years of maternal education were positively associated with increased diet quality from 4 to 7 years (9). Children with more PA equipment at home spent less time on sedentary behaviours (10). In children, as far as our knowledge, there is no previous healthy lifestyle index including more than one dimension. Therefore, this study aimed to develop an index that associates children's food habits and behaviours, PA and sleep duration, characterizing their lifestyles and their association with maternal sociodemographic characteristics and house physical environment.

METHODOLOGY

Participants

The present study was based on data from baseline and the 7-year follow-up of the population-based birth cohort Generation XXI (11). This cohort included 8647 newborns at baseline that were recruited from the five public maternity hospitals in the metropolitan area of Porto between 2005 and 2006 (91.4% of invited mothers). The Generation XXI project is in line with the Declaration of Helsinki and was approved by the Ethics Committee of the Hospital de São João/University of Porto Medical School and by the Portuguese Authority of Data Protection.

For the final sample, we considered all children with complete information on the variables of interest and excluded children with diseases that might influence food intake (celiac disease, allergy, and food intolerance) and children with congenital malformations that might affect feeding (n=24), achieving a final sample of 4336 children.

Data Collection

Children's diet was collected through a previously calibrated 38-item food frequency questionnaire (FFQ) (12), assessing usual food consumption in the previous 6 months. The main caregivers were also asked about their perception regarding certain children's eating behaviours, such as if the child 'do not eat enough', 'eat very slowly' and/or 'eat exaggerated amounts'. Children's PA was characterized by the following activities: spending one daily hour or more in active play (running, cycling, playing ball), the practice of any scheduled and regular out-of-school PA and spending more than two daily hours in sedentary activities (reading, painting, studying, watching television and playing games on the computer or console), during the week or at the weekend. Duration of sleep was calculated as the difference between bedtime and wake-up time and bedtime.

Maternal working status was divided into two groups: 'paid situations' (full-time employee, employed part-time, employed less than part-time or retired/pre-retired) and 'unpaid situations' (familiar worker unpaid, unemployed, student, domestic or another situation). Household income was grouped as '≤1000 €', '1001-1500 €' and '>1500€'. The number of rooms was categorized as '1 to 3 rooms', '4 rooms' or '5 to 12 rooms'. Having access to the garden, to the internet, and a bicycle at 7 years of age was categorized as 'yes' or 'no'.

The Healthy Lifestyle Index

For the current sample, the Cronbach alpha coefficient was obtained for the Healthy Lifestyle Index to assess its internal consistency. Initially, the Healthy Lifestyle Index included four domains (frequency of food consumption, eating behaviours, PA and sleep) and presented a Cronbach alpha value of 0.44. After excluding the questions of the domains 'eating behaviour' and 'sleep', the Cronbach alpha value increased to a maximum value of 0.52 and was considered the final index. Cronbach's alpha is a method for assessing the instrument reliability by comparing the degree of common variance among the items of an instrument against the overall variance (13).

The construction of the final healthy lifestyle index was based on two domains: frequency of food consumption and PA (including sedentary behaviours) (Table 1). Behaviours considered healthier were scored 1 point, while others considered less healthy scored -1 point (Table 1). The final points were summed to obtain the final score of the developed index, ranging from -5 to 10 points, with higher scores reflecting a healthier lifestyle.

Statistical Analysis

Comparisons of continuous variables were performed using the Student's t-test and were summarized by means and SD. Categorical variables were described as frequencies and compared using the Chi-square test.

The associations between the sociodemographic characteristics and the physical environment of the house and the healthy lifestyle index at 7 years were evaluated through linear regression models – regression coefficients and respective 95% confidence intervals [β , 95%CI]. A step-by-step approach was used: predefined blocks of variables were fitted separately, each block mutually adjusted, and introduced cumulatively into the analysis, with a fixed order. Model 1 was adjusted for maternal age and education at delivery time and the child's sex. Model 2 included maternal age, working status, child sex, and monthly household income. Model 3 included all variables of model 1 plus the number of rooms, garden, terrace, internet, bicycle, and computer.

RESULTS

Table 2 shows that mothers included in this sample were slightly older and more educated than those drawn from the larger cohort. Children in this sample practiced significantly more out-of-school PA (56.0%) than those in the remaining cohort (44.3%).

Table 3 presents that most children (64%) consume five or more portions of 'Fruits, vegetables and soup' daily and 'Fish and eggs' at least 5 times per week. Almost half of the children (46%) consume 'Sweets' and 'Soft drinks' daily, and 27% consume 'Salty snacks' at least 2 to 4 times per week. Most children practice out-of-school scheduled and regular PA (56%). Only 15.6% of the children spend 2 hours or more a day in screen time during the week. However, this percentage increases to 69.9% during the weekend. The lifestyle index of children at 7 years had a mean score of 3.6 points (SD=2.8).

