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ORIGINAL ARTICLE

The Spanish version of the Home Environment Survey (HES) among families of children with overweight/obesity: a validation study

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Abstract

Purpose The aim of this article was to validate the Spanish version of the Home Environment Survey (HES-S) and was divided in two studies: (1) to assess the reliability, convergent validity of HES-S in a survey of 145 parents of children with overweight/obesity; (2) to study the magnitude of the association between children's BMI status with the latent scores theoretically defined by the HES model.

Methods To test the scale and the model, a confirmatory factor analysis (CFA) and a path analysis were carried out among a sample of 156 parents of preadolescents (106 overweight/obesity and 50 normal-weight children). No CFA or EFA were carried out in the validation of the original instrument.

Results Study 1, both the Physical Activity and the Eating Habits components of the scale showed adequate levels of internal consistency for the majority of the scales, except for two. One of them, Healthy Eating Parental Policies (HEP) subscale was reduced after excluded two items, although it did not improve substantially. This model indicated that there was a significant association between the two Eating Habits scales and the child's weight status, but child's weight was not associated with the Physical Activity components. Convergent validity was confirmed by correlations with related variables: family eating habits (F-EAT), parent's physical activity (IPAQ), and children's physical activity (assessed via accelerometers during one week). Study 2, our results replicated the original four factor structure proposed for physical activity (CFI = 0.99; RMSEA = 0.03), but the original factor structure of the eating habits component was not supported. In addition, the relationship of the child's weight status, the Physical Activity components, and the two scales of Eating Habits (Parental Modeling and Policies) was explored with a path analysis showing good fit indices (CFI = 0.95; RMSEA = 0.06). Child's BMI was negatively associated with Healthy Eating Parental Role Modeling ($r = -0.21$) and with Healthy Eating Parental Policies ($r = -0.19$), but not with the factors of Child's Physical Activity model.

Conclusion To our knowledge, this is the first instrument to assess obesogenic family environment in Spanish speaking countries, which is a relevant dimension within a health perspective so as to implement new policies and strategies in obesity tertiary prevention. Overall, the confirmatory factor analysis of the HES-S has only provided additional support for one part related to Physical Activity. In addition, Child's BMI was correlated with scales of Eating Habits but not with Child's Physical Activity factor. These results clearly suggest that further research is warranted.

Level III Case-control analytic study.

Keywords Pediatric obesity · Families · Obesogenic environment · Physical activity · Eating habits · Confirmatory factor analysis

Introduction

The increasing prevalence rates of obesity among children and adolescents in developed countries has converted this problem into an important public health concern, leading to an increasing number of studies dedicated to this topic. Currently, 32.4% of children and adolescents between the

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ages of 6 and 19 in developed countries are overweight, and 16.5% have obesity [1]. Spain in particular has one of the highest prevalence of childhood obesity amongst European countries, with around 28% of children between 3 and 12 years presenting overweight or obesity [2].

There is growing evidence suggesting that an environmental component is involved in the development of 95% of all cases of obesity [2–5]. The last 2 decades have witnessed dramatic changes to the physical and social environment of these children and adolescents, which have arguably facilitated an increase in sedentary behaviors and a decrease in physical activity [2, 6]. An ongoing longitudinal study of > 10,000 boys and girls, aged 9–14 years, from all over the United States, showed that children who spent more time viewing television and videos and playing video/computer games during a year had greater increases in body mass index (BMI) [7]. Similar results were found in another longitudinal study in which an increase in BMI trajectory was associated with the following behaviors: drinking > 3 glasses of sugared drinks per day, < 1 h per week of participation in organized sports, and > 2 h per day of TV viewing [8].

From a social environmental framework, the home food environment is an important factor to include in multifactorial models, and its proper assessment, which would allow us to elucidate the underlying causes of childhood obesity [9, 10]. Furthermore, parental feeding styles and healthy habits serve as role models for their children's dietary, physical activity, and media behaviors and influence may influence their weight status. Evidence suggests that homes of children with obesity were less likely to have available and accessible healthy food, and parents were the key influence in the types of foods kept and consumed in the home [11].

In an effort to assess various dimensions of the home environment, as it relates to healthy habits, researchers have developed a number of instruments over the last few decades. These instruments cover a range of constructs, present adequate psychometric properties, and their use is appropriate in varying contexts. Pinard et al., (2012) [3] systematically reviewed the tools developed to measure the home environment from 1990 to 2010, revealing that several of these new tools did not report any psychometric properties. The review presented 40 instruments reporting on both their degree of validity and the reliability of their assessment. Only seven instruments combined both the food and physical activity dimensions. However, only two comprehensive instruments assessed both social and physical components of the environment that influence childhood obesity [12, 13]. The Healthy Home Survey (HHS) [12] for parents of young children (3–8 years old) includes 66 items aimed at measuring food availability, eating practices, media and the physical environment. The criterion validity was assessed among 85 mothers via telephone interview and a home visit showing a wide range of values for the validity (Kappa = 0.07–0.96), and also the test–retest reliability ($n = 45$; ICC = 0.22–1.00) of the instrument, thus, limiting its utility. The Home Environment Survey (HES) [12] for parents of children with overweight (8–13 years), provided information regarding inter-rater reliability, internal consistency, and concurrent validity (assessed via accelerometers), which the study of the HHS did not assess. For this reason, we chose to examine the construct validity and reliability of the HES for its use among families of children with overweight/obesity in Spain, as no instruments have been developed or translated into Spanish.

