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Structural equation model of physical activity in Turkish schoolchildren: an application of the integrated behavioural model

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ABSTRACT

Objectives Childhood obesity is increasingly prevalent in the developing world including Turkey. This study examined constructs of the integrated behavioural model associated with physical activity in a sample of schoolchildren in Ankara, Turkey using structural equation modelling.

Design Cross-sectional survey by probability sampling.

Setting Fifteen schools of different socioeconomic strata in Ankara, Turkey with grade 4 students.

Participants 2066 (969 girls and 1097 boys) grade 4 schoolchildren and their parents selected using a probability-based sampling frame.

Primary outcome measures Three primary outcomes were used: moderate-to-vigorous physical activity, team sport participation, sedentary behaviour.

Results Data were collected from 2066 fourth-grade children from schools of three socioeconomic strata. Missing data were imputed using multiple imputation. To examine the integrated behavioural model, a structural equation model containing latent constructs for physical activity outcome expectancies, self-efficacy, home environment and social norms were fitted with the three outcomes above. Adequate model fit was achieved in the structural equation model (χ^2=1821.97, df=872, p<0.001, Comparative Fit Index=0.91, Tucker Lewis Index=0.91, root mean square error of approximation=0.02, standardised root mean square residual=0.04). All scale items were significantly associated with their respective latent constructs (all p<0.001). Several significant pathways between latent constructs and outcomes of interest were observed (p<0.05). Self-efficacy was positively associated with moderate-to-vigorous physical activity (p<0.001) and team sport participation (p<0.001) and negatively associated with sedentary behaviour (p<0.001). Negative outcome expectancies were negatively associated with moderate-to-vigorous physical activity (p<0.01) and sedentary behaviour (p<0.01) while positive outcome expectancies were positively associated with team sport behaviour (p<0.001) and negatively associated with sedentary behaviour (p<0.05). Home support was positively associated with moderate-to-vigorous physical activity (p<0.01) and team sport participation (p<0.05). Finally, physical activity social norms were negatively associated with sedentary behaviour only (p<0.05).

Strengths and limitations of this study

► The study used a theory-driven approach to add to limited research on physical activity in Turkish children.

► Data were collected from 2066 schoolchildren and their parents in Ankara, Turkey using a probability-based sampling method.

► Structural equation modelling allowed for the simultaneous examination of the complex relationships among multiple behavioural exposures and outcomes.

► The study was cross-sectional and relied on self-reports, which might have introduced some bias.

► Generalisation of study findings to children of different ages and outside Ankara should be cautioned.

Conclusions This study supported the extension to Turkish children of the integrated behavioural model in relation to physical activity behaviours. Results illustrate multiple targets for interventions to increase physical activity.

INTRODUCTION

The developing world, including Turkey, faces a growing childhood obesity problem. Between 1990–1995 and 2011–2015, the prevalence of obesity among Turkish children increased from 0.7% to 7.1%.[1] In the capital, Ankara, the combined prevalence of overweight and obesity is 35.8% among 10 year olds.[2]

Rising childhood obesity is linked to increased energy intake and decreased physical activity (PA) which can increase adiposity.[3] Risk factors for overweight and obesity in Turkish children include medium or high socioeconomic status (SES), mother's education and parental overweight or obesity.[4] Childhood obesity is associated with adulthood obesity,[5] with life-long implications. Studies of Turkish children found links between obesity and other health

outcomes, including cardiovascular health[6] and attention deficit hyperactivity disorder,[7] indicating a potential impact on education.

Among Turkish adolescents, over 80% do not achieve the recommended 60 min of PA/day.[8] Lack of PA has been associated with childhood obesity in many populations, including Turkey.[9] Studies including Turkish populations have found diverse factors related to PA, including outdoor school environments,[10] participation in sports,[11] self-efficacy and perceived peer behaviours.[12] Individual, social and environmental factors all potentially influence childhood PA.

