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ORIGINAL RESEARCH

Childhood adversity and leisure time physical and sports activity in older adults: A cross-sectional analysis from the International Mobility in Aging Study

Phoebe W. Hwang[1], Cristiano dos Santos Gomes[2], Mohammad Auais[3], Kathryn L. Braun[1], Catherine M. Pirkle[1]

[1] Office of Public Health Studies, University of Hawaii at Mānoa, Hawaii, USA;
[2] Federal University of Rio Grande do Norte, Natal, Brazil;
[3] School of Rehabilitation Therapy, Queen's University, Ontario, Canada.

Corresponding author: Phoebe W. Hwang
Address: 1960 East West Road, Biomedical Sciences Bldg #D104T, Honolulu, Hawaii 96822;
Telephone: (808) 232-3223; E-mail: pwnhwang@hawaii.edu

Abstract

Aim: The purpose is to examine the relationship between childhood adversity and leisure time physical activity (LTPA) among community-dwelling older adults from high and middle-income sites.

Methods: Cross-sectional analysis of 2012 data from older adult ages 64-75 years old from Kingston, Canada; St. Hyacinthe, Canada; Tirana, Albania; Manizales, Colombia; and Natal, Brazil. Principal exposure variables were childhood social and economic adversity. Covariates included participant age, sex, income, and educational attainment. Outcome variables were LTPA and leisure time sports activity (LTSA).

Results: High-income sites had higher LTPA prevalence than middle-income sites. Females were less likely to engage in LTPA compared to males in Tirana (OR:0.53, 95%CI:0.30-0.94), but were more likely to engage in LTPA in Manizales (OR:2.54, 95%CI:1.54-4.18). Low education was less likely than high education to engage in LTPA in Kingston (OR:0.38, 95%CI:0.19-0.73) and Natal (OR: 0.52, 95%CI:0.28-0.97). Low income was less likely than high income to engage in LTPA in St. Hyacinthe (OR: 0.42, 95%CI:0.20-0.89) and Manizales (OR:0.33, 95%CI:0.16-0.55). In Tirana, low income was more likely than high income to engage in LTPA (OR:5.27, 95%CI:2.06-13.51).

Conclusions: Childhood economic and social adversity were not significantly associated with LTPA. Sex, income, and education were associated with older adult PA engagement, however the direction of the association varied by site location. This suggests that the paradigms surrounding PA behavior may vary from city to city. Understanding the site-specific risk factors to PA engagement may better inform clinical recommendations and public health approaches to increase PA engagement among older adults across the globe.

Keywords: *childhood adversity, gerontology, global health, physical activity.*

Conflicts of interest: None declared.

Introduction

Physical activity (PA) is protective against chronic diseases and delays the onset of age-related health complications (1). Leisure time physical activity (LTPA) in particular is more effective in improving overall health than transportation, occupational, and sport-related PA among older adults. Unfortunately, the amount of LTPA decreases as age increases (2).

A large portion of PA literature explores individual level theories of PA behavior change, such as self-efficacy theory and the transtheoretical model, or individual-micro-environment level theories, such as the social cognitive model (3). Consequently, there is no shortage of behavior-based interventions directed to increase older adult PA. Whether home, group, or educational-based, evaluations of these interventions have come to the same conclusion: individual behavior reinforcement strategies alone are not effective in maintaining older adult PA behavior (4). Etiological studies applying a life course perspective may be informative for interventions aimed in improving PA (2).

Among the many exposures life course researchers have examined, early-life exposures appear the most cogently popular. Studies have shown that early life exposures and socio-demographic characteristics affect an individual's health behaviors and outcomes. Gender, social and material adversity, and living in a disadvantaged neighborhood are all documented to influence overall health during adulthood (5,6). These findings suggest that early childhood events may have long-term consequences on health behaviors and that PA behaviors may have roots situated in early life circumstances.

This study focused on community dwelling older adults of diverse socioeconomic status and global settings, recruited as part of the International Mobility in Aging Study (IMIAS). The objective is to examine the relationship between childhood adversity, and self-reported PA behaviors. Since early-life adversity negatively impacts many later life health behaviors, the authors hypothesize that childhood adversity is associated with lower levels of older adult PA behavior. Previous early life adversity studies that utilize a life course model were unable to examine cross-societal influences on behaviors due to sample homogeneity. Cross-societal investigations may provide insights on the contribution of broad social structures to PA behaviors, which in turn, may improve interventions geared at individual behavior change.