The development of the HES was based on a theoretical framework [10], which identified two dimensions relating to the child's weight status: (a) the family environment as it relates to the availability of, and accessibility to, a variety of food, and b) the family environment as it relates to the child's physical activity, by contributing to either a healthy or unhealthy home environment. The authors developed 126 items and 10 scales divided into nutrition scales (Fruit/Vegetable Availability, Fruit/Vegetable Accessibility, Fat/Sweets Availability, Fat/Sweets Accessibility, Healthy Eating Parental Role Modeling, Healthy Eating Parental Policies) and physical activity scales (Physical Activity Availability, Physical Activity Accessibility, Physical Activity Parental Role Modeling, Physical Activity Parental Policies). The instrument was validated among 219 parents of overweight/obese children (87% obese) and the final scale comprised 106 items. The reliability for the Eating Habits scales was 0.84–0.59 and for the Physical Activity scales, 0.79–0.66. Furthermore, 41 parent dyads living in the same home ($n = 41$) completed the survey to determine inter-rater reliability, with the majority of the scales presenting high scores ($r = 0.50$ to $r = 0.88$), with the exception of Parental Policies for healthy eating ($r = 0.24$), Physical Activity modeling ($r = 0.30$) and Physical Activity parental policies ($r = 0.24$). Results showed that accessibility to physical exercise, parental role modeling and parental policies were significantly related to child ($r = 0.14$–0.21) and parent ($r = 0.15$–0.31) physical activity. Similarly, there was a low to slight moderate association between availability of Fruits and Vegetable and Fat/Sweet intake, parental modeling and policies, and child and parent eating habits [13]. However, the structural validity has not been empirically tested.

The present article aims to validate the Spanish version of the Home Environment Survey (HES-S; Gattshall et al. 2008) [13] through the following two studies: Study 1: The aim was to examine the relationship between the original authors' proposed scale scores with different external measures; in this manner evaluating the association between the HES-S and parent's physical activity, eating habits and the children's accelerometer data (convergent validity) as well as the scale's reliability. Study 2: The aim was to associate latent scores (the latent factor of the HES scales) with the

children's BMI status. To do this, CFAs were calculated to obtain these latent scores followed by a path analysis using a Structural Equation Modeling framework (SEM) so as to correlate these scores with the child's BMI status.

Study 1

Methods

Participants

The guidelines of the original manuscript [13] were followed for the selection of the participants. The inclusion criteria were: child's BMI at or above the 85th percentile ranking for age and gender, age between 8 and 12 years, ability to understand spoken and written Spanish and that their parents were the primary caregivers. In the current study, a sample of 145 parents of children ranging from 8 to 12 years old ($M = 10.04$, SD = 1.23, 51% females) completed the Spanish version of the Home Environment Survey Questionnaire (HES-S). Therefore, children were at or above the 85th percentile for body mass index (35.9% with overweight and 64.1% with obesity) ranking for age and gender [14]. Table 1 shows the sample demographics.

Table 1 Demographic and clinical characteristics of the parents and their child ($n = 145$)

	Number (%)	Range	Mean (SD)
Child age		8–12	10.04 (1.23)
Child gender			
Male	71 (49)		
Female	74 (51)		
Child body mass index (BMI)			
Overweight	52 (35.9)		
Obesity[1]	93 (64.1)		
Ethnicity			
Caucasian	101 (69.7)		
Latino	40 (27.6)		
Other (Arab, Asian)	4 (2.8)		
Parent age		25–61	41.40 (6.22)
Parent gender			
Male	20 (13.8)		
Female	125 (86.2)		
Mother's body mass index (BMI)		18.4–45.8	26.97 (49.08)
≤24.9	40 (27.6)		
25–29.9	44 (30.3)		
30–34.4	17 (11.7)		
≥35	6 (4.1)		
Father,s body mass index (BMI)		21.1–37.3	28.85 (36.19)
≤24.9	12 (8.3)		
25–29.9	44 (30.3)		
30–34.4	32 (22.1)		
≥35	6 (4.1)		

[1]A subsample of 50 children with obesity were collected via their Primary Health Care Center and wore an accelerometer

Procedure

The translation and cultural validation of the HES scale was carried out using a back translation procedure following international guidelines [15]. First, the original English version was translated into Spanish by two independent expert translators with knowledge of psychology and psychopathology. Second, this version was translated back into English by another bilingual translator. Third, a focus group was formed by the translators who had participated in the back translation procedure, and a discussion among them was carried out to consolidate the forward and back-translated versions of the HES. In the case of discrepancies between the items, the contents were analyzed to determine the appropriate course of action. Finally, the definitive version of the HES-S was generated and used for the further objectives of this study.

This study was part of the larger "ANOBAS" project that aims to identify bio-psycho-family markers for anorexia nervosa and childhood obesity. The design of the study was cross-sectional. A total of 50 children with obesity were recruited from the "Daroca" Public Primary Care Center in Madrid through response flyers provided by their child's pediatrician at routine check-ups. The remaining families were recruited from primary public and subsidized schools in Madrid through direct response flyers. The research was reviewed and approved by the relevant Institutional Review Boards (Niño Jesus Hospital Central Committee of Research (Ref. 0009/10), Primary Care Commission (Ref. 11/12); Autonomous University Committee (UAM, CEI 27-673). Participation was voluntary and informed assent and consent was obtained by each participating family. The recruitment period took place from May 2012 to May 2016.

Measures used to assess validity

Actigraph, model GT3X. The Actigraph (Actigraph TM, LLC, Fort Walton Beach, FL, EE.UU) is a small and lightweight triaxial activity monitor/accelerometer ($4.6 \times 3.3 \times 1.5$ cm, 19 g) designed to detect accelerations ranging in magnitude from −6 a 6 g with a frequency response of 0.25–2.50 Hz. Accelerometers were programmed before handing them over to the participants and the data were recorded at a frequency of 30 Hz and reinstated to a period of 10 s (epoch) for analysis. The accelerometers were attached to an elastic band and rested on the

child's back. They were worn during 7 consecutive days and were only removed for water activities and sleeping. To be included in the analysis, the children had to wear the accelerometer for at least 3 days with a minimum daily record of 10 h per day [16]. The data were downloaded and analyzed with an Actilife software (v.6.62. Actigraph TM, Pensacola, FL, USA). Only total activity (expressed as total counts per minute) was used. Only the children (n = 50) recruited from the Daroca Health Center wore the accelerometers.