Because of PA's protective role against obesity, researchers have developed health behaviour models to help explain PA-related outcomes in children.[13] The integrated behavioural model (IBM) theorises specific causal components affect health behaviours such as PA.[14] Combining elements of several health behaviour theories, the IBM posits health behaviour results from many constructs including beliefs, attitudes, norms, self-efficacy and environmental factors and these constructs act in concert when a person engages (or intends to engage) in a particular behaviour.[15] The IBM has been applied to PA primarily in developed countries; in a study of school-aged children, it was a strong theoretical framework for predicting PA.[16]

There is less research using the IBM to examine multiple dimensions of PA and psychosocial correlates in low/middle-income countries. Given the complexity of PA and obesity, an integrated approach is important to advancing programme design. Many studies apply the IBM but use multiple discrete regression models to model PA as an outcome in relation to predictors.[15 16] Addressing this gap, the current research used a structural equation model (SEM) to test a multipronged, comprehensive model of health behaviour including multiple effects, predictors, latent variables, mediators and outcomes. SEMs do require strong assumptions around controlling for confounders for every set of variables in the SEM and so the causal implications of any SEM should be interpreted cautiously.[17] However, SEMs also allow for better modelling of the complicated relationships observed in health behaviour research and in particular for testing theory-driven models such as those generated by theories of behavioural change.[18] Using this methodology, we can assess the value of key constructs in the IBM in relation to different dimensions of PA in a single model.[19]

This study draws from a population-based, obesity-related survey conducted among schoolchildren in Ankara, Turkey. The objective of the study was to test an IBM-adapted model in association with PA among Turkish children using SEM. This population has been understudied and is of interest due to increasing childhood obesity.[20] We hypothesised that PA self-efficacy, outcomes expectancies and norms would show different associations with PA, team sports participation and sedentary behaviour.

METHODS
Participants and procedures
Grade 4 schoolchildren (ages 9–11 years) in Ankara, Turkey completed a survey and physical assessment. Participants were sampled using a stratified random sample design. To recruit a representative sample of participants, a sampling frame of schools in Ankara was defined. Schools were stratified into low, medium and high SES strata based on county-level socioeconomic indicators such as income, housing and education measures. Fifteen schools were selected from each stratum. The high SES stratum consisted exclusively of private schools, public schools in Cankaya and Yenimahalle counties formed the middle SES stratum, and the lower SES stratum was made up of schools in Altindağ, Mamak and Sincan counties. The probability proportional to size procedure was used for selecting schools. Survey weights were the product of inverse selection probabilities of schools, classes and students. Three high SES stratum schools with low participation rates were excluded. Sample weights were recalculated after dropping these schools. Detailed study design has been reported elsewhere.[2 21]

Parental consent and student assent were obtained. Field teams of trained researchers working with school administrators distributed surveys over a 3-week period in 2015. Each school sent study materials to parents of selected children. Survey weights were calculated from the final sample, excluding three schools due to low participation. Of the 4022 surveys distributed to families at included schools, the overall response rate for complete parent–child dyads was 51%, resulting in a final sample size of 2066.

Patient and public involvement
There was no patient or public involvement in the conduct of the study.

Measures
Demographic measures
Demographic measures believed to have an impact of PA and sedentary behaviours included child's gender, parental obesity status, mother's education level and the school SES. Children self-reported gender, a binary variable for male and female. Parental obesity, collected in the parent survey, had four categories: neither parent overweight or obese, mother overweight or obese, father overweight or obese and both parents overweight and obese. The mother's education level—collected in the parent survey–had three categories: primary, secondary and tertiary. School SES was split into low, medium and high.

Self-efficacy for PA
Self-efficacy toward PA was assessed with an established 9-item scale with response options: (1) Not at all hard, (2) Somewhat hard and (3) Very hard.[22] Items included 'Being active physically even when I am tired' and 'Being physically active instead of watching television (TV).'

Responses were summed and the score was reverse coded so a higher score represented increased self-efficacy. Total scores could range from 9 to 27. Cronbach's alpha was 0.84 for internal consistency in boys and 0.82 in girls.[23]

PA outcome expectancies

A previously validated 17-item outcome expectancies scale was used.[22] This scale included a positive subscale (eight items) and a negative subscale (nine items). Participants responded to prompts including 'Doing physical activity would make me feel stronger' and 'Doing physical activity would ruin my hair.' Response options were (1) True for me, (2) Partially true for me, and (3) Not true for me. Items were reverse coded and summed to obtain an overall score; a higher score represented higher outcome expectancies. Cronbach's alpha for internal consistency was 0.77 for the negative subscale and 0.72 for the positive subscale in boys, and 0.73 and 0.75 in girls, respectively.[23]

Home support

To assess home support for PA, a five-item three-point scale was included.[24] Scale items included 'It is safe to play outside close to my house' and 'My family is usually physically active.' Response options were: (1) Almost never, (2) Sometimes and (3) Almost all the time. Responses were summed resulting in overall scale scores from 5 to 15. Cronbach's alpha for internal consistency was 0.69 for boys and 0.65 for girls.

