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ORIGINAL ARTICLE

Association between migration and physical activity of school-age children left behind in rural Mexico

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Abstract
Objectives The purpose of this study was to explore in rural communities of Mexico, the association between physical activity (PA) in school-age children and exposure to migration.
Methods We measured PA through a questionnaire validated in school-age children and used in Mexican National Surveys. Migration status was measured as the number of years a family member had been in the US, and the amount of remittances that family member had sent to their household in Mexico. We used multivariable linear regression to measure the association between physical activity and migration.
Results School-age children who had a migrant family member spent less time on PA per day, especially recreation activities, compared to school-age children without the migrating influence. Also, children who belonged to a family that received remittances and their migrant relative lived ≥5 years in US were less likely to engage in PA.
Conclusions Exposure to migration may predict reduction in PA in school-age children left behind in Mexican rural communities from the State of Morelos. These findings call for PA-tailored interventions that consider household migration characteristics.

Keywords School-age children · Mexico · Immigration · Physical activity

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Introduction

Recent studies indicate that there is an association between health-related behaviors and individual and community socioeconomic factors (Behanova et al. 2013). Physical activity (PA), a key component of a healthy lifestyle, is also related to environmental and socioeconomic factors (Mann et al. 2013; Pitel et al. 2013). It has been reported, for example, that the decrease in PA performance is frequently associated with lack of recreational public spaces, which are commonly absent in areas characterized by low educational and socioeconomic resources, particularly in rural communities (Jennings et al. 2009; Tompkins et al. 2005; Sonneville et al. 2009).

Throughout the years, it has been consistently documented that Mexico has one of the highest emigration rates to the United States (US) (World Bank 2011). In general, Mexican migrants in the US have lower socioeconomic status and educational attainment when compared to their US-born Mexican-origin counterparts. Mexican immigrants

living in the US tend to be employed in activities that require intense physical labor, but receive very low wages for their work (Rodríguez 2009). In spite of their limited income, most Mexican immigrants abroad send remittances to their families in their communities of origin who use the economic resources first to fulfill primary needs, such as food and clothing, and then to cover expenses associated with short-term emergencies like access to health care, pay debts, home improvements, and savings (Salgado de Snyder et al. 2010). As for family and social situations of those left behind, research findings suggest that children who have a migrant family member often experience teen pregnancy, alcohol and drug use and abuse (Aguilera-Guzmán et al. 2004; Cortés 2008). These findings reinforce the importance of studying health-related behaviors of children left behind (Salgado de Snyder et al. 2007) The literature linking health and migration has mostly focused on the study of health risks, such as sexual behavior, addictions, utilization of health services, transmission of infections, and nutritional status (D'Emilio et al. 2007; Caglar and Schiff 2006; Hildebrandt et al. 2005). Only a few studies have explored the relationship between physical activity (PA) and migration. For example, Lindsay et al. (2009) studied the association between PA and communities with heavy migration rates. Their findings showed that lower levels of social support, lack of safety in the area, housing conditions, television viewing, and socioeconomic status, among other aspects, exert a negative influence on the PA levels of school-age children of migrants. Likewise, there is a gap of knowledge about the association between remittances and their potential influence on PA among family members in migrant households. The purpose of this study was to explore in rural communities of Mexico, the association between PA in school age children and exposure to migration, measured through length of time in the US of a family member, and remittances received in the Mexican household.

Methods

Study population and source of information

A cross-sectional study was conducted between October 2006 and May 2007 in several rural communities of Tlaltizapan, in the state of Morelos, Mexico; which is the county in Morelos with the highest emigration rate (15 %) to the US (INEGI 2006).

Procedure

Participants were identified using lists provided by the office of the Mayor of Tlaltizapan which identified the families in the county that had at least one family member living in the US. Families were located by visiting elementary schools, healthcare centers, and consulting with local community leaders.

According to data from the 1999 National Nutrition Survey (Rivera-Dommarco et al. 2001), the prevalence of overweight and obesity was 27 % at National Level in children from 5 to 11 years old, and our sample selection was intended to provide 80 % probability of detecting differences in such prevalence. This study sample included a total of 239 children between 9 and 12 years of age. The sample was divided in two: (1) children who belonged to households with a migrant family member living in the US, referred to as migrant household (MH); and (2) children of households without migrant family members, referred to as non-migrant household (NMH). After explaining the general survey objectives and methods, written informed consent from the parents/guardians was obtained, as well as the childreńs agreement to participate in the study. All household-related information was obtained from the parent/guardians, and children responded the section of physical activity. The project was approved by the Ethics Committee of the National Institute of Public Health.