Methods

Site Location Descriptions

IMIAS is a longitudinal study focused on older adult health. Baseline data were obtained in 2012, with follow-up collections in 2014 and 2016 (7). Data were community samples collected from five distinct study sites: Kingston and St. Hyacinthe, Canada; Tirana, Albania; Natal, Brazil; and Manizales, Colombia. The entire sample size is 2002 (roughly 200 men and 200 women from each site), which is large enough to examine how childhood adversity influences later life physical activity behavior. Population socioeconomic, cultural, and religious demographics within each study site are relatively homogenous, whereas between sites there is substantial heterogeneity in socio-demographic characteristics. This give us a broad spectrum of different life exposures and health outcomes, thus providing a comprehensive picture of life course exposures and later life health outcomes across the globe. For a detailed description on

site locations and study, please refer to Gomez et al (7).

Population and Data Collection

Participants of this study are male and female community-dwelling older adults age 65-74 years. At Canadian sites, university ethics committees did not allow researchers to recruit potential participants directly. Family physicians sent letters of invitation to potential participants that invited them to contact a field coordinator for further information regarding the study. Participants were recruited from health center registries in Tirana, Natal, and Manizales. A random sample of potential participants was drawn from health center registries, and these individuals were recruited directly by interviewers. Interviewers were trained with a standardized protocol. Comparisons of recruited participants to census data suggest samples are representative of the towns/cities from which they were recruited (7). Individuals who had four or more errors on Leganes Cognitive Test orientation scale (8) were excluded from the study. Low scores indicated inability to complete study procedures. Recruitment continued until about 400 responses were obtained in each locale.

Exposure

Childhood adversity was measured using a series of retrospective questions on events that occurred within the first 15 years of the participants' life. IMIAS survey questions regarding childhood adversity were from the Survey on Health and Well-being Elders (SABE study) (9,10), and the Canadian Community Health Survey (CCHS) (11). The events were: death of parent, parental substance abuse, parental divorce, witnessing physical violence in the family, low economic status, having been hungry, having been physically abused, and parental unemployment. Members of the IMIAS team previously performed an exploratory factor analysis on these indicators to yield two categories: economic adversity (low economic status, hunger, and parental unemployment), and social adversity (parental substance abuse, witnessing family physical violence, having been physically abused) (12). Adversity summary scores of economic and social adversity were recoded into two variables with binary responses—having experienced adversity (having experienced >0 of the indicators listed above) in childhood and no adversity experiences in childhood (having experienced none of the indicators listed above).

Covariates

Education, income, age, and sex were chosen as covariates based on research into the social determinants of health (13). Education was previously trichotomized into three categories: illiterate/primary school only, secondary schooling, and post-secondary schooling. Analyses indicated insufficient variability within sites for comparison across sites. To allow for comparisons across sites, total years of education was split categorically into tertiles of high, medium, and low education by site to obtain a variable called "relative education". Thus, it is possible for a participant to have high educational attainment relative to his/her community, but medium or low attainment compared to another site in IMIAS. Sex is an interviewer reported categorical variable (male/female). Age is a self-reported continuous variable re-coded into a binary categorical variable (64-69/70-75 years). Income is a self-reported continuous variable of annual income recoded into an ordinal variable (poor/middle/high) based on site-specific

poverty thresholds (7). Site location is based on the location of data collection.

Outcomes

The outcomes for this study were LTPA and LTSA. LTPA was defined as leisure time activity that involved bodily movement produced by large skeletal muscles that require energy expenditure (14). LTSA was defined as any reported leisure time activity that is considered an official event in the Olympics (15). LTSA is a subset of LTPA. Participants were asked to report any leisure time activities and to specify those activities. Responses were categorized into yes or no LTPA or LTSA based on the definitions above.