Families and Eating and Activity Among Teens (F-EAT) [17]. This scale was originally designed to examine factors that are potentially relevant to adolescent weight-related behaviors within the family environment as part of an extensive North-American epidemiological project. The authors provided us with the two most widely used subscales that are related to food parenting practices and modeling: (a) The Parental model subscale, composed of 6 items assessing the mother's frequency of breakfast, fast food, fruit, vegetable, and dairy consumption [16] with response options including 0–2 days a week, 3–6 days a week, and every day; (b) The Family meal subscale, which assesses how frequently families eat a meal together, purchase a meal from a fast food restaurant, type of foods served and the style of meal service, during a week.

Short-form International Physical Activity Questionnaire (IPAQ; www.ipaq.ki.se**).** Participants reported the frequency and duration of physical activity at work, for transportation, during leisure time, and at home, and these activities were grouped into the following categories: (a) vigorous activities (e.g., fast bicycling), (b) moderate activities (e.g., bicycling at a regular pace), and (c) walking, during the last seven days. The questionnaire was validated in Spanish [18] and presented good reliability coefficients.

Statistical analysis

First, internal consistency was analyzed calculating Cronbach's alpha, with the exception of two scales: "Physical Activity Availability" which is a checklist of items and the "Fruit/Vegetable Accessibility" scale, which is comprised of only one item. In addition, the corrected item-total correlation was reported for each item. Feldt's test W was used to test reliability coefficients between both scales. Correlations between the HES-S subscales and the other methods of assessment (F-EAT, IPAQ, and accelerometer data) were computed to assess the validity of the HES-S. These analyses were computed using the Statistical Package for the Social Sciences (SPSS) software 20.0. Correlation *p* values were adjusted for multiple tests using an FDR correction, including the HEP Policies reduced (two omitted items). This correction is more appropriate in health studies than other multiple corrections, such as Bonferroni [19]. Corrected *p* values were computed using R software.

Table 2 Cronbach's alpha of the Spanish version of HES (HES-S) and original scale (HES; Gattshall et al. 2008) for each subscale

	Number of Items HES/HES-S	Alpha HES $n = 219$	Alpha HES-S $n = 145$	Feldt's test W (p)
1. PA availability	22/22	–	–	
2. PA accessibility	4/4	0.66	0.49	0.667 ***
3. PA parental role modeling	6/6	0.68	0.69	1.032 (0.578)
4. PA parental policies	5/5	0.79	0.79	1.000 (0.495)
5. F/V availability	27/29	0.84	0.80	0.800 (0.068)
6. F/V accessibility	1/1	–	–	
7. F/S availability	14/17	0.80	0.77	0.870 (0.175)
8. F/S accessibility	4/4	0.59	0.61	1.051 (0.625)
9. HEP role modeling	12/12	0.73	0.75	1.080 (0.689)
10. HEP Policies	10/10	0.79	0.59	.512 ***

PA Physical Activity, *F/V* Fruit/Vegetable, *F/S* Fat/Sweets, *HEP* Healthy Eating Parental

*$p < 0.05$

**$p < 0.01$

***$p < 0.001$

Results

Internal consistency

Table 2 displays the Cronbach's alphas for each subscale.

Regarding the Physical Activity (PA) subscales, the Parental Policies and Parental Role Modeling of Physical Activity presented similar reliability values as the original scales (see Table 2). Overall, the corrected item-total correlations were not high (range 0.19–0.36). Furthermore, "PA Accessibility" obtained low reliability compared with the original, although neither of them reached an index above 0.70. The item "*How many of your child's active toys are stored out of sight*" obtained the lowest value, and the reliability of the scale would be of 0.52 if this item was deleted. However, we decided to keep it as the scale only presented four items.

Similar values were found for the Eating Habits scales ("Fruit/Vegetable Availability", "Fruit/Vegetable Accessibility", "Fat/Sweets Availability", "Fat/Sweet Accessibility") of the Spanish adaptation in comparison to the original scale. Finally, the internal consistency of the Parental Role Modeling of Healthy Eating subscale was similar to the original scale with acceptable item-total correlations. However, the Parental Policies around eating scale showed a reliability of 0.59, which was lower than that found in the original sample (0.79). The main reason is that low correlations close to 0 were found for these two items of this scale: "*Use food as a reward*" and "*Can child eat snacks without permission*." If both of these items are deleted, the final alpha of the scale is 0.67 (Feldt's test $W = 0.636$; $p < 0.001$). We, therefore, deleted these two items from the HEP Policies scale.