Study variables

Physical activity (PA) of children

For the present analysis, the total PA was categorized into four domains: household chores, recreational activities at school and home, transportation, and school activities (Pratt and Macera 2004). Household chores included time dedicated to cleaning and taking care of animals or agricultural work. Recreation time involved activities performed outside school (running, playing soccer or jumping rope). Transportation included the time used to go from home to school (by foot or riding a bicycle). School activities entailed classroom time, break, and PA classes. The sedentary lifestyle was defined as the time devoted to activities involving sitting down, entailing low energy expenditure, such as watching TV or movies, playing videogames, or using the computer. Physical activity was assessed using a 34-item questionnaire developed by Hernández et al. (2000) and previously validated with Mexican school-age children. The questionnaire quantified the number of hours that children devoted weekly to PA and calculated the total PA in hours/day. The questionnaire was administered by trained interviewers.

Migrant and non-migrant households

Exposure to migration was measured based on the number of years the migrant family member had lived in the US

and the amount of money received from remittances. Using CONAPÓs guidelines (2008) migrant households were classified as recent migration which was defined as domestic units with a family member living in the US from 0 to 5 years; and non-recent migration household was units with a family member living more than 5 years in the US.

Household monthly expenses per equivalent adult

This variable was the total sum of household expenses for food, transportation, health care, school, services, clothes and shoes, recreational activities, and hospitalizations. The estimated expenditure was expressed in terms of equivalent adult (EA); an indicator providing a tool to compare households with different demographic characteristics (Teruel et al. 2005).

Socioeconomic status (SES and possession of assets)

A socioeconomic status (SES) index was constructed though principal component analysis using household conditions (floor, roof, and type of construction material), number of people living in the household, basic household infrastructure (e.g., piped water and sanitation services) and number of domestic appliances (e.g., radio, television, and refrigerator); which was validated in three previous surveys (Kolenikov and Angeles 2004; Filmer and Pritchett 2001). The SES index was categorized in terciles expressed as low, medium and high. This methodology was used to construct an index representing assets negatively related to energy expenditure (computer, videogames, VCR or DVD player and owning a motor vehicle) and changes in activity patterns and food consumption of households members (Cortés 2007; Bakker et al. 2010).

Nutritional status

BMI was calculated using weight and height. Values were transformed to BMI for age Z score using the 2006 World Health Organization references. Undernutrition was defined as -2 Z score standard deviation (SD); overweight $+1$ Z score SD, and obesity $+2$ Z score SD (De Onis et al. 2007).

Other variables considered in the analysis included characteristics that may have been associated with PA, such as age and sex of the participant, and parent's schooling (Hernández et al. 1999; Jennings et al. 2009; Hernández et al. 2000).

Statistical analysis

Descriptive information is presented as mean ± standard deviations for continuous variables; and proportions for categorical variables. Chi square test for proportions and Student's t test for means were used to assess differences in general characteristics and migration status. Statistical significance was defined at $p < 0.05$.

Association between migration and total physical activity (hours/day)

Using multiple regression analyses, the association between migration as the exposure variable (yes/no, remittances received, and time living in US) and PA as the outcome, was measured. There were three models used to assess this association. All models were adjusted for the following potential confounders: age, BMI, parents schooling, SES, assets, and household expenses per adult equivalent. The models' goodness-of-fit was evaluated by the least square method (Kleinbaum et al. 1998). Migration exposure was defined as whether the family received remittances, the amount received, and the time the family member had been living in US. In the first model, the independent variable was whether the household was migrant or non-migrant; the second model used the amount of money in remittances that each household received (below or above the median); and the third model used the number of years living in US as the independent variable. All the statistical analyses were performed with the STATA/S.E. 12.1. The variables considered biologically and sociologically meaningful for the PA and migration framework were used to adjust the final models. Multicollinearity between migration variables (time in the US and remittances) and other socioeconomic variables included in the model was assessed. On the other hand, the models' estimation was compared using Bayesian information criterion (BIC) and Akaike information criterion (AIC).