Statistical Analysis

Bivariate analyses were performed using Pearson's chi-squared test for categorical data in order to assess potential differences in proportions between different groups. Assumptions were met for all comparisons. The exposures and covariates listed above were tested as correlates to LTPA and LTSA behavior using logistic regression. Preliminary analysis demonstrated a strong site-specific interaction with the outcome variables childhood social and economic adversities. This was expected given the substantial economic and societal differences between the sites. Therefore, this study focuses on the effect modification per site and analyses were stratified by site to highlight the different relationships. Please refer to the IMIAS cohort profile for additional information regarding study sites (7). All regression models statistically adjusted for age, educational attainment, current income, sex, and site location. STATA/SE 14.0 was used to conduct the analyses.

Results

The prevalence of LTPA and LTSA engagement by site is displayed in Table 1. Kingston (68.1%) and St. Hyacinthe (51.4%) had higher prevalence of LTPA compared to Tirana (17.5%), Manizales (27.3%), and Natal (22.6%). Similar patterns were also observed in LTSA. Of all the participants, 36.7% in Kingston, 31.7% in St. Hyacinthe, 4.1% in Tirana, 5.7% in Manizales, and 5.5% in Natal engaged in LTSA.

Table 1. Proportion of participants reporting leisure time physical and sports activity engagement by site

	Kingston (*N*=398)	St. Hyacinthe (*N*=401)	Tirana (*N*=394)	Manizales (*N*=407)	Natal (*N*=402)
LTPA engagement, n (%)*	68.1%	51.4%	17.5%	27.3%	22.6%
LTSA engagement, n (%)†	36.7%	31.7%	4.1%	5.7%	5.5%

Missing data: Kingston=24; St. Hyacinthe= 46; Tirana= 7; Manizales= 10.
**LTPA = activity done for leisure that results in energy expenditure by major skeletal muscles.*
†LTSA = activity done for leisure that requires physical exertion and skill for competition.

Table 2 summarizes socio-demographic characteristics and adversity. In Manizales, compared to men, women were significantly more likely to report LTPA engagement (33.8% versus 21.9%). At both Canadian sites, those with higher levels of education were significantly more likely to report LTPA compared to those with medium and low site-specific education levels. In Kingston for example, 81.8% of highly educated participants report LTPA compared to 63.5% of those with low education. It should be

noted, however, that even low educated participants from Kingston and St. Hyacinthe reported more LTPA than any educational category at the middle-income sites. Income was significantly associated with LTPA engagement in St. Hyacinthe, Tirana, and Manizales. However, the nature of these associations varied by site. In both St. Hyacinthe and Manizales, high income participants were more likely to report LTPA engagement (67.4% and 41.7%, respectively), compared to poor income participants (47.2% and 23.2%, respectively). The opposite was true in Tirana. Poor income participants were more likely to report LTPA engagement (32.6%) compared to high income (10.6%). In Tirana, 21.3% of participants who experienced childhood economic adversity engaged in LTPA compared to 13.3% of those who didn't experience childhood economic adversity.

Table 2. Summary of leisure time physical activity engagement (LTPA)‡ by participant socio-demographic characteristics and childhood adversity, according to site

	LTPA Engagement				
	Kingston (*N*=398)	**St. Hyacinthe (*N*=401)**	**Tirana (*N*=394)**	**Manizales (*N*=407)**	**Natal (*N*=402)**
Sex *(%)*					
Male	76.6%	59.9%	21.7%	21.9%†	24.0%
Female	68.7%	56.4%	14.3%	33.8%	21.4%
Age in years *(%)*					
64 to 69	72.4%	59.5%	17.1%	26.9%	24.2%
70 to 74	72.6%	55.5%	18.7%	29.2%	20.9%
Education *(%)*¶					
Low	63.5%†	50.0%†	17.9%	26.1%	16.7%†
Medium	76.5%	61.3%	18.3%	23.2%	24.5%
High	81.8%	66.1%	17.0%	35.9%	19.0%
Income *(%)*					
Poor	64.4%	47.2%*	32.6%*	23.2%†	12.1%
Middle	72.9%	66.4%	19.0%	28.07%	21.0%
High	74.5%	67.4%	10.6%	41.7%	27.6%
Childhood Economic Adversity *(%)*§					
Yes	71.7%	55.0%	21.3%†	28.9%	22.0%
No	72.7%	59.7%	13.3%	27.4%	22.0%
Childhood Social Adversity *(%)*II					
Yes	74.7%	55.0%	21.7%	27.7%	26.2%
No	71.6%	59.1%	17.0%	28.2%	21.4%