Convergent validity

Table 3 reports the Pearson correlations that were computed between the different scales of the HES-S and measures employed for validation: total physical activity (IPAQ), food parenting practices and modeling (F-EAT) reported by the mothers, and the child's total physical activity, calculated by the accelerometer. After using an FDR correction, most of the inter-scale correlations of the HES-S were below 0.30, except for Parental Role Modeling and Parental Policies related to Physical Activity, which were moderate ($r = 0.46$, $p < 0.01$); and Fat/Sweet availability and HE Parental Role Modeling, which were also moderate ($r = 0.41$, $p < 0.01$). Regarding convergent validity, correlations with HES-S scales were few and low except for the HEP Parental Policies scale (reduced), whose correlation improved slightly in both parenting eating practices and modeling scales (F-EAT), and with mother and child's physical activity. As we expected, PA Role Modeling was correlated with higher child's physical activity ($r = 0.32$, $p < 0.01$), and the PA Policies with

Table 3 Correlations between scales of HES-S and validation measures reported by the mother ($n = 145$)

	1	2	3	4	5	6	7	8	9	10	10.2	11	12	13	14
1. PA availability		.16	.23**	.27**	.19*	.10	.17*	−0.02	0.04	0.12	0.06	.15	.05	.08	−.05
2. PA accessibility			.12	.26**	.03	.26**	−.13	.08	.07	.11	.04	.16	−.13	.05	−.06
3. PA parental role modeling				.46**	.24**	.05	−.10	−.21*	.31**	.29**	.27**	.23**	.32**	.13	.19*
4. PA parental policies					.31**	.19*	−.10	.03	.27**	.33**	.30**	.27**	.22*	.16	.09
5. F/V availability						.01	.18*	−.05	.16	.26**	.30**	.05	.12	.17	.24**
6. F/V accessibility							−.06	.22**	.02	.05	.05	.11	-.05	.05	.04
7. F/S availability								.20*	−.41**	−.09	−.08	−.01	-.16	.11	−.04
8. F/S accessibility									−.12	−.06	−.06	.09	.02	.02	−.09
9. HEP role modeling										.03	.02	−.15	.20*	.03	.14
10. HEP policies											.95**	.16	.19	.25**	.19*
10.2 HEP polices reduced												−.17*	.22*	.20*	.26**
11. IPAQ mother													-.03	.11	.09
12. Accelerometer child														-.01	−.03
13. F-EAT-family model															.16
14. F-EAT-family meals															

Correlation survived to FDR correction (q = .05) are underlined

Total physical activity by accelerometer-calculated only for 50 children

PA Physical Activity, *F/V* Fruit/Vegetable, *F/S* Fat/Sweets, *HEP* Healthy Eating Parental, *HEP Polices reduced* HEP without 2 items, *IPAQ* International Physical Activity Questionnaire, *F-EAT* Families and Eating and Activity Among Teens, 2 subscales

*$p < .05$

**$p < .01$

both measures of the mother and child's physical activity ($r = 0.27$, $p < 0.01$; $r = 0.22$, $p < 0.05$),

Study 2

The aim of the second study was to correlate children's BMI status with the latent scores theoretically defined by the HES model. Therefore, we computed several CFAs for each part of the HES model (Child's Eating Habits and Child's Physical Activity). The Physical Environment factors include the accessibility and availability to food or physical activity, while Social Environment factors are operationalized as Parental Role Modeling and Parental Policies around physical activity and nutrition. Afterwards, these scores were related with the children's BMI using a path analysis.

Method

Participants

Only Spanish families were selected to participate in this study, to avoid differences in dietary habits and food choices. A sample of 156 parents and their children ($M_{age} = 10.08$, $SD_{age} = 1.29$, 55.1% females) took part in the study. Of these, 101 families participated in Study 1 and the other 50 participants were parents with non-overweight children who were invited from schools and who also wore an accelerometer. BMI was calculated for each child ($M = 22.2$, $SD = 4.4$). BMI range was 19–30.4. A total of 50 children were categorized as normal weight (32.1%; $M_{BMI} = 17.3$, $SD_{BMI} = 2.9$), 38 as children with overweight (24.4%; $M_{BMI} = 22.0$, $SD_{BMI} = 1.5$), and 68 as children with obesity (43.6%; $M_{BMI} = 25.9$, $SD_{BMI} = 2.3$).

Statistical analysis

Two different types of analyses were carried out. First, one-way ANOVAs were computed for each subscale of the HES-S (DV: score on the variable, IV: weight group). Then, post hoc comparisons were carried out with Bonferonni corrections. The second level of analysis was confirmatory factor analyses (CFA) of theoretical factors: Child's Eating Habits and Child's Physical Activity and a model where BMI was related with the HES scales was also computed. MLM was used through the Mplus software as an estimation method, since multivariate normality was not assumed. Model fit was assessed using the ${}_{SB}\chi^2$ statistical test, the root mean square error of approximation, and the comparative fit index. Values close to 0.95 for CFI and below 0.06 for RMSEA indicate a good fit.

Results

Differences in HES-S scores for each weight group

One-way ANOVAs showed that there were statistically significant differences between normal-weight group and obesity group on two subscales (see Fig. 1): Healthy Eating Parental Role Modeling and Healthy Eating Parental Policies, and marginally significant differences on one scale: Physical Activity Availability.

More specifically, children with a healthy weight had access to an average of 9 active toys or sports equipment while parents of the children with obesity or overweight reported an average of 8 objects. These discrepancies were marginally significant ($F_{2,151} = 2.57$, $p = 0.080$; $\eta^2_p = 0.033$). In terms of Healthy Eating Parental Role Modeling, the mean scores were 2.8 for children with a normal weight, 2.5 for children with overweight and 2.6 for children with obesity ($F_{2,153} = 4.12$, $p = 0.018$; $\eta^2_p = 0.051$). Post hoc comparisons showed that differences between normal-weight and overweight children were significant ($p = 0.024$) and this discrepancy was marginally significant between normal-weight and obesity children ($p = 0.082$).

Finally, Fig. 1 shows the mean scores for Healthy Eating Parental Policies were of 2.7 for normal-weight, 2.5 for overweight children and 2.4 for children with obesity ($F_{2,153} = 3.97$, $p = 0.021$; $\eta^2_p = 0.049$). Post hoc comparison showed that the difference between obesity and normal-weight children was statistically significant ($p = 0.017$), however, this difference was not significant between those with overweight and normal-weight children ($p = 0.64$). However, when the reduced version of the Healthy Eating Parental Policies (8 items) was employed, the ANOVA outcomes were not statistically significant ($F_{2,153} = 1.04$, $p = 0.356$; $\eta^2_p = 0.013$). Therefore, the items "*Use food as a reward*" and "*Can child eat snacks without permission*" played an important role in the differences between groups. After omitting these items, the scale reliability of the final version, as well as their comprehension, was improved.

