Lifestyle Clusters in School-Aged Youth and Longitudinal Associations with Fatness: The UP&DOWN Study

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Objectives To identify lifestyle clusters in children and adolescents, to analyze associations between lifestyle clusters and body fat percentage (BFP) at baseline and 2 years later, and to examine if BFP at baseline is associated with BFP 2 years later.

Study design This longitudinal study involved 1634 Spanish youth (804 girls) aged 8-18 years (mean, 12.45 ± 2.51 years). Cluster analysis was performed by including objectively measured sedentary time and physical activity and self-reported screen time and diet. The associations between cluster membership and BFP was analyzed through general linear models. All the analyses were separated by 3 age groups: older children, younger adolescents, and older adolescents.

Results Four clusters were identified in the 3 age groups: (1) healthy lifestyle cluster (high moderate-to-vigorous physical activity, low screen and total sedentary time), (2) predominantly sedentary cluster, (3) mainly screen time consumers cluster, and (4) nonhealthy lifestyle cluster (predominantly low moderate-to-vigorous physical activity and unhealthy diet). Participants belonging to the healthy lifestyle cluster showed significantly lower BFP at baseline and 2 years later compared with the other profiles. These differences remained significant when adjusted by BFP at baseline within the younger adolescents. Moreover, BFP at baseline positively predicted BFP 2 years later in all groups.

Conclusions These findings identify distinct lifestyle patterns. These clusters could be useful to develop interventions to reduce overweight and obesity in children and adolescents. *(J Pediatr 2018;203:317-24).*

In the last decade, several studies aimed at evaluation of the clustering of obesity-related risk factors among children and adolescents. Studies including sedentary behavior, physical activity, and diet habits found 3-7 clusters[1-3] and they agreed in identifying a healthy lifestyle cluster (ie, high levels of moderate-to-vigorous physical activity and low levels of sedentary behaviors), a highly sedentary cluster, and an unhealthy lifestyle cluster (ie, low levels of moderate-to-vigorous physical activity and diet and high levels of sedentary behaviors). However, mixed findings were found with respect to other patterns (ie, high-diet quality, high energy-dense eaters, or screen time consumer clusters). Most of these studies also analyzed the associations between the identified clusters and body mass index (BMI). However, although BMI has been widely used to estimate adiposity, it does not distinguish body composition.[4] The subscapular and triceps skinfold thicknesses are a well established method for estimating the body fat percentage (BFP) in children and adolescents.[5] Thus, whereas many studies evaluated BMI,[1] only 2 studies analyzed the associations between lifestyle clusters and BFP and no clear associations were found.[3,6]

The current study extends previous research by comparing the lifestyle behaviors and associations with BFP across age groups (ie, older children, younger adolescents, and older adolescents) using a longitudinal design. The current study aimed to identify lifestyle patterns by including screen time, total sedentary time, physical activity, and adherence to the Mediterranean diet in a sample of Spanish children and adolescents, to analyze associations between lifestyle clusters and BFP at baseline and 2 years later, and to examine if BFP at baseline is associated with BFP 2 years later in each cluster.

Methods

Participants were enrolled in the UP&DOWN study, using a convenience sample of Spanish children and adolescents (6-18 years of age) recruited from schools in the Cadiz and Madrid regions. This 3-year longitudinal study was designed to assess the impact over time of physical activity and sedentary behavior on health indicators, as well as to identify the psychoenvironmental and genetic determinants

BFP	Body fat percentage
BMI	Body mass index

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of physical activity. Baseline data were collected in 2011-2012, and the 2-year follow-up in 2013-2014. Complete information of the study has been described elsewhere.[7]

For the current analysis, 6- and 7-year-old children were not included, because they did not complete self-reported measures (eg, sedentary behavior or diet questionnaires). Furthermore, those youth who did not meet the accelerometry criteria (ie, <3 valid days with ≥10 hours of valid wear time) or with unusual patterns of responses were excluded (n = 31 [2.45%]). Thus, the final sample included 1263 youth (625 girls) aged 8-18 years (mean, 12.45 ± 2.51 years). All the analyses were performed by dividing the sample into 3 age groups at baseline: older children (aged 8-11 years; M = 9.66 years old; n = 397), younger adolescents (aged 12-15 years; M = 12.83 years old; n = 505), and older adolescents (aged 15-18 years; M = 15.90 years old; n = 361).