Results

Table 1 shows the main socio-demographic differences between children by migration status. Children from non-migrant households (NMH) were almost 5 months older than their counterparts of migrant households (MH) ($p = 0.020$). At household level, NMH tended to own a computer and an automobile, as opposed to MH ($p = 0.010$, $p = 0.029$, respectively). The highest proportion of MH belonged to the lower SES, while NMH was located in the highest SES. Monthly expenses of NMH were significantly higher than MH by an average of $765 Mexican pesos (MP) by adult equivalent—one Mexican Peso (MP) is equivalent to approximately 0.075 US cents—including $500MP for both, industrial and non-industrial foods; and almost $100MP for health care. In MH, informants reported that 31.8 % of the active migrants were the head of the domestic unit or their spouse (2 %).

Table 1 Sociodemographic profile of the study population by migration status Mexico 2006–2007

	Migrant household[a]		Non-migrant household[b]		Difference
	($n = 120$)		($n = 119$)		
	Mean or %	SD	Mean or %	SD	p value
School-age children characteristics					
Male	51.69		55.46		0.561
Age (year)	10.31	1.04	10.70	1.10	0.020
Weight (kg)	41.10	10.90	43.10	11.70	0.170
Height (m)	1.42	0.09	1.43	0.09	0.510
Nutritional status					
Body Mass Index (BMI)[c]	20.00	3.83	20.80	4.37	0.140
Normal	60.17		55.93		0.310
Overweight	29.66		27.12		
Obesity	10.17		16.95		
Parents' characteristics					
Years of schooling					
Maternal	8.26	3.12	8.91	3.52	0.140
Paternal	8.43	3.50	8.69	3.94	0.620
Household characteristics					
Participate in a social program[d]	45.38		42.02		0.601
Affiliation to public health services[e]	67.23		70.34		0.605
Possession of assets					
TV	96.64		98.32		0.408
VCR or DVD player	68.07		72.27		0.479
Video game player	21.85		28.57		0.232
Computer	8.47		20.17		0.010
Motor vehicle	34.75		48.74		0.029
Radio	52.10		54.62		0.697
Stereo	68.07		66.39		0.782
Socioeconomic status (SES)[f]					
Low	38.79		24.58		0.025
Medium	33.62		34.75		
High	27.59		40.68		
Household monthly expenses per EA[g]					
Foods	1,239.1	695.9	1,750.9	1,271.0	0.000
Industrial	300.1	238.3	381.0	415.6	0.070
Non-industrial	939.1	611.0	1,369.8	1,076.2	0.000
Health	173.3	212.3	257.8	369.5	0.030
Clothes and shoes	83.5	113.3	87.4	131.9	0.800
Transportation	193.0	240.9	214.8	318.3	0.550
Household services[h]	193.0	503.4	248.7	249.2	0.280
School	109.8	141.6	128.1	158.4	0.350
Others	42.4	116.6	94.7	370.1	0.140
Total expenses[i]	2,150.1	1,219.9	2,915.2	1,746.3	0.000

Reported percentages, except for age, BMI and years of schooling of the parents. Statistical differences at 95 % confidence

[a] At least one family member living in the US sending remittances

[b] Non migrant family members, no remittances

[c] Z-score ($Z = +1$, $+2$ overweight, $Z \geq +2$ obesity), OMS 2006

[d] Social assistance government programs (Oportunidades, Programa de Apoyo Alimentario (PAL), Programa de Abasto Social de Leche (LICONSA), Programa de Abasto Rural (DICONSA)

[e] Affiliation to Public Health Services: yes/no

[f] SES: household conditions (floor, roof and type of construction material), number of people living in the household, basic household infrastructure (e.g., piped, water and sanitation services) and number of domestic appliances (e.g., radio, television and refrigerator). SES divided in tertiles of household conditions

[g] Equivalent adult. Indicator to compare well-being indicators between households with different demographic characteristics

[h] Household services: as electricity and water expenses in Mexican Pesos per Adult Equivalent

[i] Total monthly family expenses per equivalent adult in food, health, clothing, transportation, and household services, among others

Table 2 shows four domains of PA by migration status of the households. On average, children of NMH performed 30 min/day more PA in recreational activities than MH. There were no statistical differences between MH and NMH regarding sedentary activities (data not shown).