Confirmatory factor models

The second step of analysis was to calculate the proposed latent factor scores of the two home environment factors of the HES-S: Child's Eating Habits and Child's Physical Activity (using HEP Policies reduced). Figure 2 depicts the results for each model.

The top panel (Fig. 2a) shows the results for Child's Physical Activity factor. The fit of the model was excellent: ${}_{SB}\chi^{2(1)} = 1.14$, $p = 0.285$, RMSEA = 0.030, CFI = 0.997. Social Environment and Physical Environment factors were well defined with weights higher than 0.40. Correlation

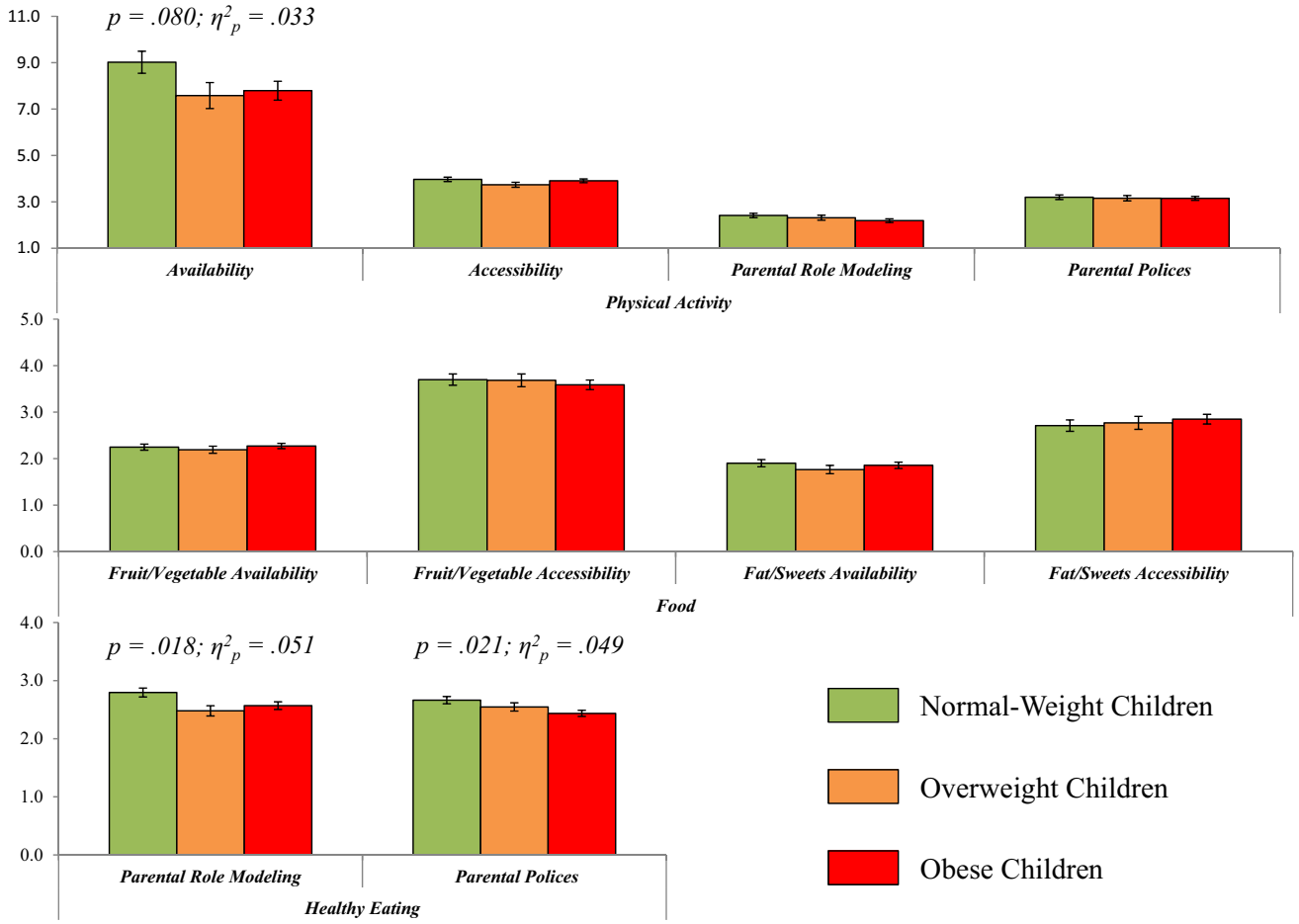

Fig. 1 Differences in the distribution of means and standard deviations of the 10-subscales of the HES-S (responded by the mothers) between normal, overweight and obese children

between factors was statistically significant ($r=0.68$). The middle panel (Fig. 2b) shows the theoretical model for Child's Eating Habits. Our data did not support this theoretical model. Therefore, a relationship mode between Child's Eating Habits factor, Child's Physical Activity and Body Mass Index was not estimated, since Child's Eating Habits was not supported.