Participants, their families, and school supervisors were informed about the nature and purpose of the study at a meeting, in which informed consent from parents or legal guardians and participants was obtained. The study protocols were approved by the Ethics Committee of the Hospital Puerta de Hierro (Madrid, Spain), the Bioethics Committee of the National Research Council (Madrid, Spain), and the Committee for Research Involving Human Subjects at University of Cádiz.

Self-reported screen time behaviors were assessed using the Youth Leisure-time Sedentary Behavior Questionnaire.[8] The Youth Leisure-time Sedentary Behavior Questionnaire is a valid and reliable scale to assess the amount of time spent in 12 sedentary behaviors.[8] For the current study, we only included 3 screen time items: watching television/videos, playing computer/video games, and Internet surfing. Participants were asked to report the estimated average time devoted to each behavior in the previous week during weekdays and weekends, separately. Responses were recorded as 0 minutes, 1 hour, 2 hours, 3 hours, 4 hours, and 5 hours or more. The average screen time per day was calculated as follows: ([weekday time × 5] + [weekend time × 2])/7. To avoid overreporting, an adjustment to leisure time was applied before performing analyses taking into account sleep hours, school time, time in physical activities, and prevalence of each behavior (more information about the adjustment process is available in the Supplementary Appendix 3 of Cabanas-Sánchez et al[8]).

Objectively measured sedentary time and physical activity were analyzed by the ActiGraph accelerometer models GT1M, GT3X and GT3X + (Actigraph, LLC, Pensacola, Florida). The agreement between measures from the 3 models of ActiGraph activity monitors in children and adolescents has been demonstrated.[9,10] The ActiGraph accelerometers have been calibrated for children and adolescents in laboratory and free-living conditions.[11] Participants wore the accelerometer at the lower back for 7 consecutive days, removing it during sleep and water-based activities (eg, showering, swimming). The inclusion criterion was an activity monitor recording of at least 10 hours day^{-1} for 3 days.[12] Before analyses, we reintegrated data into 10-second epochs. Nonwear time was defined as a period of 60 minutes of zero counts and an allowance of up to 2 consecutive minutes of less than 100 counts per minutes with the up/downstream 30 minutes consecutive of zero counts for detection of artifactual movements.[13] Sedentary behavior was estimated by using the cutpoint of 100 counts per minutes.[14,15] Further, in line with previous studies with European children and adolescents,[14,15] moderate-to-vigorous physical activity was estimated by using the cutpoint of 2000 counts per minutes.[14,15] Both daily averages sedentary and physical activity time were calculated by dividing total time by valid days of accelerometry (minutes per day).

The adherence to the Mediterranean diet was assessed using the Mediterranean Diet Quality Index,[16] which is composed of 16 categorical questions (yes/no), with 12 denoting positive response and 4 with a negative response. Positive items were scored a value of "+1" (0 if they answered "no") and negative items were scored a value of "−1" (0 if they answered "no"). This scale has been previously validated with the Spanish population (information about the questions can be found in Serra-Majem et al[16]). The index of adherence to the Mediterranean diet was calculated as the sum of each answer and ranged from −4 to 12, with higher scores indicating higher adherence to the Mediterranean diet.

Triceps and subscapular skinfold thickness were used to estimated BFP, with a Holtain caliper (range, 0-40 mm; precision, 0.2 mm). Two nonconsecutive measurements were performed on the nondominant side of the body and the averages were recorded. BFP was calculated by using the equations developed by Slaughter et al.[5]

Fathers and mothers were asked to report their level of education. The variable was dichotomized into 2 homogeneous categories: (1) low education (no education, elementary education, or secondary education) and (2) high education (university degree).