Social norms

PA Social norms were assessed using a three-item, five-point Likert scale. This scale was developed for the study based on constructs from the IBM as illustrated by Montano and Kasprzyk.[25(p6)] The three items were 'My friends think that exercising and being physically active is important,' 'When the issue is exercising, I want to be like my friends' and 'Most of my friends exercise every day.' Scale scores were calculated by summing all items. Cronbach's alpha for internal consistency was 0.71 and 0.67 for boys and girls, respectively.

Physical activity

Three continuous measures of PA were used as outcomes. Participants were asked how many days per week they engaged in the following behaviours: (1): moderate-to-vigorous PA (MVPA) for at least 60 min, (2) participation in team sports and (3) sedentary behaviours (ie, screen time) for more than 2 hours. For participants, MVPA was defined as self-reported PA for 60 min or longer. Responses for each ranged from 0 to 7.

Statistical analysis

Continuous variables were inspected visually for normality (tests for normality were not used due to the large sample size). We examined bivariate associations among variables of interest including self-efficacy, outcome expectancies, home support and social norms using χ^2 tests and Mann-Whitney U tests. Then, we fitted an SEM containing variables of interest to test whether these scales were associated with MVPA, team sports participation and sedentary behaviour in a population-based sample of children in Ankara, Turkey. Maximum likelihood estimation with robust standard errors and a Scatorra-Bentler scaled (SB) test statistic was used. The lavaan.survey package was used in R to weight the SEM results appropriately using survey weights.[26] A priori acceptable model fit statistics were established as having a Comparative Fit Index (CFI) >0.90, Tucker Lewis index (TLI) >0.90, root mean square error of approximation (RMSEA) <0.08 and standardised root mean square residual (SRMR) <0.08.

Missing data were addressed in R (V.3.4.3)[27] using the mice (V.2.46.0)[28] and miceadds (V.2.10-14)[29] packages for multiple imputation while accounting for survey weights. Twenty imputations with a maximum of 50 iterations were created. Model variables as well as other demographic and socioeconomic variables not used in later analyses were included for multiple imputation. These socioeconomic variables included parental obesity status, student gender, school socioeconomic stratum and the mother's education level. These variables were potential confounders in the relationship between the exposures and outcomes of interest. Imputations were then pooled and used in a sample probability-weighted (3) SEM for the variables of interest using the lavaan (0.5–23.1097)[30] and lavaan.survey (1.1.3.1)[26] packages. Modification indices were examined and covariances were added to the final model for any scale items with modification indices greater than 30.

RESULTS

Sample characteristics

Table 1 provides sample characteristics based on the non-imputed data. Visual inspections of histograms revealed non-normal distributions of continuous variables so medians and IQRs are reported. The median age was 10 (SD=0.4 years). The sample was 46.9% boys and 53.1% girls. For a typical week, children reported a median 4 days of PA (IQR: 2–7), 3 days of team sports participation (IQR: 1–6) and 2 days of sedentariness (IQR: 1–3). Significant differences in all three PA-related measures were observed between boys and girls with boys being more likely to be physically active, engage in team sports and have sedentary behaviours.

Self-efficacy scores ranged from 9 to 24 with a median score of 16 (IQR: 14–18). The negative outcome expectancies subscale ranged from 1 to 19 with a median of 7 (IQR: 4–10). In contrast, positive outcome expectancies ranged from 8 to 24 with a median of 19 (IQR: 16–20)). Social norms scores median score was 10 (IQR: 8–12), ranging from 3 to 15. The home environment scale scores ranged from 5 to 15 with a mean of 12 (IQR: 10–13)). No statistically significant differences were observed between boys and girls in these scores except on negative outcome expectances where boys had higher scores.