Nevertheless, following the results obtained in the step 1, using a path analysis, a relationship model was tested that included Child's Physical Activity factors (Physical and Social Environment) and two subscales of the HES-S (Healthy Eating Parental Role Modeling and Healthy Eating Parental Policies) and their relationship with child's BMI status. The two Healthy Eating Parental scales were selected since statistically significant differences between weights groups were found, while other variables were not sensitive to weight groups. Results of this relationship model are shown in bottom panel of Fig. 2 (Fig. 2c). Outcomes were good for Satorra–Bentler χ^2 statistical test CFI index ($_{SB}\chi^{2(7)}=11.789$, $p=0.108$ and CFI = 0.956) and acceptable for RMSEA (RMSEA = 0.066). BMI was negatively associated with Healthy Eating Parental Role Modeling ($r=-0.21$) and with Healthy Eating Parental Policies ($r=-0.19$), but not with the factors of Child's Physical Activity model. Note, that two variables of the HES-S were not correlates ($r=0.03$), while both these variables were highly related with Social Environment of Child's Physical Activity model ($r>0.40$). However, only Healthy Eating Parental Role Modeling was related with Physical Environment ($r=0.34$).

Discussion

To our knowledge, this study was the first to validate the psychometric properties of an instrument, which measures both physical and social factors within the home environment of children with overweight/obesity. The systematic and updated review of the available instruments that assess the home environment presented adequate evidence regarding their reliability and validity [3]. Although many of these questionnaires promised good internal reliability and

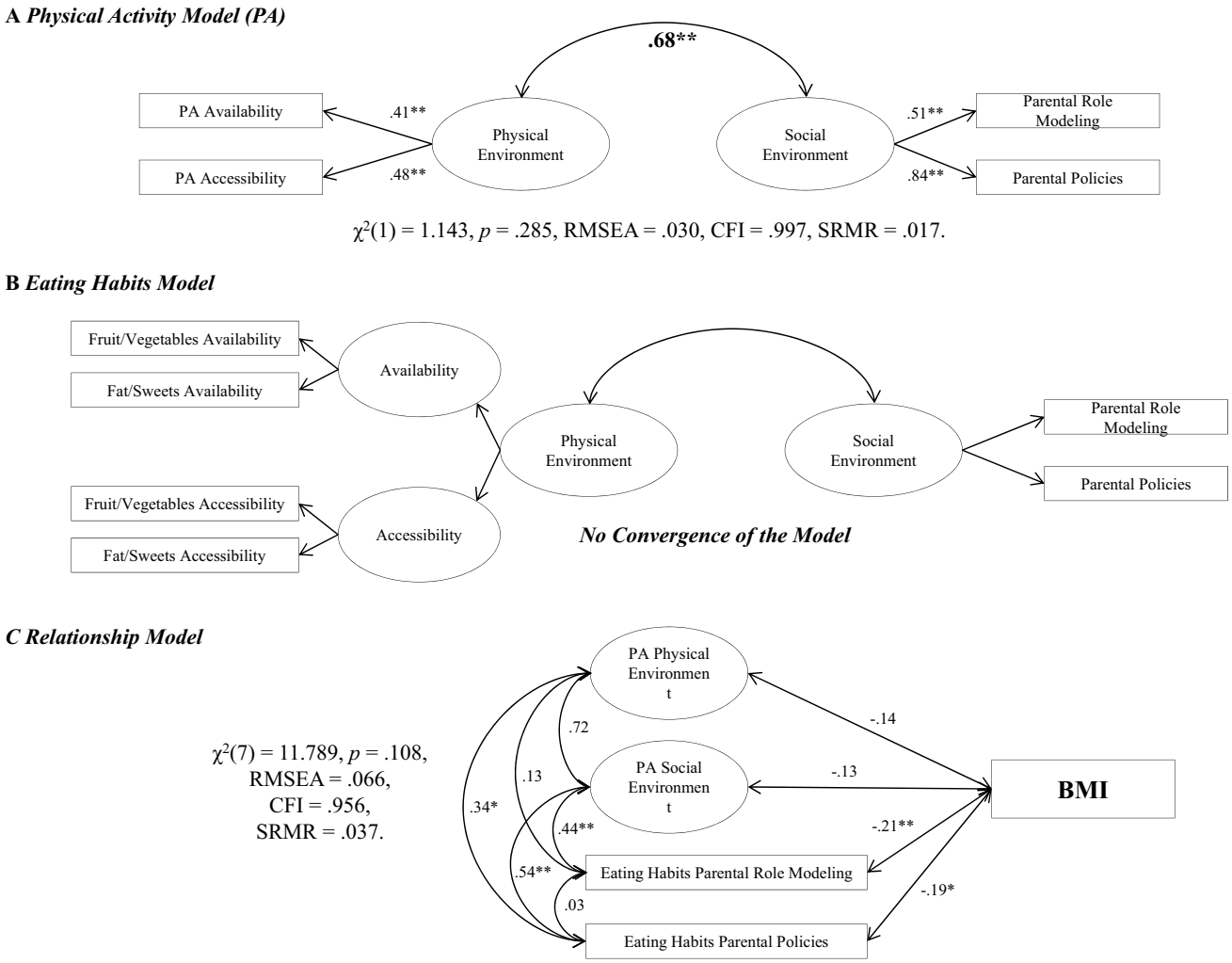

Fig. 2 The empirical fit of three theoretical models tested: **A** and **B** Child's Eating Habits and Child's Physical Activity models; and **C** The relationship of the global model of the HES and the children' BMI status

test–retest reliability, their criterion or structural validity had not been previously assessed as HES questionnaire. Furthermore, these questionnaires have not been used in additional studies or translated into other languages. Likewise, we were not able to compare our convergent validity results for the HES-S with almost any of the above-mentioned studies, as the validity of the instruments for these studies is unknown. An exception can be found for the criterion validity of the HHS tool [12], where the authors also found that the lowest reliability was for the assessment of food availability in the home.