Statistical Analyses

All the analyses were performed with the SPSS Statistics software package version 21.0 (IBM Software Group, Chicago, Illinois). Initially, descriptive statistics (mean and standard deviation) and Pearson correlations among the study variables were calculated. Cluster analyses were used to generate lifestyle profiles. Because the variables used in the cluster analysis had different units and arithmetic scales, they were transformed into standardized scores (z-scores) to provide a common range. The cluster analysis was divided into 2 steps. Because cluster analysis is sensitive to the existence of outliers, values of more than 3 standard deviations above or below the mean were deleted as univariate outliers (older children, 68; younger adolescents, 19; older adolescents, 21), whereas Mahalanobis distance was used to delete multivariate outliers (older children, 6; younger adolescents, 4; older adolescents, 5). First, a hierarchical cluster analysis was carried out using Ward's method based on squared Euclidean distances.[17] Second, the k-means cluster analysis was used to obtain the final cluster solution, including the number of clusters obtained in the previous step. A visual inspection of the dendogram, the percentage change in the agglomeration coefficient at each step, and conceptual considerations were used to select the number of clusters identified. To examine the stability of cluster solutions, the sample was randomly split into halves, and the same process previously described (Ward and K-means steps) were tested. The Cohen k coefficient was used to measure the degree of agreement between classification of subjects of each of the new subsample and the original sample.

We used χ^2 tests to examine clusters differences on sex and parental education distributions. Also, general linear models were used to analyze differences between the identified clusters (fixed factor) and BFP (dependent variable) at baseline and at the 2-year follow-up. After finding maternal education as a significant correlate of cluster membership, this variable was included as a covariate. Accelerometer wear time was also included as a covariate for possible differences in exposure that might influence the sedentary time and moderate-to-vigorous physical activity, whereas the potential effect of sex on BFP was already controlled by the Slaughter equations.[5] The cluster*sex interaction was included retrospectively and nonsignificant scores were found. Finally, linear regression with enter method was used to analyze the associations between BFP at baseline and BFP 2 years later for each cluster group in each age group. In the first step, we included BFP 2-year follow-up as dependent variable and BFP at baseline as an independent variable, whereas maternal education and accelerometer wear time were added in the second step.

Results

Descriptive, mean differences by age groups, and correlational analysis at baseline are displayed in **Table I**. With respect to the mean differences among age groups, older children showed significantly lower scores in screen and total sedentary times when compared with younger and older adolescents, whereas younger adolescents displayed lower scores compared with older adolescents. Furthermore, older children reported significantly greater scores of moderate-to-vigorous physical activity than younger and older adolescents. Screen time was negatively associated with adherence to the Mediterranean diet in the 3 age groups, whereas screen time and sedentary time were positively associated only in the older children group. Further, moderate-to-vigorous physical activity was negatively associated with sedentary time and BFP in all age groups, and sedentary time was also positively associated with BFP in the older children group.

The 4-cluster solution was identified as the most adequate, reliable, and stable representation for the 3 age groups. The stability of these solutions was tested by repeating the procedure in 2 randomly selected subsamples for each age group sample. Agreement between solutions was acceptable (Cohen kappa: range, 0.75-0.91; median, 0.82). **Figure 1** displays the cluster representation for the 3 age groups. Scores between −0.2 and 0.2 were average. Scores between −0.2 and −0.5 and between 0.2 and 0.5 were slightly low and slightly high, respectively. Scores between −0.5 and −1 and between 0.5 and 1 were low and high, respectively. Scores lower than 1 or greater than 1 were very low and very high, respectively.

Older children were grouped into the following clusters. (1) The Healthy Lifestyle cluster (n = 103 [26%]) was characterized by slightly low levels of screen time, low levels of total sedentary time, high levels of moderate-to-vigorous physical activity, and average levels of adherence to the Mediterranean diet. (2) The sedentary/healthy diet cluster (n = 121 [30%]) showed slightly low levels of screen time, slightly high levels of total sedentary time, low levels of moderate-to-vigorous physical activity, and high levels of adherence to the Mediterranean diet. (3) The high screen cluster (n = 86 [22%]) consists of high levels of screen time, average levels of total sedentary

Table I. Descriptive statistics, correlational, and differential analysis between age groups at baseline