Of 2066 total cases, 1433 cases were complete (69.4%). The most commonly missing variable was parental obesity

Table 1 Sample descriptive statistics and missing data for model variables of interest
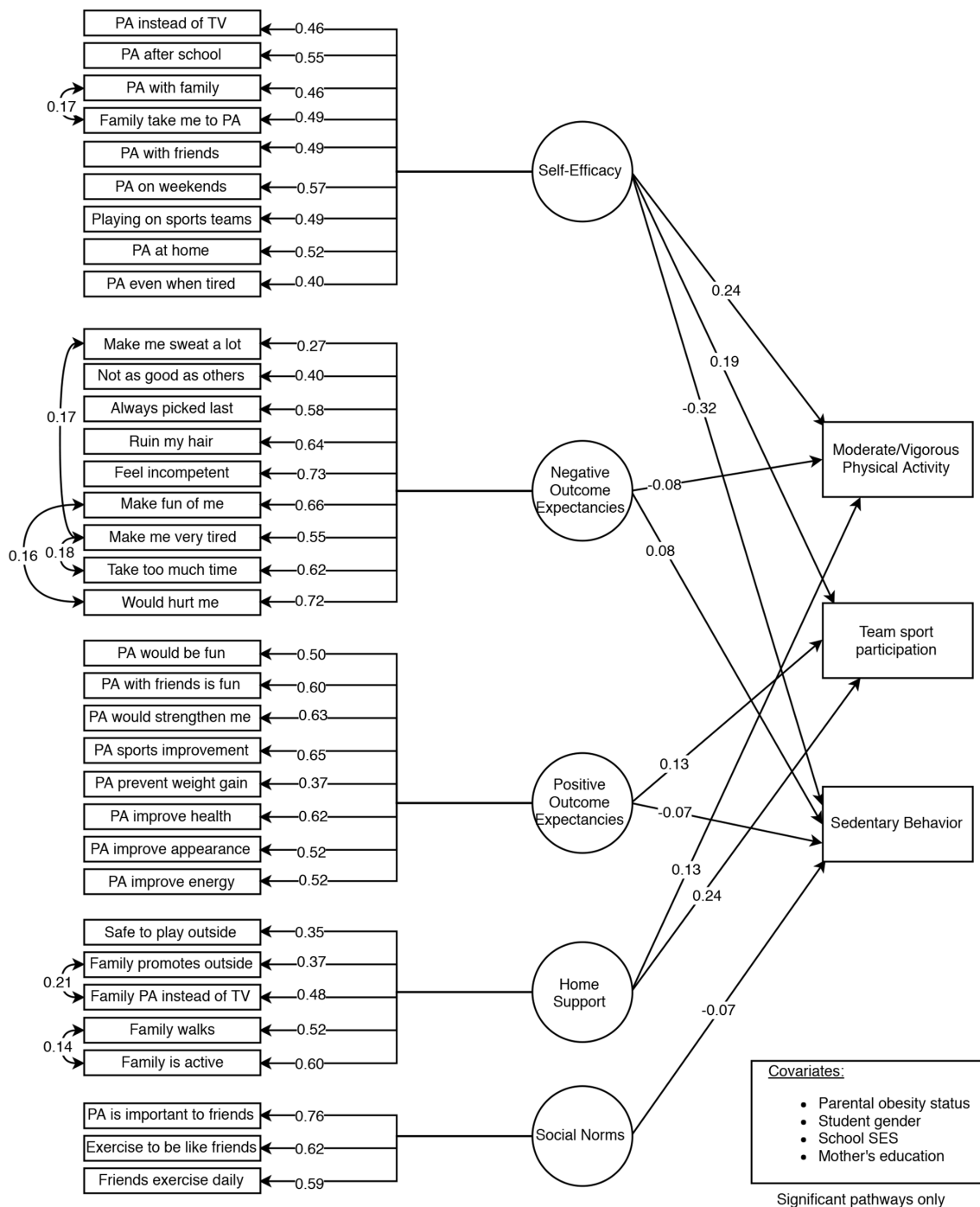
Variable	Total N	Median (IQR) % of sample	Boys N	Median (IQR) or column %	Girls N	Median (IQR) or column %	P value
Age (years)	2066	10.0 (9.8–10.3)	968	10.1 (9.8–10.3)	1098	10.0 (9.8–10.3)	0.220
Missing	0	0.0%	0		0		
Mother's education level							0.412
Primary	775	37.5%	347	37.5%	428	40.4%	
Secondary	768	37.2%	366	39.5%	402	37.9%	
Tertiary	443	21.5%	213	23.0%	230	21.7%	
Missing	80	3.9%					
SES (school level)							0.486
Low	1100	53.2%	503	51.9%	597	54.4%	
Medium	715	34.6%	348	35.9%	368	33.5%	
High	251	12.1%	118	12.2%	133	12.1%	
Missing	0	0.0%					
Parental overweight/obese							
Neither parent	1171	56.7%	528	67.0%	643	69.4%	0.697
Mother	199	96%	94	11.9%	105	11.3%	
Father	271	13.1%	129	16.4%	142	15.3%	
Both	73	3.5%	37	4.7%	36	3.9%	
Missing	353	17.1%					
Self-efficacy	1986	16 (14, 18)	926	16 (14, 18)	1060	16 (14, 18)	0.339
Missing	80	3.9%	42	4.4%	38	3.5%	
Negative outcome expectancies	1907	7 (4, 10)	881	8 (5, 11.8)	1014	6 (4, 9.4)	<0.001
Missing	171	8.3%	87	9.0%	83	7.6%	
Positive outcome expectancies	1955	19 (16, 20)	916	19 (16, 20)	1039	19 (16, 20)	0.140
Missing	111	5.4%	52	5.4%	59	5.4%	
Home support	2023	12 (10, 13)	950	11 (10, 13)	1073	12 (10, 13)	0.434
Missing	43	2.1%	19	1.9%	24	2.2%	
Social norms	2055	10 (8, 12)	962	10 (8, 12)	1093	10 (8, 12)	0.352
Missing	11	0.4%	6	0.6%	5	0.4%	
Days of physical activity	2012	4 (2, 7)	941	4 (2, 7)	1071	3 (2, 6)	<0.001
Missing	54	2.6%	27	2.8%	27	2.4%	
Days of team sports	2025	3 (1, 6)	941	4 (2, 7)	1084	2 (1, 5)	<0.001
Missing	41	2.0%	27	2.8%	14	1.3%	
Days of sedentary behaviour	2032	2 (1, 3)	943	2 (1, 4)	1089	2 (1, 3)	0.012
Missing	34	1.7%	25	2.6%	9	0.8%	