In general, most scales on the HES-S obtained adequate and similar reliability scores compared to the original scale, except the Healthy Eating Parental Policies, Physical Activity Accessibility. The items "*How often do you use food as a reward*" and "*How often can your child eat snacks or sweets without your permission*" were omitted from analyses and therefore from the questionnaire. The reason for this was that both items obtained almost null answers (90% of the sample scored zero for these items). Possibly reasons for this unexpected result may be that literal translations from English into Spanish do not always correctly match how Spanish families conceptualize their familial relations regarding food and intake behaviors. Furthermore, concepts of permission and accessibility, as in the case of the second above-mentioned item, may also be ambiguous and/or confusing for parents as children may indeed be *attempting* to eat sweets/snacks although their parents may not permit this behavior. Once we omitted these items the reliability improved substantially to 0.67. Regarding Physical Activity accessibility, the item "*How many of your child's active toys are stored out of sight*" did not work adequately as it may not be clear what *active* means. However, this item was retained as the scale only presents four items and its omission did not alter the scale's reliability.

Regarding convergent validity, low to moderate associations between scales of HES-S was observed, and low and few correlations were found with parenting eating practices and modeling scales (F-EAT) and with mother and child's physical activity. The F-EAT questionnaire used to measure the validity of feeding scales is less specific than the subscales of the HES-S. This may explain in part why the relationship between the two scales was not stronger. We expected mothers' frequency and duration of physical activity were higher associated with PA Parental modeling and PA Policies scales, due the parents motivate their children to engage in physical activity or exercise with them. However, parents' physical activity can be performed when children are not present. The family environment construct related to the child's physical activity is grouped in four scales that appear to be stronger as one dimension. In contrast, the family environment construct related to the availability of, and accessibility to, a variety of food, presented fewer and lower associations between their six suggesting a less strong dimension. Results improved when analyses were carried out using the HEP Policies reduced with slight increases reaching positive statistical significance for correlations between child's physical Activity, Mother's Physical Activity, and Meal Frequency.

The secondary purpose of the present study was to associate the Home Environment Survey (HES) factors [13] with children's BMI status among a sample of 156 Spanish families. For this, first we need to evaluate the factor structure of the HES. Results suggest that the HES-S yielded a factor structure and a pattern of relationships for the physical activity component; however, did not confirm the pattern of relationships with the eating component. However, the structure of the original HES has not been proven, and therefore, this confirmatory factor analysis of the HES-S has provided additional support for one part of the two dimensions that make up the original two-factor model.

Second, a relevant aspect of our study was to evaluate whether this instrument identified both eating habits and physical activity environmental components that are related to children's BMI status. The Physical and Social Environment of Child's Physical Activity model resulted in a strong factor related with child's weight status. Adult enjoyment of physical activity has been shown to be a consistent predictor of children's physical activity [18, 20] which is suggested by higher levels of physical activity obtained in the family models and supports the relation with the higher levels of their children's sport/activities. However, Child's Eating Habits was not supported. Neither dietary fruit and vegetable intake nor dietary fat/sweet intake had a direct effect on child's BMI. These results were similar to those found in other studies [12]. Gasthall et al. (2008) [13] proposed this conceptual model, but the internal consistency in their study for these scales was low and was not significantly correlated with the children's behavior. These authors hypothesized that perhaps children obtained fats or sweets outside the home (e.g. small shops close to school) and that fruits and vegetables were not as easy to obtain outside the home environment. They also suggested that there may have been problems with differing interpretations of the items relating to the availability and accessibility of these foods.

The current study is not without its limitations. For instance, it is important to evaluate the sensitivity of the HES-S instrument with preventive interventions. Studies are also needed to explore the test–retest reliability across time. Likewise, furthermore, the instrument is based on self-reported answers of the previous 30 days, which may introduce a social desirability bias from families on some items. To reduce this bias, a previous interview with the families can be performed to ensure that their possibly spontaneous or unplanned behaviors or attitudes are not judged so that experts can intervene more appropriately.

In summary, the original HES structure was not proven in our sample, and therefore, our confirmatory factor analysis of the HES-S has only provided additional support for one part of the two proposed dimensions. Until further research is carried out, this limits the use of the HES questionnaire outside of its original language. However, despite the overall disappointing and unexpected results, there are aspects of the tool can be retained. We are referring specifically to the dimension of 'Physical Activity', which presents four scales with an adequate reliability except for PA Accessibility. In line with further research that we are carrying out, our team is currently adding more items to this scale so as to improve its reliability.

In conclusion, we believe that our research and results provide the scientific community interested in this field of enquiry with a tool that may allow further research to learn from our experience. We are happy to provide the HES-S related to Physical Activity if requested.

From a preventive perspective, this instrument may be used the family environmental related to physical activity to assess the effectiveness of school-based interventions that strategies to promote children's physical activities and reduce sedentary behavior among children and adolescents [20–23]. For example, a recent randomized controlled trial aimed at reducing children's sedentary activities, such as TV viewing or computer use, and increasing the physical activity of both parents and children, using principles of positive reinforcement of physical activity and to restrict TV viewing using behavioral contracts were feasible as behavioral modification approaches in the program called "Switch-Play" [21]. "ENTREN-F" program [23] is ongoing RCT study to intervene in improving psycho-family environment and also family physical activity. It is recommended to

test the sensitivity of the HES-S scale to change, that is, its capacity to detect changes among children and adolescents after intervention.

What is already known on this subject

The new tools to measure the home environment do not report psychometric properties. Only the HHS and HES assesses both social and physical factors of the environment that influence childhood obesity.

What this study adds

Our translation to Spanish (HES-S) provides the scientific community with a partial tool. It has only provided support for one part related to the Physical Activity of the original two-factor model.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures were approved by the Ethics Committee of the Autonomous University of Madrid, Child Hospital Niño Jesus and Primary Care Commission.

Informed consent All participants gave their written informed consent.