Pearson's Chi-square analysis was used to test for association of categories within sites
**p<0.001*
†p<0.05
‡Leisure time physical activity is defined as activity done for leisure that results in energy expenditure by major skeletal muscles.
§Childhood economic adversity is defined as having experienced poor economic status, hunger, or parental unemployment.
IIChildhood social adversity is defined as having experienced parental substance abuse, family physical violence, or physical abuse.
¶Education calculated from total years of education categorized by site-specific tertiles

Table 3 summarizes socio-demographic characteristics and adversity by LTSA engagement. Men were significantly more likely to report LTSA engagement in Kingston (49.3%), St. Hyacinthe (43.1%), and Tirana (7.1%) compared to women (29.8%, 29.3%, and 1.5%, respectively). The younger age group (43.8%) was significantly more likely to engage in LTSA compared to the older age group (32.9%) only in Kingston. In Manizales, high education and high income were significantly associated with LTSA engagement. In Tirana, presence of childhood economic adversity was significantly associated with LTSA engagement. In Natal, presence of childhood social adversity was significantly associated with LTSA.

Table 3. Summary of leisure time sport activity engagement (LTSA)‡ by participant socio-demographic characteristics and childhood adversity, according to site

	LTSA Engagement				
	Kingston (*N*=398)	**St. Hyacinthe (*N*=401)**	**Tirana (*N*=394)**	**Manizales (*N*=407)**	**Natal (*N*=402)**
Sex *(%)*					
Male	49.3%*	43.1%†	7.1%†	6.1%	6.8%
Female	29.8%	29.3%	1.5%	5.5%	4.3%
Age in years *(%)*					
64 to 69	43.8%†	35.3%	3.6%	7.1%	6.5%
70 to 74	32.93%	36.7%	4.7%	4.3%	4.3%
Education *(%)*¶					
Low	33.9%	34.5%	5.2%	4.9%†	5.1%
Medium	43.1%	33.1%	3.9%	2.9%	5.8%
High	39.4%	39.1%	3.0%	10.3%	5.8%
Income *(%)*					
Poor	34.0%	32.0%	5.2%	4.9%†	5.1%
Middle	45.9%	36.6%	3.9%	2.9%	5.8%
High	39.4%	40.2%	3.0%	10.3%	5.6%
Childhood Economic Adversity *(%)*§					
Yes	44.2%	34.9%	6.3%†	5.4%	4.6%
No	36.8%	36.3%	1.2%	6.09%	7.1%
Childhood Social Adversity *(%)*II					
Yes	35.8%	34.1%	5.8%	2.1%	9.4%†
No	40.3%	36.4%	3.8%	7.0%	4.1%

Pearson's Chi-square analysis was used to test for association of categories within sites.
** p<0.001*
† p<0.05
‡ Leisure time sport activity is defined as activity done for leisure that requires physical exertion and skill for competition.
§ Childhood economic adversity is defined as having experienced poor economic status, hunger, or parental unemployment.
II Childhood social adversity is defined as having experienced parental substance abuse, family physical violence, or physical abused
¶ Education calculated from total years of education categorized by site-specific tertiles

Tables 4 and 5 summarize the results of the multivariate models. Childhood social and economic adversities were not significantly associated with LTPA engagement in all sites. In Kingston, participants with lower education were less likely to engage in LTPA (OR:0.38, 95%CI:0.19-0.73) compared to high education. In St. Hyacinthe, poor income participants were less likely to engage

in LTPA (OR:0.42, 95%CI:0.20-0.89) compared to high income. The opposite relationship was observed in Tirana. Poor (OR:5.27, 95%CI:2.06-13.51) and middle income (OR:2.44, 95%CI:1.20-4.99) participants were more likely to engage in LTPA compared to high income. In Manizales, women were more likely to engage in LTPA compared to men (OR:2.54, 95%CI:1.54-4.18). Also, poor (OR:0.33, 95%CI:0.16-0.65) and medium income participants (OR:0.46, 95%CI:0.23-0.92) were less likely to engage in LTPA compared to high income participants from this site. In Natal, participants with low education were also less likely to engage in LTPA compared to high education (OR:0.52, 95%CI0.28-0.97). For LTSA in Natal, participants who experienced childhood social adversity were more likely to engage in LTSA compared to those who did not (OR:3.31, 95%CI:1.31-8.41). Females were less likely to engage in LTSA compared to males in Kingston (OR:0.40, 95%CI:0.25-0.65) and Tirana (OR:0.17, 95%CI:0.04-0.64). In Manizales, participants with medium level education were less likely to engage in LTSA compared to high level (OR:0.25, 95%CI:0.10-0.82). In Natal, middle income participants were less likely to engage in LTSA compared to high income (OR:0.29, 95% CI:0.10-0.82).