Table 1

Variables included in the healthy lifestyle index and respective score assigned

SCORE	FREQUENCY OF FOOD CONSUMPTION
+1	Consume fruit every day (≥ 2 /day).
+1	Consume vegetable soup regularly (≥ 1 x/day).
+1	Consume vegetables (cooked or raw) on the plate regularly (≥ 1 x/day).
+1	Consume fish and eggs regularly (≥ 5 x/week).
-1	Consume sugary drinks (carbonated and non-carbonated drinks, nectars, ice-tea, and cola) daily (≥ 1 x/day).
-1	Consume sweet snacks (candies, gums, cakes, biscuits and chocolate) daily (≥ 1 x/day).
-1	Consume salty snacks (chips, patties, pizzas and hamburgers) regularly (≥ 2 /week).
PHYSICAL ACTIVITY	
-1	Spend 2 hours or more a day watching TV and playing electronic games (computer or console) during the week.
-1	Spend 2 hours or more a day watching TV and playing electronic games (computer or console) during the weekend.
+1	Practice scheduled and regular out-of-school sports activity.

Table 2

Comparison between characteristics of eligible participants and the remaining cohort

	STUDY SAMPLE (n= 4336)	REMAINING COHORT (n = 4311)	P-value
Maternal age (years), mean (sd)	29.8 (5.18)	28.1 (5.87)	$\leq 0.001^a$
Maternal education (years), mean (sd)	11.4 (4.31)	9.5 (3.99)	$\leq 0.001^a$
Child's sex (girl), n (%)	2120 (48.9%)	2112 (49.0%)	0.754 ^b
Out-of-school physical activity, n (%)	2426 (56.0%)	1910 (44.3%)	$\leq 0.001^b$

^a Student's t-test

^b Chi-Square test

SD: Standard deviation

Table 3

Food intake and physical activity habits of children at 7 years of age

	7 YEARS
Fruit, vegetables and soup (frequency/day), mean (sd)	4.6 (1.66)
Fruit, vegetables and soup (≥ 5 /day), n (%)	2787 (64.3)
Fish and eggs (frequency/day), median (IQR)	0.9 (0.57)
Fish and eggs (≥ 5 -6/week), n (%)	2788 (64.3)
Sweets (frequency/day), median (IQR)	0.8 (0.98)
Sweets (≥ 1 /day), n (%)	2006 (46.3)
Salty snacks (frequency/day), median (IQR)	0.3 (0.28)
Salty snacks (≥ 2 -4/week) n (%)	1148 (26.5)
Soft drinks (frequency/day), median (IQR)	0.9 (1.11)
Soft drinks (≥ 1 /day) n (%)	2004 (46.2)
Out-of-school physical activity, n (%)	2426 (56)
Screen time during the week (≥ 2 hour/day), n (%)	676 (15.6)
Screen time during the weekend (≥ 2 hour/day), n (%)	3032 (69.9)
Healthy lifestyle index, mean (sd)	3.6 (2.8)

IQR: Interquartile range

SD: Standard deviation

In Table 4, it was described that higher maternal age and education was associated with a higher healthy lifestyle index score. Model 2 shows that children whose mothers have unpaid jobs have an inverse association with the index score compared to children whose mothers have paid work. Similarly, the higher the total household monthly income, the higher the index score. Also, in model 3, having access to the garden, internet, a bicycle, and living in a house with 5 or more rooms were significantly associated with a higher lifestyle index score.

Table 4

Association between sociodemographic factors, physical environment of the house and children's BMI and adherence to a healthy lifestyle at 7 years old

	MODEL 1	MODEL 2	MODEL 3
	β (95%CI)	β (95%CI)	β (95%CI)
SOCIODEMOGRAPHIC FACTORS			
Maternal age (years)	1.066 (1.050; 1.082)	1.069 (1.052; 1.086)	1.066 (1.045; 1.087)
Maternal education (years)	1.245 (1.222; 1.268)	—	1.216 (1.186; 1.246)
Mother's working status			
Unpaid	—	Ref.	—
Paid	—	1.435 (1.158; 1.776)	—
Monthly income			
$\leq 1000\text{€}$	—	Ref.	—
1001-1500€	—	1.420 (1.127; 1.788)	—
$> 1500\text{€}$	—	4.035 (3.254; 5.004)	—
PHYSICAL ENVIRONMENT OF THE HOUSE			
Number of rooms in the house			
1 a 3	—	—	Ref.
4	—	—	0.993 (0.785; 1.257)
≥ 5	—	—	1.347 (1.011; 1.796)
Garden			
Yes	—	—	1.630 (1.304; 2.037)
Terrace			
Yes	—	—	0.907 (0.727; 1.132)
Internet			
Yes	—	—	1.524 (1.086; 2.139)
Bicycle			
Yes	—	—	1.710 (1.086; 2.694)
Computer			
Yes	—	—	0.921 (0.750; 1.131)
Adjusted r^2	0.137	0.141	0.140

Model 1 was adjusted for maternal age and education at delivery time and the child's sex. Model 2 was adjusted for maternal age, working status, child sex, and monthly household income.