Results are based on non-imputed, unweighted data; results from imputed and weighted data were similar (not shown). χ^2 tests were used for categorical variables and Mann-Whitney's U tests were used for continuous variables.

status (16.9%). Missing data were imputed (see the Methods section). Pooled results from multiple imputation are presented for all subsequent analyses.

Structural equation model

The final model with standardised coefficients is in figure 1; full model unstandardised coefficients, SE

Figure 1 All unstandardised coefficients for the SEM with SEs, z-scores and CIs. PA, physical activity; SEM, structural equation model; SES, socioeconomic status; TV, television.

estimates and p values are available as online supplemental file 1. The model included constructs of interest and parental obesity status, gender, school SES and mother's education level. All scale items were statistically significantly associated with their respective latent constructs. The model was adjusted for survey weights. Because of the large sample size, significant χ^2 tests were obtained for both the maximum likelihood (ml) and SB χ^2 test statistics: χ^2_{ml}=2568.24, df_{ml}=872, p value$_{ml}$<0.001 and χ^2_{SB}=1821.97, df_{SB}=872, p value$_{SB}$<0.001; however, other model fit statistics indicated good model

fit: CFI=0.91, TLI=0.91, RMSEA=0.02 and SRMR=0.04. In the model, modest R-squared values were observed for outcome variables (R^2_{MVPA}=0.133, $R^2_{Team\ sports}$=0.157, $R^2_{Sedentary\ behaviour}$=0.110).

In the final model, several significant associations were observed between latent constructs and outcomes. Self-efficacy and home support were positively associated with MVPA (standardised β=0.25, unstandardised B=2.62, SE=0.45, p<0.001 and β=0.11, B=1.03, SE=0.37, p<0.01, respectively) while the construct of negative outcome expectancies was inversely related to MVPA (β=−0.08,

B=−0.88, SE=0.32, p<0.01). Self-efficacy (β=0.21, B=2.37, SE=0.47, p<0.001), positive outcome expectancies (β=0.12, B=1.68, SE=0.48, p<0.001) and home support (β=0.20, B=2.08, SE=0.43, p<0.001) were directly associated with team sport participation. Negative outcome expectancies were positively associated with sedentary behaviour (β=0.08, B=0.88, SE=0.29, p<0.01) while self-efficacy (β=−0.32, B=−3.14, SE=0.44, p<0.001), positive outcome expectancies (β=−0.73, B=−0.89, SE=0.44, p<0.05) and social norms (β=−0.07, B=−0.15, SE=0.06, p<0.05) were inversely associated with sedentary behaviour.