There was no multicollinearity between the variables included in the three models, especially for those that could be related, such as migration duration and household expenses. The VIF value for these variables was 1.27 and 1.17, respectively. For all variables included in the three models, the VIF average was 1.46, which is lower than 10—the cutoff point to consider the existence of colinearity. AIC and BIC are similar between the three models, this result means that the estimation with the three models is comparable.

Table 3 describes the association between PA and migration. In model one, children exposed to migration had 0.56 less time (hours) per day devoted to PA in comparison to children in NMH. Within MH, children who received remittances below the median performed less PA $\sim$45 min/day and the children who received more remittances than the median performed $\sim$36 min/day less PA ($p < 0.10$). In MH, there was no significant association between years of migration and time devoted to PA; however, children with more than 5 years of exposure to

Table 2 Physical activity of school-age children by migration status Mexico 2006–2007

	Migrant household		Non-migrant household migrante		Difference
	($n = 120$)		($n = 119$)		
	Mean or %	SD	Mean or %	SD	p value
Physical activity					
Hours/day (Min/day)					
Household	0.59 (35.4)	0.53 (31.8)	0.69 (41.4)	0.62 (37.2)	0.160
Recreation time[a]	1.77 (1 h, 46.2 min)	1.21 (1 h, 12.6 min)	2.32 (2 h, 19.2 min)	1.61 (1 h, 36.6 min)	0.000
Transportation by foot	0.07 (4.2)	0.02 (1.2)	0.08 (4.8)	0.05 (3)	0.360
Transportation by bicycle	0.07 (4.2)	0.00	0.07 (4.2)	0.00	–

[a] Time devoted to recreation activities (running, play soccer and jump rope)

migration had a total PA in hours/day lower than children from NMH. In all models, the age of 12 years was associated with more time (hours/day) dedicated to PA, than the age of 9 years. Finally, the relationships between PA and BMI, parentś schooling, SES, possession of assets, and household expenses per adult equivalent, were not statistically significant.

Graphic 1 shows the significant regression coefficients for models 1 and 2. Belonging to MH, the remittances amount received and maternal schooling were significant coefficients in the regression models.

Table 4 reports the proportion of children who perform different leisure activities that involve PA. A greater proportion of children of MH spend more time playing soccer than children in NMH. The proportion of children who walk between 2 and 4 h was higher in MH than children in NMH; however, the proportion of kids who walked more than 4 h was higher in the group of children from NMH than in those who belong to MH. Children from MH spent more time in free play than children from NMH. There was almost a difference of 5 % points in the proportion of kids who spent from 2 to 4 h doing homework or reading during the weekend in MH vs NMH. In relation to sedentary activities, there were fewer kids watching movies at home longer than 2 hours during the weekend in MH than in NMH. The percentage of kids playing video games for longer than 2 hours was 5 % was similar among children from MH than NMH. The proportion of children performing structured activities (swimming, dancing, gymnastics and other aerobic activities) was 37.9 % in MH vs 48.31 % in NMH ($p = 0.082$).

Discussion

The findings of this study provide evidence that support the existence of a negative association between emigration to the US and physical activity (hours/day) in school-age children of rural areas in Morelos, Mexico. Children's total PA per day in households that received remittances was significantly lower than the PA of children whose household did not receive remittances. Likewise, there was a significant negative association between PA and time elapsed since the family member had migrated to the US; the longer the migrant had been in the US, the less PA performed by children of those households. Using the amount of money received through remittances as the independent variable, one of the models revealed that children in MH who received remittance performed less PA. The fact that children from MH performed less PA than children form NMH is relevant since it has been reported a negative association between PA and mental and social health (self-image, life satisfaction, family and peer relationships) and a higher probability of involvement in high-risk health-related behaviors (Iannotti et al. 2009).

These results suggest that the exposure to migration—expressed in household remittances—could influence rural children's lifestyle. These findings may be explained by different arguments. First, it is possible that migrant family members influence the lifestyles of their families left behind through their increased income from remittances, allowing them to purchase household appliances which in turn may ease house chores for all members of the family, and thus, reducing PA in children (Bakker et al. 2010). Another possibility is that remittances in MH are a proxy of an association between migration and reduction in the time children devote to PA (Creighton et al. 2011). Possession of assets—one of the main mechanisms of lifestyle transference—particularly electronic devices, such as computers and videogames has been also related to a reduction in PA in MH. However, we did not find a significant association between PA and assets possession in the multivariate analysis. In fact, the characteristics of MH (lower SES, and lower monthly expenditures) suggest that remittances are