Model 3 included all variables of model 1 plus the number of rooms, garden, terrace, internet, bicycle, and computer.

DISCUSSION OF THE RESULTS

In the present study, the average lifestyle index score for children at 7 years old was 3.6 points on a scale ranging from -5 to 10. In a previous study exploring the association between PA status and several lifestyle characteristics in children and youth, participants classified as having inadequate levels of PA reported poorer eating habits, more screen time, and less sleep time. These children presented a worse lifestyle profile compared to those with adequate levels of PA (14). Thus, in the present study, the low score on the lifestyle index reflects unhealthy eating habits and low levels of PA in children of 7 years. Most children in this study fulfilled the WHO recommendations for daily consumption of at least 400 g of FV (5 or more portions per day). However, almost half of the children consume sweets and soft drinks daily, which does not fulfil the recommendations of a healthy eating pattern that should include limited consumption of ultra-processed foods, saturated and trans fats, added sugars and salt (15). In this study, most children practice scheduled and regular PA out-of-school. It is also reported that increasing PA during school hours is associated with children's

better physical, psychological, and social health (16). In the present study, the higher the level of the mother's education at the time of the children's birth, the better the children's lifestyle at 7 years of age. A previous study (9) described that higher maternal education is related to increased children's diet quality from 4 to 7 years of age, supporting our results. Another study concluded that children whose mothers had a lower level of education consumed less healthy foods (17). Children with more PA equipment have been found to spend less time on sedentary behaviours (18), and the lack of gardens was identified as a barrier to the practice of PA and active play (10, 19). These data support the positive association, verified in this study, between having access to a garden and a bicycle and having a better lifestyle index score. Besides that, as seen in this study, a better socioeconomic environment increases the Healthy Lifestyle Index score, which supports that the index has criterion validity.

One of the main strengths of this study is to focus on developing an instrument that identifies, in an early phase, less healthy lifestyles that could lead to non-communicable diseases. In that way, it can be used as a rapid diagnostic tool in schools, at a population level, by public health doctors, which allows the development of more sustainable and effective interventions that can correct those less healthy lifestyles. It might also be used in the clinical setting by nutritionists or general practitioners. Besides this, the study has a population basis allowing a greater scope and detail of the information.

Most of the information was obtained through the main caregiver report, which can lead to a misinterpretation of the questions asked (bias of social desirability). However, in the case of the FFQ used, it was previously calibrated and validated (12), and no relevant changes were expected. Additionally, despite the size of the cohort and its scope, children included in the cohort were recruited only in public hospitals. Assuming that the costs associated with childbirth in a private hospital are higher than in a public one, data available for this study may exclude children from higher economic class families. Thus, there may be some selection bias, although the number of children born in private hospitals was relatively low at the time of recruitment. Finally, we only used data from a single assessment, namely at 7 years of age and not at various time points, as part of a possible longitudinal study. In this way, it may limit the scope of the study to school-age children in general. In addition, assessing children at a younger age (preschool age) may be important.

CONCLUSIONS

The final healthy lifestyle index developed is a short instrument based on the frequency of food consumption and PA practice that was able to identify the low level of a healthy lifestyle in school-aged children. This instrument can be applied in future intervention studies and in clinical settings for a quick lifestyle assessment. Overall, children living in a house with access to a garden, internet, and bicycle and whose mothers were older and more educated had a healthier lifestyle.

FINANCIAL SUPPORT

Generation XXI was funded by the Health Operational Programme – Saúde XXI, Community Support Framework III and the Regional Department of Ministry of Health. This study was supported by the Portuguese Foundation for Science and Technology (FCT), under the Epidemiology Research Unit of the Institute of Public Health of the University of Porto (UIDB/04750/2020) and the Laboratory for Integrative and Translational Research in Population Health of the University of Porto (LA/P/0064/2020), and DOI identifiers <https://doi.org/10.54499/UIDB/04750/2020> and <https://doi.org/10.54499/LA/P/0064/2020>. MPC benefited from an FCT individual doctoral grant (2020.08314.BD) [<https://doi.org/10.54499/2020.08314.BD>] and SV is supported by

national funds through FCT, under the programme of 'Stimulus of Scientific Employment – Individual Support' within the contract 10.54499/2021.01096.CEECIND/CP1686/CT0001 [<https://doi.org/10.54499/2021.01096.CEECIND/CP1686/CT0001>]. FCT had no role in the design, analysis or writing of this article.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the families enrolled in Generation XXI for their kindness, all members of the research team for their enthusiasm and perseverance and the participating hospitals and their staff for their help and support.