	Minimum	Maximum	M	SD	Screen time	Sedentary time	Moderate-to-vigorous physical activity	KIDMED	BFP
Older children									
Screen time	0.25	184.89	49.81*,†,‡	32.30	—				
Sedentary time	198.84	715.25	357.41*,†,‡	65.82	0.14¶	—			
Moderate-to-vigorous physical activity	7.06	66.04	27.21*,†	10.85	−0.03	−0.47¶	—		
KIDMED	0	12	6.61	2.19	−0.18¶	−0.05	0.02	—	
BFP	8.00	92.61	23.86	10.48	0.05	0.13¶	−0.33¶	−0.00	—
Younger adolescents									
Screen time	0	177.11	55.71	35.67	—				
Sedentary time	181.83	790.67	405.84	106.31	0.06	—			
Moderate-to-vigorous physical activity	5.49	68.11	23.79	10.04	0.02	−0.26¶	—		
KIDMED	−1	12	6.85	2.32	−0.21¶	−0.04	0.08	—	
BFP	5.44	71.07	22.41	9.80	0.07	0.10§	−0.23¶	−0.06	—
Older adolescents									
Screen TIME	3.7	180.69	65.05	34.77	—				
Sedentary time	175.89	837.7	431.7	99.65	−0.00	—			
Moderate-to-vigorous physical activity	5.42	68.97	24.27	10.59	0.07	−0.38¶	—		
KIDMED	−1	11	6.49	2.33	−0.13§	0.03	−0.02	—	
BFP	6.74	62.46	22.40	8.98	−0.03	0.10	−0.19¶	−0.06	—

KIDMED, adherence to the Mediterranean diet.
*Mean differences ($P < .05$) between old children and young adolescents.
†Mean differences ($P < .05$) between old children and old adolescents.
‡Mean differences ($P < .05$) between young adolescents and old adolescents.
§$P < .05$.
¶$P < .01$.

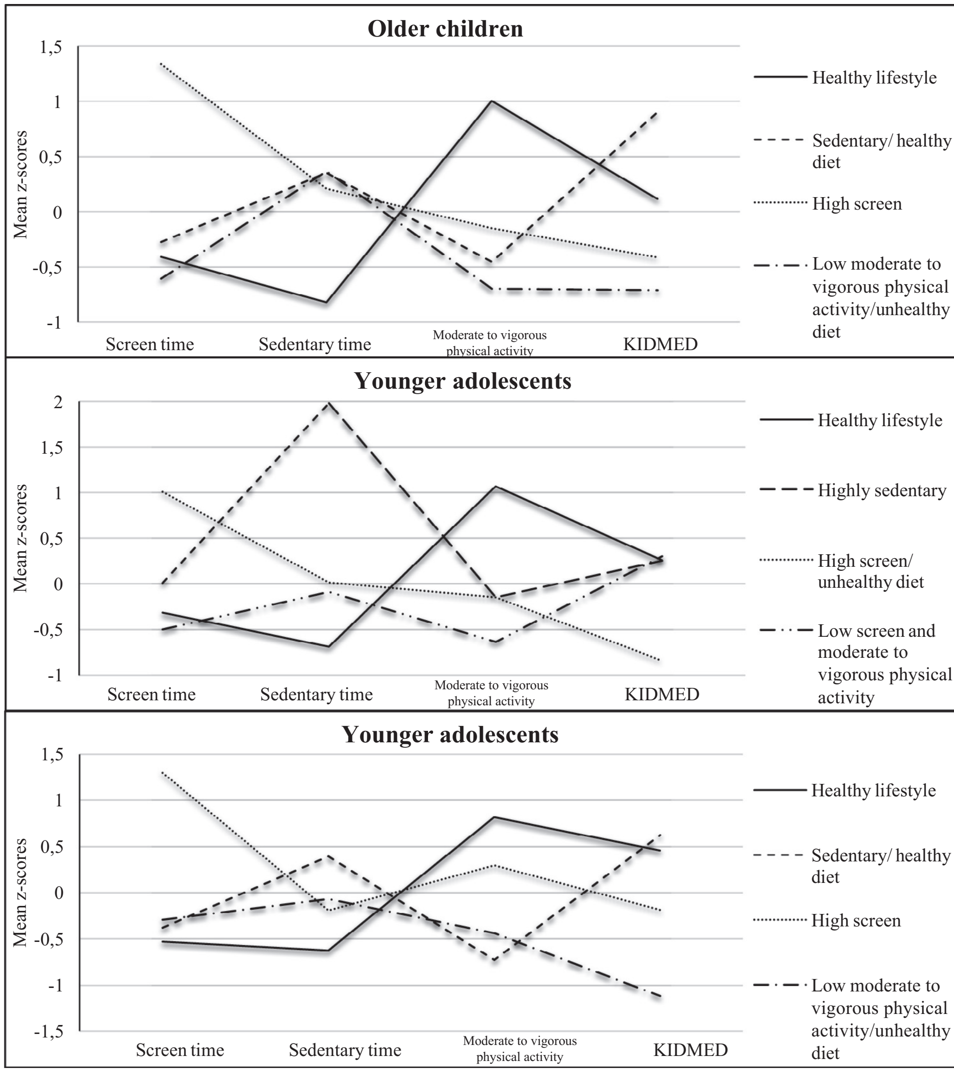

Figure 1. Patterns of the lifestyle clusters by age group. *KIDMED*, adherence to the Mediterranean diet.