Table 3 Association between exposure to migration and physical activity of school-age children Mexico 2006–2007

	Physical activity (h/day)		
	(Model 1)	(Model 2)	(Model 3)
Exposure to migration (yes = 1, no = 0)[a]			
Household with migrant member	−0.56* [0.242]		
Remittances: below the median group (average = $398)		−0.609* [0.285]	
Remittances: over the median group (average = $4,298)		−0.500^{+} [0.298]	
Recent migration (less than 5 years)[b]			−0.161 [0.311]
Non-recent migration (more than 5 years)[b]			−0.50^{+} [0.282]
Individual characteristics			
Age 10 years (yes = 1)[c]	−0.031 [0.31]	−0.044 [0.316]	0.034 [0.316]
Age 11 years (yes = 1)[c]	0.496 [0.30]	0.509 [0.307]	0.514 [0.309^{+}]
Age 12 years (yes = 1)[c]	0.945* [0.38]	0.982* [0.387]	1.119** [0.400]
Sex (Male = 1)	0.351 [0.236]	0.353 [0.237]	0.345 [0.241]
Body mass index[d]	−0.21 [0.026]	−0.023 [0.027]	−0.019 [0.027]
Characteristics of the parents			
Maternal schooling (in years)	−0.014* [0.007]	−0.014^{+} [0.007]	−0.013^{+} [0.007]
Paternal schooling (in years)	−0.013 [0.0339]	−0.012 [0.034]	−0.007 [0.034]
Household characteristics			
Medium SES (yes = 1)[e]	0.154 [0.322]	0.154 [0.323]	0.0154 [0.323]
High SES (yes = 1)[e]	−0.101 [0.361]	−0.103 [0.363]	−0.129 [0.372]
Possession of assets	0.028 [0.187]	0.027 [0.186]	0.068 [0.189]
Household expenses per adult equivalent[f]	0.00004 [0.650]	0.00004 [0.0001]	0.001 [0.0001]
Intercept	3.038** [0.676]	3.045** [0.681]	2.672** [0.691]
R^2	0.127	0.127	0.123
F	2.3	2.11	1.94
Prob > F	0.0093	0.015	0.03
AIC	786	788	779
BIC	829	834	824

AIC, BIC: parameters to evaluate the models comparability. Robust standard errors in brackets

[a] At least one family member living in the US and sending remittances

[b] Non-migrants information inside parenthesis

[c] Age: 9 years

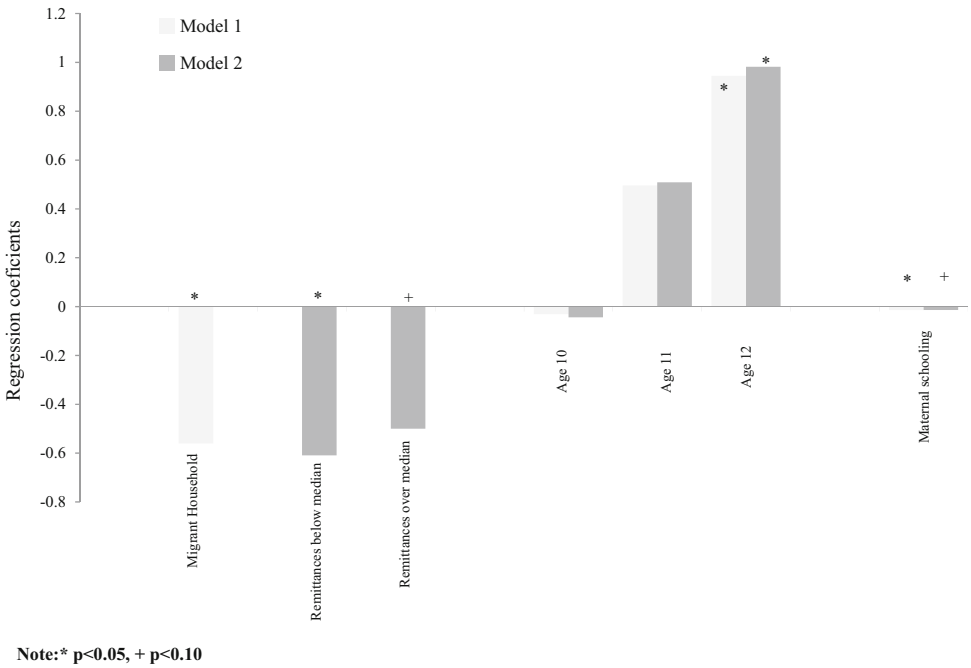
[d] Z-score ($Z = +1, +2$ overweight, $Z \geq +2$ obesity), OMS 2006

