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Research Article

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Sedentary Lifestyle, Levels of Physical Activity and Adiposity in The Costa Rican Adult Population 18 To 69 Yrs

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Abstract

Purpose: *To determine sedentary lifestyle, sitting time, physical activity levels, and overweight-obesity in Costa Rican population aged 18-69 yr.*

Methods*: By multistage sampling method, 843 adults self-reported height, weight, and the International Physical Activity Questionnaire. Physical Activity (PA) intensity groupings (i.e., sedentary, moderate and high-intensity) were created by K-means cluster analysis. Multiple linear regression analysis determined whether sociodemographic features predicted PA levels. Predictor variables were dummy-coded for analysis and assumptions for multiple regression were analyzed.*

Results: *Self-reported sedentary lifestyle 64.8%, moderate-intensity PA 27.5%, and high-intensity PA 7.4%. Males spent more time sitting (7-10 $h \cdot d^{-1}$), than females (1-4 $h \cdot d^{-1}$). Males predicted higher levels of PA than females ($p \leq 0.0001$). Individuals 30-49 yr. predicted higher levels of PA ($p = 0.031$) than those aged 18-29 and 50-69 yr. High amounts of overweight and obesity were self-reported (male 56.1%, female 56.4%).*

Conclusion: *Costa Rican adult population from 18 to 69 yr. are at an increased risk of developing chronic diseases due to the lack of PA, high amounts of sitting time and prevalence of overweight and obesity. This is a major concern for local health authorities to establish public health guidelines and interventions to ameliorate these disparities.*

Keywords*: Sedentary behavior, obesity, chronic diseases.*

Introduction

Sedentary lifestyle levels are on the rise. Global data estimates that one in four adults and 81% of adolescents do not engage in enough physical activity (PA). The changes in transportation patterns, increased use of technology, cultural values and urbanization have influenced this behavior [1]. Furthermore, sedentary behavior represents the lower level of the spectrum of PA; the construct is defined as those activities that represent a low energy expenditure. This low energy cost is understood as less than 1.5 metabolic equivalents of task (MET), with activities representative of this behavior such as sitting, watching television, using the computer, reading or sleeping [2].

There is a robust body of evidence that relates sedentary behavior with chronic diseases such as diabetes, obesity, cardiovascular diseases, cancer, and metabolic syndrome, among others [3]. This plethora of maladies represents a severe public health problem [4-10]. The World Health Organization indicates that regular PA helps to prevent and control chronic diseases. It also supports maintaining a healthy body weight and can improve mental health, quality of life, and overall well-being. To perceive these benefits of PA, the global recommendations for adults aged 18-64 yr. indicate that they should accumulate at least 150 min per week of moderate aerobic physical activity, or a minimum of 75 min per week of vigorous aerobic physical activity, or an equivalent combination of moderate and vigorous activity [11].

The volume of PA modifies the associations between sedentary behaviors and CVD and cancer mortality. A harmonized meta-analytical study considered deaths in four groups of sedentary behaviors (<2.5 MET-h/week, 16 MET-h/week, 30 MET-h/week, >35 MET-h/week) where a dose-response association was found between sitting time (9% to 32% more risk) and time in front of television (3% to 59% more risk) and CVD mortality in the "inactive group" of the lowest PA. The associations were less consistent in the

second and third groups of PA, and there was no increased risk of CVD mortality with the increase in sedentary behaviors in the most active group [4]. These findings emphasize the importance of higher volumes of moderate and vigorous activity to reduce, or even eliminate these risks, especially for those sitting for prolonged time during their daily routine. These findings emphasize the importance of higher volumes of moderate and vigorous activity to reduce, or even eliminate these risks, especially for those who sit a lot in their daily lives. However, there is evidence proving that accumulated moderate-to-vigorous PA (MVPA) in form of short bouts during the day is also helpful to improve health incomes [12-14].

In a previous study [15], researchers analyzed the association between high amounts of PA and all-cause mortality risk in the general population. The mortality risk was lower at PA levels well above the recommended target range (almost 150 min/week); furthermore, there was no threshold beyond which lifespan was compromised.

In Costa Rica, chronic diseases represent an important public health problem. Health conditions such as arterial hypertension show a prevalence of 36.2% of the population, diabetes mellitus 12.8%, overweight and obesity 36.8% and 29.4% respectively, and cancer shows a prevalence of 33.8% in adults ≥ 18 yr. [16]. These diseases are exacerbated by sedentary habits and increased PA represent a preventive factor to attenuate these diseases. However, no current statistics exist on sedentary habits, PA, body height, and body weight in the Costa Rican population. Therefore, the purpose of the study was to survey sedentary lifestyle, PA and adiposity in a National representative sample of the Costa Rican population aged 18 to 69 yr. [16].

Methods

All procedures described herein are conformed to the standards set by the latest revision of the Declaration of Helsinki.