time and moderate-to-vigorous physical activity, and slightly low levels of adherence to the Mediterranean diet. (4) The low moderate-to-vigorous physical activity/unhealthy diet cluster (n = 87 [22%]) was characterized by low levels of screen time, slightly high levels of total sedentary time, and low levels of moderate-to-vigorous physical activity and adherence to the Mediterranean diet.

In younger adolescents, the following clusters were identified. (1) The healthy lifestyle cluster (n = 134 [27%]) consists of slightly low levels of screen time, low levels of total sedentary time, high levels of moderate-to-vigorous physical activity and average levels of adherence to the Mediterranean diet. (2) The highly sedentary cluster (n = 43 [9%]) was characterized by average levels of screen time, very high levels of total sedentary time, and average levels of moderate-to-vigorous physical activity and adherence to the Mediterranean diet. (3) the high screen/unhealthy diet cluster (n = 128 [25%]) showed high levels of screen time, average levels of total sedentary time and moderate-to-vigorous physical activity, and low levels of adherence to the Mediterranean diet. (4) The low screen and moderate-to-vigorous physical activity cluster (n = 200 [40%]) was characterized by low levels of screen time and moderate-to-vigorous physical activity, average levels of total sedentary time, and slightly high levels of adherence to the Mediterranean diet.

Last, the older adolescents displayed the following clusters. (1) The Healthy Lifestyle cluster (n = 91 [25%]) showed low levels of screen time and sedentary time, high levels of moderate-to-vigorous physical activity and slightly high levels of adherence to the Mediterranean diet. (2) The sedentary/healthy diet cluster (n = 103 [29%]) was characterized by slightly low levels of screen time, slightly high levels of sedentary time, low levels of moderate-to-vigorous physical activity, and high levels of adherence to the Mediterranean diet. (3) The high screen cluster (n = 81 [22%]) consists of high levels of screen time and average levels of sedentary time, moderate-to-vigorous physical activity and adherence to the Mediterranean diet. (4) The low moderate-to-vigorous physical activity/

unhealthy diet cluster (n = 86 [24%]) was characterized by average levels of screen time and total sedentary time, slightly low levels of moderate-to-vigorous physical activity and low levels of adherence to the Mediterranean diet.

We also analyzed differences by sex, parental education, and BFP among lifestyles clusters (**Table II**). For the 3 age groups, the largest proportion of boys were included in the healthy lifestyle cluster (range, 35%-42%), whereas the largest proportion of girls were included in nonhealthy clusters (38% of girls in sedentary clusters within older children and older adolescents and 54% in low screen and moderate-to-vigorous physical activity cluster within younger adolescents). No differences were found between cluster groups and father's education, whereas significant differences were found with respect to the mother's education only in younger adolescents. Moreover, within the younger adolescent group, a lower mother education was associated with a higher proportion of adolescents in the high screen/unhealthy diet cluster.