References

1. Ogden CL, Carroll MD, Kit BK, Flegal KM (2012) Prevalence of obesity and trends in body mass index among US children and adolescents, 1999–2010. JAMA 307(5):483–490. https://doi.org/10.1001/jama.2012.40
2. Ferreira I, Van Der Horst K, Wendel-Vos W, Kremers S, Van Lenthe FJ, Brug J (2007) Environmental correlates of physical activity in youth—a review and update. Obes rev 8(2):129–154. https://doi.org/10.1111/j.1467-789X.2006.00264.x
3. Pinard CA, Yaroch AL, Hart MH, Serrano EL, McFerren MM, Estabrooks PA (2012) Measures of the home environment related to childhood obesity: a systematic review. Pub health nutr 15(1):97–109. https://doi.org/10.1017/S1368980011002059
4. Swinburn B, Egger G, Raza F (1999) Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. Prev Med 29:563–570. https://doi.org/10.1006/pmed.1999.0585
5. Swinburn BA, Caterson I, Seidell JC, James WPT (2004) Diet, nutrition and the prevention of excess weight gain and obesity. Pub Health Nutr 7(1A):123–146. https://doi.org/10.1079/PHN2003585
6. Owen N, Healy GN, Matthews CE, Dunstan DW (2010) Too much sitting: the population health science of sedentary behavior. Exerc Sport Sci 38:105–113. https://doi.org/10.1097/JES.0b013e3181e373a2
7. Berkey CS, Rockett HR, Field AE, Gillman MW, Frazier AL, Camargo CA, Colditz GA (2000) Activity, dietary intake, and weight changes in a longitudinal study of preadolescent and adolescent boys and girls. Pediatrics 105(4):e56. https://doi.org/10.1542/peds.105.4.e56
8. Koning M, Hoekstra T, de Jong E, Visscher TL, Seidell JC, Renders CM (2016) Identifying developmental trajectories of body mass index in childhood using latent class growth (mixture) modelling: associations with dietary, sedentary and physical activity behaviors: a longitudinal study. BMC 16(1):1128. https://doi.org/10.1186/s12889-016-3757-7
9. Davison KK, Birch LL (2001) Childhood overweight: a contextual model and recommendations for future research. Obes rev 2:159–171. https://doi.org/10.1046/j.1467-789x.2001.00036.x
10. Golan M, Weizman A (2008) Reliability and validity of the family eating and activity habits questionnaire. Eur J Clin Nutr 52:771–777. https://doi.org/10.1038/sj.ejcn.1600647
11. Hanson NI, Neumark-Sztainer D, Eisenberg ME, Story M, Wall M (2005) Associations between parental report of the home food environment and adolescent intakes of fruits, vegetables and dairy foods. Pub Health Nutr 8(1):77–85. https://doi.org/10.1079/PHN2004661
12. Bryant MJ, Ward DS, Hales D, Vaughn A, Tabak RG, Stevens J (2008) Reliability and validity of the healthy home survey: a tool to measure factors within homes hypothesized to relate to overweight in children. Int J of Behav Nutr and Phys Act 5:23. https://doi.org/10.1079/PHN2004661
13. Gattshall ML, Shoup JA, Marshall JA, Crane LA, Estabrooks PA (2008) Validation of a survey instrument to assess home environments for physical activity and healthy eating in overweight children. Int J of Behav Nutr and Phys Act 5:3. https://doi.org/10.1186/1479-5868-5-3
14. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH (2000) Establishing a standard definition for child overweight and obesity worldwide: international survey. British Medical J 320:1–6. https://doi.org/10.1136/bmj.320.7244.1240
15. Balluerka NG, Gorostiaga AA, Alonso-Arbiol I, Aranburu M (2007) La adaptación de instrumentos de medida de unas culturas a otras: una perspectiva práctica. Psicothema 19:124–133
16. Cain KL, Sallis JF, Conway TL, Van Dyck D, Calhoon L (2013) Using accelerometers in youth physical activity studies: a review of methods. J Phys Act Health 10(3):473–450. https://doi.org/10.1123/jpah.10.3.437
17. Boutelle KN, Fulkerson JA, Neumark-Sztainer D, Story M, French SA (2007) Fast food for family meals: relationships with parent and adolescent food intake, home food availability and weight

status. Public Health Nutr 10(1):16–23. https://doi.org/10.1017/S1368980007217794X
18. Roman-Viñas B, Serra-Majem L, Hagströmer M, Ribas-Barba L, Sjöström M, Segura-Cardona R (2010) International physical activity questionnaire: reliability and validity in a Spanish population. Europ J of Sport Sci 10(5):297–304. https://doi.org/10.1080/17461390903426667
19. Glickman ME, Rao SR, Schultz MR (2014) False discovery rate control is a recommended alternative to Bonferroni-type adjustments in health studies. J Clin Epidemiol 67(8):850–857. https://doi.org/10.1016/j.jclinepi.2014.03.012
20. Salmon J, Timperio A, Telford A (2005) Association of family environment with children's television viewing and with low level of physical activity. Obes Res 13:1939–1951. https://doi.org/10.1038/oby.2005.239
21. Salmon J, Ball K, Crawford D, Booth M, Telford A, Hume C (2005) Reducing sedentary behaviour and increasing physical activity among 10 year old children: overview and process evaluation of the "Switch-Play" intervention. Health Promot Int 20:7–17. https://doi.org/10.1093/heapro/dah502
22. Robinson T (1999) Reducing children's television viewing to prevent obesity. JAMA 282:1561–1566. https://doi.org/10.1001/jama.282.16.1561
23. Sepúlveda AR, Solano S, Blanco M, Lacruz T, Veiga O (2020) Feasibility, acceptability, and effectiveness of a multidisciplinary intervention in childhood obesity from primary care: nutrition, physical activity, emotional regulation, and family. Eur Eat Disord Rev 28:184–198. https://doi.org/10.1002/erv.2702

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