[e] Low socioeconomic status

[f] Adult Equivalent. Indicator to compare well-being indicators between households with different demographic characteristics

** $p < 0.01$, * $p < 0.05$, $^{+}$ $p < 0.10$

mostly destined to cover basic needs such as food, health and transportation, followed by school and clothing. Interestingly, remittances were not used to purchase other assets like domestic appliances or electronics. This finding does not support what has been previously reported in the literature, that MH in rural Mexico possesses more electric and electronic appliances than NMH (Salgado de Snyder et al. 2007). This apparently inconsistent finding could be explained by the fact that Morelos (particularly the county of Tlaltizapan) is a state of recent incorporation to the emigration phenomenon in Mexico. It is possible that the migrants of Tlaltizapan may in fact come from the poorest households in that county. According to Census data, the Morelos households that received remittances in 2000–2005 were the poorest and with the lowest level of education (INEGI 2006). Between 2000 and 2005, Tlaltizapan reduced its levels of total poverty, but did not improve in patrimony poverty and poverty of capacities (CONEVAL 2012). It is possible that remittances in rural communities of recent incorporation to the migration phenomenon may be used to provide the basics to family members left behind, and not used for non-essential commodities. In fact, other authors have reported that remittances are programed to be invested in health



Graphic 1 Regression coefficients for models in the presence of a migrant family member and amount of remittances received in MH. Mexico 2006–2007

expenses even before the families left behind begin receiving the resources (Valero and Treviño 2007).

Other studies have documented an inverse association between migration and PA, which is similar to our findings. For instance, Bakker et al. (2010) reported that children whose mother or father migrated had to work instead of doing their usual activities such as going to school. It could be possible that a similar situation is experienced by rural Mexican children such as the ones in the present study. This hypothesis is reinforced by the fact that MH spends less money (monthly) in basic necessities, such as food and health, in comparison to NMH, even when MH has higher incomes through remittances (Hildrebandt et al. 2005).

In relation to migration's negative association with PA, some authors have suggested that the absence of one or both parents may favor non-healthy lifestyles or habits. When parents are not with their children during meal times, and do not provide basic care to them, children's BMI is higher than those of kids whose parents are in charge of their care (Lehto et al. 2012).Other authors have related one family member migration with a lower probability for children to receive vaccines and be breast fed. In this study, only one-third of the children in MH had a migrant parent (father or mother) and almost two-thirds had a migrant sibling. It is feasible that the absence of one parent and/or a sibling diminishes the time of care the children receive in MH (Hesketh et al. 2007). This may have negative consequences in the modeling of healthy behaviors such as PA performance. In our study the longer the time the family member had lived in the US, the less PA performed by children, particularly recreational/leisure activities. This finding could support the notion that one parent́s absence may turn into a risk factor that deteriorates a healthy lifestyle in MH children. Furthermore, literature about this issue reports that children with one or both parents migrating, experience a decrease in psychological wealth, which is manifested through abandonment feelings, low self-esteem and interpersonal relationship problems, hunger, depression, and violence (Bakker et al. 2010).

Almost one-fourth of children from both types of households, MH and NMH, watched movies more than 3 h during the weekend and 10 % used the computer more than 4 h. This result is relevant in terms of overweight and obesity risk since it has been reported a positive association between the time in watching TV during childhood and sedentary behaviors in adulthood (Smith et al. 2014). In fact, time in watching TV can be a proxy of cultural and socioeconomic status as has been reported by Smith et al. who found that children with parents with managerial and professional jobs had less risk of sedentary behaviors in adulthood vs those children who had parents with manual jobs (Smith et al. 2014). Variables such as pocket money, occupation, education and income have been considered as indicators of socioeconomic status components that are strongly related to PA (Kheirollahpour and Sahohaimi 2014; Dogra and Stahthokostas 2014). In our study, the fact that NMH owns computers and motor vehicles, and MH did not have these kinds of assets may be an indicator of socioeconomic status rather than indicators of cultural factors related to PA.