The bottom section of **Table II** represents the association between cluster membership and BFP. The older children belonging to the healthy lifestyle cluster, when comparing with the other 3 clusters, showed significantly lower BFP at baseline (adjusted $R^2 = 0.06$) and 2 years later (adjusted $R^2 = 0.05$). When the latter model was also adjusted by BFP at baseline, no differences were found among clusters (adjusted $R^2 = 0.60$). With respect to the BFP changes, although all age groups displayed higher BFP at follow-up when compared with baseline, these differences were not significant. Within the younger adolescents group, participants belonging to the healthy lifestyle cluster displayed significantly lower BFP at baseline (adjusted $R^2 = 0.06$) and 2 years later (adjusted $R^2 = 0.10$) compared with the high screen/unhealthy diet and low screen and moderate-to-vigorous physical activity clusters. When the model was additionally adjusted by BFP at baseline, in the 2-year follow-up, the healthy lifestyle cluster retained lower BFP than the high screen/unhealthy diet and low screen and moderate-to-vigorous physical activity clusters (adjusted $R^2 = 0.67$). In terms of BFP changes, the healthy lifestyle cluster represented a significantly greater decrease compared with the high screen/unhealthy diet and low screen and moderate-to-vigorous physical activity clusters. Additionally, the older adolescents belonging to the healthy lifestyle cluster had significantly lower BFP at baseline when compared with the sedentary/healthy diet cluster (adjusted $R^2 = 0.05$), whereas no differences were found 2 years later unadjusted (adjusted $R^2 = 0.03$) and adjusted by BFP at baseline (adjusted $R^2 = 0.67$). In this age group, no significant differences in BFP changes were detected across clusters.

Finally, we analyzed the associations between BFP at baseline and BFP 2-year follow-up for each cluster within each age group (**Figure 2**). In all cases, BFP at baseline positively predicted BFP 2-year follow-up (R^2 ranged between 0.477 and 0.787; β ranged between 0.665 and 0.892; all $P < .001$).

Discussion

Initially, similar to other studies we found a negative association between moderate-to-vigorous physical activity and BFP at baseline.[18] We also found a positive association between sedentary time and BFP within older children and younger adolescents (but not for older adolescents), whereas screen time was not found as a significative correlate of BFP. These findings are not in line with previous studies that found screen time was a better predictor of adiposity compared with the total sedentary time.[19] Our results suggest that there are other types of sedentary behaviors (ie, social, educative, or passive sedentary behaviors) that could affect adiposity. Furthermore, no associations were found between adherence to Mediterranean diet and BFP. Contrary to previous studies,[20] this finding seems to indicate that this relationship could be mediated by other variables (eg, physical activity).

The 4-cluster solution was retained as the best solution within the 3 age groups. Our findings are in line with previous studies,[1-3] which also revealed a healthy lifestyle cluster, a predominantly sedentary cluster, and a nonhealthy lifestyle. The latter profile displayed a significantly higher percentage of participants (ie, 40%) within the younger adolescents group. Previous studies also found the highest prevalence of an unhealthy profile in adolescents. These results highlight the need to develop intervention programs for this age group (ie, 12-15 years old), because it seems to be a critical period when adolescents decrease their physical activity levels.[21]

Our results suggest that screen time consumers report a poor adherence to the Mediterranean diet,[1,3,22] whereas total sedentary time can cooccur with good adherence to the Mediterranean diet. These findings confirm the negative impact of screen time (more concretely digital media forms) in the lifestyle of children and adolescents.

A high percentage of participants belonging to the healthy lifestyle cluster were boys (between 68% and 81%). Girls were more likely to be classified in the sedentary clusters within all age groups. The results of the present study are in line with previous studies that found girls to have a more inactive lifestyles.[1]

Our results suggest that, in addition to the positive association found between the lifestyle and BFP in all age groups, a healthy lifestyle within the earlier adolescence stage is associated with an even more accentuated improvement of fatness during the following years. Our findings are not in line with Landsberg et al, who found the high media time and high-risk behavior cluster to have the lowest BFP, whereas the high activity and medium-risk behavior cluster showed the highest BFP.[6] Furthermore, they found an increase over time in the BFP for the healthy lifestyle cluster (ie, high activity and medium-risk behavior), whereas adolescents within the high media time and high-risk behavior cluster decreased their BFP over time.

The present study is subject to some limitations. First, although this study found sex differences across clusters, the present study did not evaluate boys and girls separately. In a preliminary analysis carried out with the total sample of children and adolescents, boys and girls displayed similar patterns of lifestyle behaviors. Second, given the data-driven nature of cluster analysis, the cluster solution found in this

Table II. Lifestyle clustering and associations with sex, parental education, and BFP†