DISCUSSION

To our knowledge, this was the first study to examine self-efficacy, outcome expectancies, home environment and social norms in relation to PA-related behaviour in Turkish children. We found good fit in our model, with evidence of different relationships between behavioural exposures and PA-related outcomes. This paper illustrates how SEM allows researchers to test complicated models of health-related behaviours with multiple constructs and outcomes in a single model.

PA is important throughout a person's life course given its association with reduced morbidity and mortality as well as improved functioning and quality of life. Studies have identified lifelong trajectories of PA that begin in childhood and continue into adulthood.[31] For instance, a Slovakian study found that children who engage in PA classes and sports education are more likely to have a positive attitude toward PA as adults.[32] PA participation during childhood has been found to influence a variety of social and health outcomes in adulthood such as adult income,[33] sleep quality[34] and mental health.[35] However, despite strong evidence showing the benefit of PA, many children around the world, including those in Turkey, do not meet the recommended levels of PA.[36] Improving and sustaining daily PA are challenges in a rapidly developing world.

Of the constructs included in the SEM, only self-efficacy was statistically significantly associated with all three measures of PA, indicating the potential of self-efficacy interventions to increase PA and decrease sedentary behaviours. Other studies have identified the importance of self-efficacy in regards to PA among young adults and in school-based settings.[37] Health promotion programmes could emphasise self-efficacy which given the connection between PA and adiposity[38] could help reduce childhood overweight and obesity.

Both positive and negative outcome expectancies were associated with two measures of PA in our study, in contrast to some previous studies.[39] The negative outcome expectancies subscale was associated with sedentary behaviour and inversely associated with MVPA, but not associated with team sport participation. Potentially, children worry less about negative outcomes when participating in PA with a group. This could present an opportunity for interventions to increase PA among children with highly

negative outcome expectancies through group-based PA. In contrast, the positive outcome expectancies subscale was associated with increased team sport participation and decreased sedentary behaviour but not MVPA. Individuals with high positive outcome expectancies may be willing to exercise regardless of the team context.

Home support was associated with MVPA and team sport participation, indicating the importance of home environment and familial support in driving PA. Interestingly, home support was not associated with sedentary behaviour. Social norms, however, was associated with sedentary behaviour, but not either of the PA measures. This could indicate the social norms established by a child's friends at this age are less important than familial support for PA. Interventions to increase familial, especially parental, support for PA could be effective, while targeting peer networks could have a beneficial effect on reducing sedentary behaviour.

This paper fitted an SEM including multiple IBM constructs in a unified model. Overall, the SEM appeared to be a good fit for the outcomes of interest, indicating the IBM may be a useful framework for conceptualising psychosocial predictors of PA. Studies in different populations have also identified and used the IBM in PA models,[16] and this study generalises the approach and those findings to Turkish children. Interventions can be designed based on the IBM to increase PA.[40] Since all these constructs were significantly associated with measures of PA, this reinforces the idea that these constructs do not exist in isolation; they exist on both intrapersonal and social levels. These constructs affect PA in schoolchildren independently, highlighting the complexity of PA as a behaviour, but also presenting several intervention strategies. Interventions designed to affect multiple constructs may provide more benefit than interventions with a single focus. A systematic review found interventions targeting multiple factors to promote PA can be more effective.[41] Interventions incorporating multiple psychosocial and behavioural targets to increasing PA should be a key strategy to prevent overweight and obesity and improve health among Turkish children. Increasingly, it is recognised that a systems approach is needed to promoting PA that links policy, environmental and behavioural strategies.[42]

Limitations of the study include the fact that we only sampled fourth grade schoolchildren from one region, thus potentially limiting generalisability of findings to children of other ages or regions. However, the study used a probability based, weighted sample, which is a strength. Parental obesity status was self reported via survey instrument and therefore may be subject to biases such as social desirability bias. The study also used relatively simple measures of PA that were self-reported by children. Children may incorrectly remember PA behaviours. Future studies could use more sophisticated measures of PA such as direct observation or device-based monitoring.[33] As the paper was based on secondary analyses of previously collected data, not all of the IBM measures, including

behavioural intentionality, were available. Finally, as the study was cross-sectional, temporality could not be assessed to infer causality. This is of particular note in the context of SEM where the direction of the associations between variables cannot be assessed at a single time point. There is the possibility of outcomes affecting the exposure. Future research is warranted to examine these variables longitudinally.