Table 4. Association of participant socio-demographic characteristics and childhood adversity measures with self-reported LTPA†,‡

	Kingston (*N*=398)		St. Hyacinthe (*N*=401)		Tirana (*N*=394)		Manizales (*N*=407)		Natal (*N*=402)	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sex										
Male	1.00		1.00		1.00		1.00		1.00	
Female	0.74	0.44-1.23	1.24	0.74-2.05	0.53*	0.30-0.94	2.54*	1.54-4.18	0.99	0.60-1.65
Age (years)										
64 to 69	1.00		1.00		1.00		1.00		1.00	
70 to 74	1.18	0.72-1.95	0.89	0.56-1.43	0.91	0.53-1.58	1.08	0.68-1.70	0.81	0.50-1.31
Education¶										
Low	0.38*	0.19-0.73	0.78		0.80	0.38-1.71	0.83	0.44-1.54	0.52*	0.28-0.97
Medium	0.88	0.43-1.78	1.05	0.55-2.00	0.83	0.41-1.69	0.65	0.36-1.19	0.85	0.47-1.52
High	1.00		1.00		1.00		1.00		1.00	
Income										
Poor	0.82	0.40-1.67	0.42*	0.20-0.89	5.27*	2.06-13.51	0.33*	0.16-0.65	0.35	0.11-1.10
Middle	1.31	0.72-2.39	0.95	0.49-1.83	2.44*	1.20-4.99	0.46*	0.23-0.92	0.76	0.44-1.31
High	1.00		1.00		1.00		1.00		1.00	
Childhood Economic Adversity§										
Yes	0.96	0.56-1.64	0.86	0.53-1.39	1.65	0.92-2.93	1.29	0.79-2.09	1.19	0.71-1.99
No	1.00		1.00		1.00		1.00		1.00	
Childhood Social Adversity‖										
Yes	1.42	0.78-2.56	1.08	0.63-1.85	0.93	0.47-1.87	0.90	0.52-1.56	1.43	0.84-2.45
No	1.00		1.00		1.00		1.00		1.00	

**p<0.05*
†Leisure time physical activity is defined as activity done for leisure that results in energy expenditure by major skeletal muscles.
‡Logistic regression models have been adjusted for age, sex, education, and income.
§Childhood economic adversity is defined as having experienced poor economic status, hunger, or parental unemployment.
‖Childhood social adversity is defined as having experienced parental substance abuse, family physical violence, or physical abuse
¶Education calculated from total years of education categorized by site-specific tertiles

Table 5. Association of participant socio-demographic characteristics and childhood adversity measures with self-reported LTSA†,‡

	Kingston (*N*=398)		St. Hyacinthe (*N*=401)		Tirana (*N*=394)		Manizales (*N*=407)		Natal (*N*=402)	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Sex										
Male	1.00		1.00		1.00		1.00		1.00	
Female	0.40*	0.25-0.65	0.65	0.39-1.08	0.17*	0.04-0.64	1.09	0.44-2.67	0.70	0.27-1.85
Age (years)										
64 to 69	1.00		1.00		1.00		1.00		1.00	
70 to 74	0.64	0.40-1.02	1.14	0.71-1.83	1.04	0.36-2.97	0.59	0.24-1.46	0.64	0.25-1.60
Education¶										
Low	0.89	0.49-1.61	0.95	0.51-1.75	2.05	0.46-9.10	0.54	0.17-1.69	1.56	0.48-5.10
Medium	1.62	0.90-2.93	1.17	0.62-2.19	1.28	0.29-5.65	0.25*	0.07-0.87	1.44	0.46-4.54
High	1.00		1.00		1.00		1.00		1.00	
Income										
Poor	1.01	0.50-2.05	0.59	0.28-1.24	3.88	0.79-10.07	0.65	0.18-2.36	0.53	0.10-2.69
Middle	1.21	0.69-2.10	0.84	0.44-1.59	1.37	0.37-5.03	1.42	0.44-4.58	0.29*	0.10-0.82
High	1.00		1.00		1.00		1.00		1.00	
Childhood Economic Adversity§										
Yes	1.62	0.98-2.66	0.88	0.54-1.43	4.35	0.94-20.13	1.31	0.50-3.39	0.60	0.24-1.51
No	1.00		1.00		1.00		1.00		1.00	
Childhood Social Adversity‖										
Yes	0.78	0.46-1.34	1.10	0.64-1.92	0.76	0.22-2.69	0.24	0.5-1.10	3.31*	1.31-8.41
No	1.00		1.00		1.00		1.00		1.00	