	Older children				Younger adolescents				Older adolescents			
	Healthy lifestyle (n = 103)	Sedentary/ Healthy diet (n = 121)	High screen (n = 86)	Low moderate-to-vigorous physical activity/unhealthy diet (n = 87)	Healthy lifestyle (n = 134)	Highly sedentary (n = 43)	High screen /Unhealthy diet (n = 128)	Low Screen and moderate-to-vigorous physical activity (n = 200)	Healthy lifestyle (n = 91)	Sedentary/ Healthy diet (n = 103)	High screen (n = 81)	Low moderate-to-vigorous physical activity/Unhealthy diet (n = 86)
Profiles indicators												
Screen time	–0.41[a]	–0.27[b]	1.34[b]	–0.61[c]	–0.31[ac]	0.01[a]	1.01[b]	–0.50[c]	–0.53[a]	–0.38[ab]	1.30[c]	–0.29[a]
Sedentary time	–0.82[a]	0.35[b]	0.21[b]	0.37[b]	–0.69[a]	1.98[b]	0.01[c]	–0.08[c]	–0.62[a]	0.40[b]	–0.19[c]	–0.07[c]
Moderate-to-vigorous physical activity	1.01[a]	–0.45[b]	–0.15[bc]	–0.70[d]	1.07[a]	–0.14[b]	–0.15[b]	–0.64[c]	0.82[a]	–0.73[b]	0.30[c]	–0.44[d]
KIDMED	0.12[a]	0.90[b]	–0.41[c]	–0.71[d]	0.26[a]	0.26[a]	–0.84[b]	0.30[a]	0.46[a]	0.63[a]	–0.18[b]	–1.11[c]
Sex			$\chi^2 = 71.88$‡				$\chi^2 = 37.85$‡				$\chi^2 = 37.99$‡	
% Boys	38.70%	22.60%	16.60%	22.10%	41,60%	7,30%	24,80%	26,30%	35,00%	18,60%	28,80%	17,50%
% Girls	13.10%	38.40%	26.80%	21.70%	10,30%	9,90%	25,90%	53,90%	15,80%	38,00%	16,30%	29,90%
Father education			$\chi^2 = 3.20$				$\chi^2 = 7.63$				$\chi^2 = 1.98$	
% low	27,50%	30,10%	18,70%	23,80%	20,10%	8,80%	28,90%	42,30%	23,10%	26,90%	23,80%	26,20%
% High	26,00%	31,10%	24,90%	18,10%	29,90%	9,30%	20,60%	40,20%	25,10%	32,30%	19,00%	23,60%
Mother education			$\chi^2 = 4.96$				$\chi^2 = 12.94$‡				$\chi^2 = 1.86$	
% Low	27,90%	25,10%	21,80%	25,10%	22,70%	9,90%	33,10%	34,30%	20,90%	29,50%	25,60%	24,00%
% High	24,30%	34,60%	22,00%	19,20%	28,20%	7,80%	19,80%	44,20%	25,20%	30,70%	19,80%	24,30%
BFP												
T0	19.70[a]	25.52[b]	24.49[b]	24.80[b]	19.36[a]	21.74[ab]	22.66[b]	24.49[b]	19.85[a]	24.49[b]	20.73[a]	23.45[ab]
T1	20.73[a]	26.85[b]	24.79[b]	25.56[b]	16.82[a]	20.53[ab]	21.81[b]	23.89[b]	19.15[a]	22.75[a]	19.68[a]	22.38[a]
T1 (adjusted)*	24.08[a]	25.09[a]	23.95[a]	24.93[a]	19.20[a]	21.66[ab]	21.68[b]	22.11[b]	21.22[a]	20.99[a]	21.03[a]	21.37[a]
Δ (T1-T0)*	1.02[a]	2.03[a]	0.89[a]	1.88[a]	–3.53[a]	–1.07[ab]	–1.05[b]	–0.61[b]	–0.69[a]	–0.92[a]	–0.89[a]	–0.54[a]

T0, baseline; *T1*, 2-year follow-up.
*Model additionally adjusted for baseline BFP. A cluster mean is significantly different ($P < .05$) from another mean if they have another superscript letter.
†$P < .05$.
‡$P < .01$.