CONCLUSIONS

This study used SEM to create a model of three measures of PA and IBM constructs in a population of Turkish schoolchildren. Several significant relationships between these constructs of interest were found, supporting the usefulness of the IBM for understanding PA in this population. Several psychosocial targets including self-efficacy, outcome expectancies, family support and social norms were identified for potential health promotion programmes. PA programmes should account for the holistic nature of PA with multipronged targets to increase PA, reduce obesity and improve health among children in Turkey.

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REFERENCES

1 Alper Z, Ercan İlker, Uncu Y. A meta-analysis and an evaluation of trends in obesity prevalence among children and adolescents in Turkey: 1990 through 2015. *J Clin Res Pediatr Endocrinol* 2018;10:59–67.
2 Yardim MS, Ozcebe H, Araz OM. Prevalence of childhood obesity and related parental factors in Ankara, Turkey. *East Mediterr Health J* 2019;25:374–84.
3 Sahoo K, Sahoo B, Choudhury AK, et al. Childhood obesity: causes and consequences. *J Family Med Prim Care* 2015;4:187–92.
4 Geckil E, Aslan S, Derya Ister E, et al. Prevalence and risk factors of obesity and overweight in elementary school-age (5 to 15 years old) children in south-eastern turkey. *Iran J Pediatr* 2017;27:e7218.
5 Simmonds M, Llewellyn A, Owen CG, et al. Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. *Obes Rev* 2016;17:95–107.
6 Gökler ME, Buğrul N, Metintaş S, et al. Adolescent obesity and associated cardiovascular risk factors of rural and urban life (Eskisehir, Turkey). *Cent Eur J Public Health* 2015;23:20–5.
7 Onal Sonmez A, Goksan Yavuz B, Aka S, et al. Examining the relationship between attention deficit hyperactivity disorder, behavioural features and obesity in Turkish children and adolescents. *Eur Neuropsychopharmacol* 2017;27:S1088.
8 Guthold R, Stevens GA, Riley LM, et al. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants. *Lancet Child Adolesc Health* 2020;4:23–35.
9 Sağlam H, Tarım Ömer. Prevalence and correlates of obesity in schoolchildren from the city of bursa, Turkey. *J Clin Res Pediatr Endocrinol* 2008;1:80–8.
10 Ozdemir A, Yilmaz O. Assessment of outdoor school environments and physical activity in Ankara's primary schools. *J Environ Psychol* 2008;28:287–300.
11 Koçak S, Harris MB, Kin İşler A, et al. Physical activity level, sport participation, and parental education level in Turkish junior high school students. *Pediatr Exerc Sci* 2002;14:147–54.
12 Luszczynska A, Gibbons FX, Piko BF, et al. Self-regulatory cognitions, social comparison, and perceived peers' behaviors as predictors of nutrition and physical activity: a comparison among adolescents in Hungary, Poland, Turkey, and USA. *Psychol Health* 2004;19:577–93.
13 Branscum P, Crowson HM. The association between environmental and psychosocial factors towards physical activity and screen time of children: an application of the integrative behavioural model. *J Sports Sci* 2017;35:982–8.
14 Glanz K, Rimer BK, Viswanath K. *Health Behavior and Health Education: Theory, Research, and Practice*. John Wiley & Sons, 2008.
15 Branscum P, Lora K. Using the integrative behavioral model to predict monitoring of fruit and vegetable consumption among Hispanic mothers. *Fam Community Health* 2017;40:32–8.
16 Branscum P, Bhochhibhoya A. Exploring gender differences in predicting physical activity among elementary aged children: an application of the integrated behavioral model. *Am J Health Educ* 2016;47:234–42.
17 VanderWeele TJ. Mediation analysis: a practitioner's guide. *Annu Rev Public Health* 2016;37:17–32.
18 Buhi ER, Goodson P, Neilands TB. Structural equation modeling: a primer for health behavior researchers. *Am J Health Behav* 2007;31:74–85.
19 Kroshus E, Baugh CM, Daneshvar DH, et al. Understanding concussion reporting using a model based on the theory of planned behavior. *J Adolesc Health* 2014;54:269–74.