**p<0.05*
†Leisure time physical activity is defined as activity done for leisure that results in energy expenditure by major skeletal muscles.
‡Logistic regression models have been adjusted for age, sex, education, and income.
§Childhood economic adversity is defined as having experienced poor economic status, hunger, or parental unemployment.
‖Childhood social adversity is defined as having experienced parental substance abuse, family physical violence, or physical abuse.
¶Education calculated from total years of education categorized by site-specific tertiles.

Discussion

This study examined the relationship between childhood adversity, occurring before 15 years of age, and self-reported later life PA behaviors among community-dwelling older adults from diverse global settings. This study hypothesized that since previous IMIAS studies demonstrated a strong association between childhood adversity and older adult physical performance, there must also be a relationship between childhood adversity and physical activity behavior. However, findings from these studies demonstrated that childhood social adversity was associated with self-reported LTPA only in Tirana and Natal, and childhood economic adversity was not associated with PA engagement at all. As expected, sex, income and education were associated with older adult PA engagement, however the direction of the association varied by site location. This suggests that the paradigms surrounding PA behavior may vary, possibly depending on geographical, cultural, social, and/or historical influences. Thus, the risk factors associated with low PA engagement differ from city to city. Understanding the site-specific risk factors to PA

engagement may better inform clinical recommendations and public health approaches to increase PA engagement among older adults across the globe.

Childhood adversity and physical activity behavior

In a previous IMIAS study, the presence of social and economic childhood adversity was associated with poor physical performance. However, the mechanisms of this relationship were unexplored. Since physical activity is commonly associated with good physical performance (16), we hypothesized that low physical activity engagement may partially explain the association observed by Sousa et al. Contrary to our hypotheses, self-reported childhood adversity experiences did not correlate strongly with LTPA/LTSA engagement among older adults. Moreover, the nature of the association differed from what we hypothesized. In Tirana, self-reported childhood economic adversity was marginally associated with both LTPA/LTSA engagement. While not statistically significant, participants in Tirana who reported childhood economic adversity had 4.35 times the odds of reporting LTSA engagement. In Natal, reporting childhood social adversity was also associated with LTSA.

There is no doubt that early life adversity is associated to poor health behaviors and health outcomes in later life. Therefore, it was puzzling to find that early life adversity did not correlate strongly with LTPA/LTSA. Unfortunately, there is currently no literature that examines the relationship between childhood adversity and later life physical activity behaviors to which we can compare this study. Our current results suggest that physical activity behavior may not explain the relationship between early life adversity and physical performance.

One possible explanation for our contrary findings may be selective survival, since data were collected only among older adults aged 65-74 (17), and the average life expectancies at birth between the sampled sites varied greatly. For example, in 1960, the life expectancy at birth in Brazil was 54.7 years, whereas Canada's average life expectancy was 71.13 years old (18). Therefore, those in Brazil who survived until study recruitment reflect the survivors of their birth cohort. Selective survival has been observed in previous studies where the differences in health and mortality between groups of high and low socioeconomic statuses decline as age increases (19). In fact, a study conducted in Israel found that older adults who survived past 61 years old have higher community resilience scores compared to the younger population, indicating that healthy older adults have a better ability to alleviate the detrimental effects of adverse events (20). This may explain why childhood adversity was associated with physical activity engagement in the middle income sites. Those who managed to overcome childhood adversity and live past the average life expectancy of their cohort may have distinctively different behaviors from those who did not survive.