CONFLICTS OF INTEREST

None of the authors reported a conflict of interest.

AUTHORS' CONTRIBUTIONS

BF: Responsible for the literature review, statistical analysis and interpretation, and writing the original draft preparation; MPC: Statistical analysis and interpretation, writing review and editing; SV: Study conceptualization, design, supervision and final approval. All authors read and provided critical feedback on the manuscript before the approval.

REFERENCES

1. World Health Organization (WHO). WHO's 2019 Global Health Estimates. Geneva; 2020.
2. Kowalkowska J, Wadolowska L, et al. Reproducibility of a Short-Form, Multicomponent Dietary Questionnaire to Assess Food Frequency Consumption, Nutrition Knowledge, and Lifestyle (SF FFQ4 Polish Children) in Polish Children and Adolescents. *Nutrients* 2019 Dec; 11(12):2929.
3. Direção-Geral do Consumidor, Associação Portuguesa dos Nutricionistas. Guia para educadores - Alimentação em idade escolar. Outubro 2013.
4. Aubert S, Barnes JD, et al. Global Matrix 3.0 Physical Activity Report Card Grades for Children and Youth: Results and Analysis From 49 Countries. *J Phys Act Health* 2018 Nov; 15(S2):S251-S273.
5. Marker AM, Steele RG, et al. Physical Activity and Health-Related Quality of Life in Children and Adolescents: A Systematic Review and Meta-Analysis. *Health Psychol* 2018 Oct; 37(10):893-903.
6. Direção Geral da Saúde (DGS). Programa Nacional para a Promoção da Alimentação Saudável. Lisboa; 2021.
7. Schulze MB, Martínez-González MA, et al. Food based dietary patterns and chronic disease prevention. *Science and Politics of Nutrition* 2018.
8. Wu Y, Gong Q et al. Short sleep duration and obesity among children: A systematic review and meta-analysis of prospective studies. *Obes Res Clin Pract*. 2017 Mar-Apr;11(2):140-150.
9. da Costa MP, Durao C, et al. Adherence to a healthy eating index from pre-school to school age and its associations with sociodemographic and early life factors. *The British Journal of Nutrition* 2019 Jul; 122(2):220-230.
10. Veitch J, Bagley S, et al. Where do children usually play? A qualitative study of parents' perceptions of influences on children's active free-play. *Health Place* 2006 Dec; 12(4):383-93.
11. Larsen PS, Kamper-Jørgensen M, et al. Pregnancy and birth cohort resources in Europe: a large opportunity for aetiological child health research. *Paediatr Perinat Epidemiol* 2013;27(4):393-414.
12. Vilela S, Severo M, et al. Evaluation of a short food frequency questionnaire for dietary intake assessment among children. *Eur J Clin Nutr* 2019 May; 73(5):679-691.
13. Cronbach L. Coefficient alpha and the internal structure of tests. *Psychometrika* 1951; 16(5):679-691.
14. Tambalis KD, Panagiotakos DB, et al. Concomitant Associations between Lifestyle Characteristics and Physical Activity Status in Children and Adolescents. *J Res Health Sci*. 2019; 19(1): e00439.

15. Hosker DK, Elkins RM, et al. Promoting Mental Health and Wellness in Youth Through Physical Activity, Nutrition, and Sleep. *Child Adolesc Psychiatric Clin N Am* 2019 Apr; 28(2):171-193.
16. Smedegaard S, Christiansen LB, et al. Improving the well-being of children and youths: a randomized multicomponent, school-based, physical activity intervention. *BMC Public Health*. 2016; 16: 1127.
17. Aranceta, J., Perez-Rodrigo, et al. Sociodemographic and lifestyle determinants of food patterns in Spanish children and adolescents: The enKid study. *Eur J Clin Nutr*, 2003; 57, S40-S44.
18. Maitland C, Stratton G, et al. A place for play? The influence of the home physical environment on children's physical activity and sedentary behavior. *International Journal of Behavioral Nutrition and Physical Activity* 2013; 10:99.
19. Hesketh K, Waters E, et al. Healthy eating, activity and obesity prevention: a qualitative study of parent and child perceptions in Australia. *Health Promotion Int* 2005 Mar; 20(1):19-26