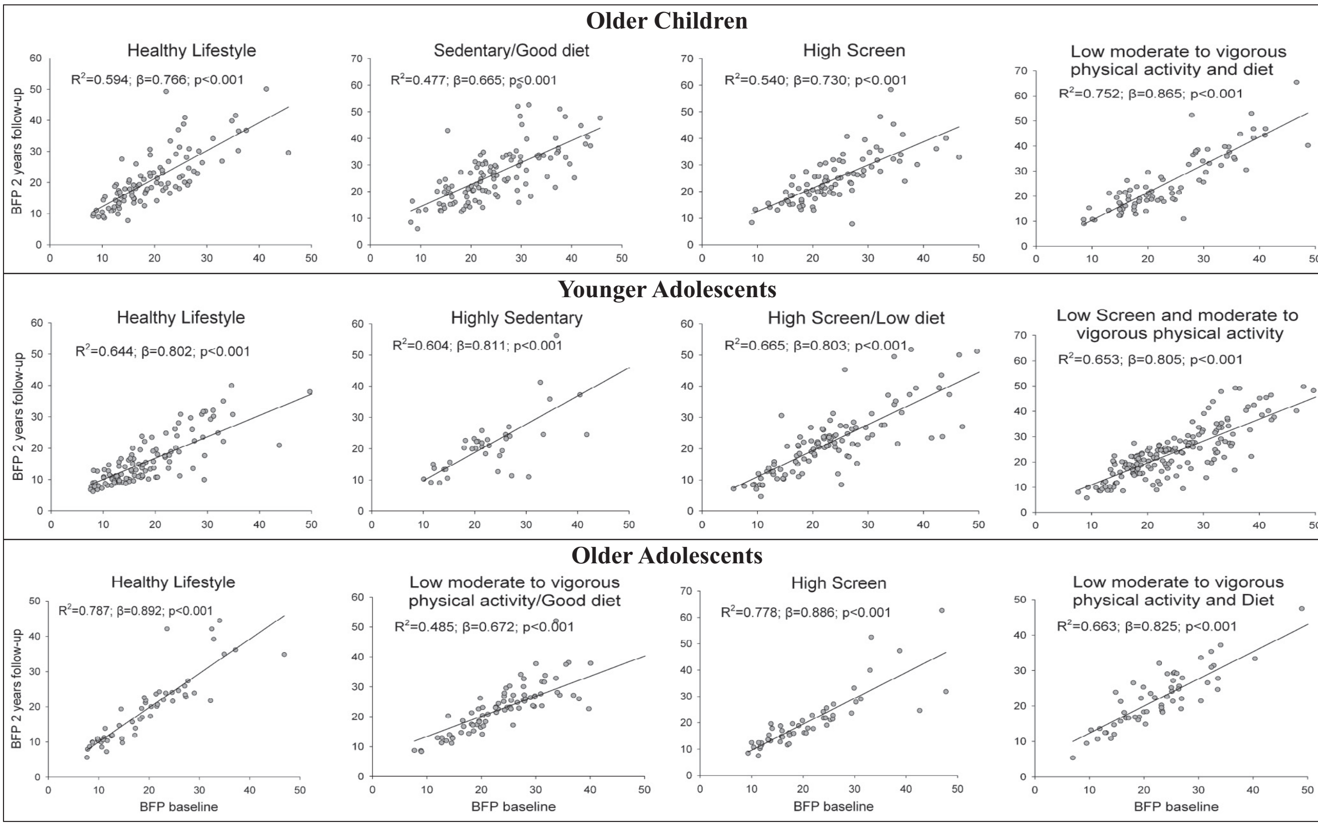

Figure 2. Association between baseline and follow-up BFP in lifestyle clusters by age group.

study is not necessarily generalizable to other populations and it implies the need for caution when generalizing the findings. Future studies could explore lifestyle profiles in larger samples from other countries/cultures. Third, we assumed that all participants continued the same lifestyle over time, as the cluster analysis was only created at baseline. Future studies should evaluate the stability of this cluster over time, and testing how changes in a cluster membership could be associated with changes in dependent variables (eg, fatness, fitness). Furthermore, BFP was evaluated by using skinfolds. This measurement method has substantial variability. Last, we included moderate-to-vigorous physical activity as the measure of physical activity levels. Future studies should analyze separately the different forms of physical activity (ie, moderate and vigorous physical activity).

We demonstrated the importance of lifestyle behaviors on the adiposity, given the lower BFP found in the participants with a healthy lifestyle. However, more research is necessary to clarify these associations. Results could be different depending on the lifestyle indicators including on the cluster analysis, as well as the measure of fatness (eg, BMI, BFP, fat mass, waist circumference, etc.). ■

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Appendix

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