Table 4 Children performing different physical activities in MH and NMH Mexico 2006–2007

Activity performed	MH % of children	NMH % of children	*p* value
Play soccer			
Less than 30 min	33.3	37.1	0.08
30 min–2 h	36.7	20.3	
2–4 h	14.2	15.3	
More than 4 h	15.8	27.1	
Ride a bike			
Less than 30 min	64.5	51.7	0.07
30 min–2 h	20.7	28.8	
>2–4 h	8.3	5.1	
More than 4 h	6.6	14.4	
Walk			
Less than 30 min	26.5	26.5	0.01
30 min–2 h	41.3	28.2	
>2–4 h	16.5	14.5	
>4 h	15.7	30.8	
Run			
Less than 30 min	50.0	48.3	0.08
30 min–2 h	28.3	22.0	
>2–4 h	12.5	7.6	
>4 h	9.2	22.0	
Free play			
Less than 30 min	74.2	89.2	0.04
30 min–2 h	19.7	9.0	
>2–4 h	6.1	1.8	
>4 h	0.0	0.0	
Do homework or read[a]			
<1 h	52.1	40.7	0.05
1–2 h	42.2	53.4	
>2–4 h	2.5	5.9	
>4	3.3	0.0	
Watch movies at home[a]			
Less than 1 h	13.2	9.3	0.06
1–2 h	24.8	27.1	
2–4 h	26.5	36.4	
>4 h	8.26	7.6	
Used computer or play videogames[a]			
Less than 1 h	47.9	29.7	0.05
1–2 h	20.7	38.1	
2–3 h	16.5	16.9	
>4 h	8.3	7.6	

Other categories were explored, nonetheless the table shows only those reaching statistical significance

[a] Activities performed during weekends expressed as hours

The pathways through which migration to the US affects the PA patterns in our study population are not clear. Some hypotheses that may account for the differences between PA of children from MH and NMH include: (a) the role played by the social and cultural dimensions of migration and the remittances in the family cycle; (b) the assignment of responsibilities to children, which may include working; (c) individual factors such as the meaning given to physical activity and its relationship to health and well-being; (d) gender-determined physical activities; and (e) environmental, social and cultural factors that may inhibit PA in children of MH.

The present study contributes to reduce the knowledge gaps about the effect of certain socioeconomic determinants that may place migrant populations as vulnerable groups, driven by the reduced amount of PA in day-to-day tasks, particularly important are recreational activities. The framework use to explain PA and its relationship with health must include individual, environmental and cultural factors related to physical activity. Moreover, a socioeconomic approach may be valuable to broaden the current theoretical framework especially in relation to a phenomenon such as migration and remittances reception. Such insights may improve the odds of more successful rates of quality of life improvement in school-age children who stay in communities of origin. A longitudinal study design may contribute to corroborate the findings of this study and clarify how these effects and mechanisms coexist. Health policies directed to obesity prevention in rural children may become more accurate and appropriate if these differences and interactions are factored in.

Finally, this study is not exempt of limitations. Among these is the cross-sectional nature of the study, which reduces the possibility of making causal inferences about the studied phenomenon. Another limitation is the fact that the questionnaire investigated only the main and most likely activities of a school-age child and does not consider sedentary work or other activities that might contribute to reduce the PA of MH children. Another possible limitation is the comparability of the data obtained in the study with data that could be gathered today. However, a comparison between 2006 and 2010 National Health and Nutrition Surveys showed that there is a difference of only 2.5 % points more in overweight and obesity prevalence in children from 5 to 11 years of age in the State of Morelos. This difference makes us think that social, economic and cultural situation of families living in the studied communities has not changed drastically (Gutiérrez et al. 2012) Moreover, national data about migration show that the State of Morelos continues with a high rate migration to the US (INEGI 2010).

Conclusions

To our knowledge, this study is one of the few that evaluates the association between PA in children and

migration, expressed as remittances reception and time living in USA. Results suggest that migration of a family member to the US is associated with reduced PA in Mexican school-age children. The exposure to migration expressed in reception of remittances and longer periods residing in the US of a family member, the lower the PA, particularly time dedicated to recreation/leisure activities. This finding needs to be considered when designing interventions and strategies for PA promotion in communities with high migration to the US. Also, stronger evidence is required to evaluate the actual effect of the social standards, beliefs and values that prevail in the US and how they impact the lifestyles of those left behind in the communities of origin.

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