20 Bereket A, Atay Z. Current status of childhood obesity and its associated morbidities in Turkey. *J Clin Res Pediatr Endocrinol* 2012;4:1–7.

21 Yardim MS, Özcebe LH, Araz OM, *et al*. Prevalence of childhood obesity and related parental factors across socioeconomic strata in Ankara, Turkey. *East Mediterr Health J* 2019;25:374–84.

22 Sherwood NE, Taylor WC, Treuth M, *et al*. Measurement characteristics of activity-related psychosocial measures in 8- to 10-year-old African-American girls in the girls health enrichment multisite study (GEMs). *Prev Med* 2004;38:60–8.

23 Özcebe H, Üner S, Arslan U. *Nutrition and physical activity scales: Turkish validity and reliability results for children and adults*. 72 Tasarim Printing, 2017.

24 Adkins S, Sherwood NE, Story M, *et al*. Physical activity among African-American girls: the role of parents and the home environment. *Obes Res* 2004;12 Suppl:38S–45.

25 Montano DE, Kasprzyk D. Chapter 6: Theory of Reasoned Action, Theory of Planned Behavior, and the Integrated Behavioral Model. In: *Health Behavior: Theory, Research, and Practice*. 5th ed. Jossey-Bass Public Health. Wiley, 2015: 95–124.

26 Oberski D. lavaan.survey: an R package for complex survey analysis of structural equation models. *J Stat Softw* 2014;57:1–27.

27 R Core Team, R Foundation for Statistical Computing. R: a language and environment for statistical computing, 2017. Available: https://www.R-project.org/

28 van BS, Groothuis-Oudshoorn K. Mice: multivariate imputation by chained equations in R. *J Stat Softw* 2011;45:1–67.

29 Robitzsch A, Grund S, Henke T. *Miceadds: some additional multiple imputation functions, especially for mice*, 2018. Available: https://CRAN.R-project.org/package=miceadds

30 Rosseel Y. lavaan: an R package for structural equation modeling. *J Stat Softw* 2012;48:1–36.

31 Rovio SP, Yang X, Kankaanpää A, *et al*. Longitudinal physical activity trajectories from childhood to adulthood and their determinants: the young Finns study. *Scand J Med Sci Sports* 2018;28:1073–83.

32 Bendíková E, Dobay B. Physical and sport education as a tool for development of a positive attitude toward health and physical activity in adulthood. *Eur J Contemp Educ* 2017;6:14–21.

33 Kari JT, Tammelin TH, Viinikainen J, *et al*. Childhood physical activity and adulthood earnings. *Med Sci Sports Exerc* 2016;48:1340–6.

34 Canhin DdaS, Tebar WR, Scarabottolo CC, *et al*. Physical activity across life stages and sleep quality in adulthood - an epidemiological study. *Sleep Med* 2021;83:34–9.

35 Jacka FN, Pasco JA, Williams LJ, *et al*. Lower levels of physical activity in childhood associated with adult depression. *J Sci Med Sport* 2011;14:222–6.

36 Ozdirenç M, Özcan A, Akin F, *et al*. Physical fitness in rural children compared with urban children in Turkey. *Pediatr Int* 2005;47:26–31.

37 Rovniak LS, Anderson ES, Winett RA, *et al*. Social cognitive determinants of physical activity in young adults: a prospective structural equation analysis. *Ann Behav Med* 2002;24:149–56.

38 Hills AP, Andersen LB, Byrne NM. Physical activity and obesity in children. *Br J Sports Med* 2011;45:866–70.

39 Sharma SV, Hoelscher DM, Kelder SH, *et al*. A path analysis to identify the psychosocial factors influencing physical activity and bone health in middle-school girls. *J Phys Act Health* 2009;6:606–16.

40 Smith LH. Piloting the use of teen mentors to promote a healthy diet and physical activity among children in Appalachia. *J Spec Pediatr Nurs* 2011;16:16–26.

41 Greaves CJ, Sheppard KE, Abraham C, *et al*. Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. *BMC Public Health* 2011;11:119.

42 Reis RS, Salvo D, Ogilvie D, *et al*. Scaling up physical activity interventions worldwide: stepping up to larger and smarter approaches to get people moving. *Lancet* 2016;388:1337–48.