Site-specific influences on physical activity behavior

Overall, childhood adversity did not correlate as strongly to LTPA/LTSA as compared to the other socio-demographic factors that were observed in this study. LTPA/LTSA engagement was notably greater in high income (Kingston, St. Hyacinthe) compared to middle-income sites (Tirana, Manizales, Natal). These results were consistent with a study that analyzed physical activity trends using data from the World Health Organization. Among adults aged 15 years and over, Brazil,

Colombia, and Albania's physical inactivity rates were higher than Canada's (21). Additionally, the authors found that LTPA increased as occupational PA decreased over time in high-income countries. The same analysis could not be done with low and middle-income countries because these data were not available (21). Our study is one of the first to estimate LTPA prevalence in community dwelling older adults from middle-income settings.

The observed associations between socio-demographic factors and reported PA behavior varied notably by study site as well. The relationships between LTPA/LTSA engagement and socio-demographic variables may be dependent on site-specific norms. For example, income was significantly associated with LTPA engagement in St. Hyacinthe, Tirana, and Manizales, but not in a consistent direction. In Tirana, poor income participants were five times more likely to engage in LTPA compared to high income participants, whereas in St. Hyacinthe, poor income participants were less likely to engage in LTPA compared to high income. Our study further justifies that social norms may influence PA behaviors. Similar results can be found within the United States (22), and high-income East Asian countries (23). However, to the authors' knowledge, no studies have identified cross-societal differences of factors associated to LTPA engagement across study sites of varying income categorization.

LTPA versus LTSA

This paper examined PA behavior by type—LTPA and LTSA. LTSA is a subcategory of LTPA. It can be said that all LTSA is considered LTPA, but not all LTPA is considered LTSA. LTSA have a set of rules and goals to train and excel in specific athletic skills. Moreover, LTSA in general, has a more competitive edge (24). In this study, sex was a significant correlate to LTSA engagement for all sites except Natal. Males were more likely to engage in LTSA compared to females. Yet, sex was not significantly associated to LTPA. Results from this study were congruent to other studies that examined sex differences in PA behaviors. In the United States, females are less likely to engage in vigorous PA from adolescence to adulthood (2). Among college attending young adults, females were less likely to engage in sports compared to males (25). Historical and anthropological studies suggest that males experience an evolutionary history of physical competition for courtship and warfare more often than females (26). Further, men are more likely to engage in extreme physical competitive aggression compared to women (27). Understanding how sex is correlated with physical activity type preference may give us insight on the social norms of PA, and guide sex-specific PA intervention design.

Limitations

Although the large gap between middle and high-income sites clearly shows a difference in PA engagement prevalence, bivariate site-specific analyses that examine the correlates to PA engagement may have been underpowered as very few participants from middle income sites reported LTSA engagement, and relatively few reported LTPA engagement. A second limitation to this study is that the LTPA/LTSA measure used has not been previously validated. However, widely used LTPA measurement tools such as Godin Leisure Time Questionnaire, International Physical Activity Questionnaire, and Sedentary Behavior Questionnaire have been only validated with populations aged 18 to 69 years old, just missing the older adult population.

Further, pilot studies were previously conducted to validate the IPAQ in Santa Cruz, Brazil, using accelerometers. Results showed that IPAQ had poor validity (28); therefore, it was not considered for this study. Lastly, since this is a secondary data analysis, sample size could not be determined a priori. Thus, the sample size may not be powered for this particular analysis. However, given the richness of the data, it allows us to deeply examine the multiple factors involved in the life course.

Conclusions

Since the 1990's, there has been a progress in research that examines environment-level factors correlates and causes of PA. Unfortunately, many studies focused only on high-income countries (29). As the world ages, and the global burden of non-communicable diseases increase, health behaviors such as PA are becoming more relevant in lower-income settings. Several studies have shown a link between childhood adversity at adult PA behavior, but have not followed the participants into older adulthood (30). This study is one of the few that makes cross-societal inferences on the effects of childhood adversity on older adult PA behavior and it highlights the powerful influences of social norms on LTPA/LTSA engagement.

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