Population and sampling framework

Male and female Costa Rican citizens ≥ 18 yr. old throughout the country residing in private homes completed a face-to-face survey. The survey was conducted by students from the School of Statistics of the University of Costa Rica, as a practical experience for the "Survey Design" course (10/2016). The sampling framework used was the 2011 Housing Sample Framework (HSF-2011) obtained from the Costa Rica's National Institute of Statistics and Census (INEC, for its acronym in Spanish), which contains 10 470 primary sampling units (PSU). The HSF-2011 includes private homes located throughout the national territory, organized by province, canton and district, urban and rural areas, and development regions.

A multistage sampling method used (two-stages, stratified, proportional by area), with a PSU probability proportional to the size (i.e., number of dwellings). The sampling error was 3.0% points for the total variables, and there was a response rate of 70%. The treatment of the non-response consisted of visiting again the dwelling (second visit) and through telephone interview. An expansion factor for homes was built by PSUs, as well as an expansion factor for people. The non-response was adjusted based on population projections and the National Household Survey 2016 (ENAHO-2016, for its acronym in Spanish) developed by INEC. All partial weights were multiplied to compute the final expansion factor. Thus, the final sample size consisted of 1059 participants, with 100% coverage of the country's housing.

Sociodemographic characteristics	ENAHO-2016	Current Survey
Total	100	100
Gender		
Male	48.0	48.1
Female	52.0	51.9
Age group (yr.)		
18-29	31.4	34.0
30-49	38.6	39.9
50-69	30.0	26.0
Education level		
Elementary or less	37.5	35.5
High-school	38.8	39.8
University	23.8	24.7
Socioeconomic level		
Low	-	29.5
Middle	-	52.4
High	-	18.0
ENAHO-2016: National Household Survey 2016 from Costa Rica's National Institute of Statistics and Census.		

Table 1: Comparison of the Costa Rican population aged 18 to 69 yr. (ENAHO-2016) and the current survey based on sociodemographic characteristics. Values are %.

It is known that disabilities reduce physical activity [17]; therefore, during the face-to-face interview participants were asked: "Do you currently have any permanent condition or disability (i.e., physical, cognitive, or sensory impairment that substantially limit your major activities)?" The answers were coded based on the information provided.

A total of 121 subjects (9%) were excluded from the final analysis. In addition, a second adjustment was done given that the physical activity instrument showed evidence of validity only for individuals between 15 and 69 yr. [18]. Thus, adults older than 70 yr. (n = 66, or 6.2% of the sample) were excluded from the final analysis. With these adjustments, the original representative sample went from 1051 Costa Ricans aged ≥ 18 yr. to 843 adults aged 18 to 69 yr. free of disabilities (~2.6 million of the population).

Measurement

The participants completed a survey where demographic information, and self-reported body height and weight were asked. The body mass index (BMI) was computed from these measures as BMI (kg/m^2) = body weight (kg)/height (m^2). The participants also completed the Spanish short-version of the International Physical Activity Questionnaire (IPAQ) (18). The IPAQ has shown acceptable reliability (r = 0.80) and evidence of criterion validity (r = 0.30), which is similar to many other self-report instruments (18). The instrument is designed to be applied to individuals between 18 and 69 yr. The PA intensity levels were computed with the algorithm provided in the IPAQ guidelines [19].

Statistical analysis

Statistical analysis was performed with the IBM-SPSS Statistics, version 22 (IBM Corporation, Armonk, New York). Descriptive statistics is presented as percentages for categorical variables and mean and 95% confidence intervals ($CI_{95\%}$) for continuous variables, unless otherwise noted. The PA intensity groupings (i.e., sedentary, moderate-intensity, high-intensity) were created by K-means cluster analysis.

A multiple linear regression analysis was computed to determine whether sociodemographic features predicted PA levels. The criterion or dependent variable was PA recorded on MET-min/week, and the predictor or independent variables were gender, age group, education level, and socioeconomic level. Predictor variables were dummy-coded for analysis and assumptions for multiple regression were studied [20].

Results

The final population (expanded cases, N) and sampling cases (n) are presented in table 2. Sedentary lifestyle was reported by 65% of the population, while moderate-intensity PA was reported by 27.5% and high-intensity PA was reported in 7.4% of the population.

Physical activity	Mean MET-min/week	CV (%)	Sample cases (n)	Expanded cases (N)
Low	981.0	3.1	560	1 723 896
Moderate	4 781.2	6.7	224	727 855
High	11 855.3	19.4	59	196 218
Total	2 831.4	3.9	843	2 647 969

Table 2: Physical activity classification based on energy expenditure (MET-min/week) for the Costa Rican population aged 18 to 69 yr. The physical activity intensity levels were computed with the algorithm provided in theIPAQ Research Committee (45) guidelines. The frequency groupings were created by K-means cluster analysis.

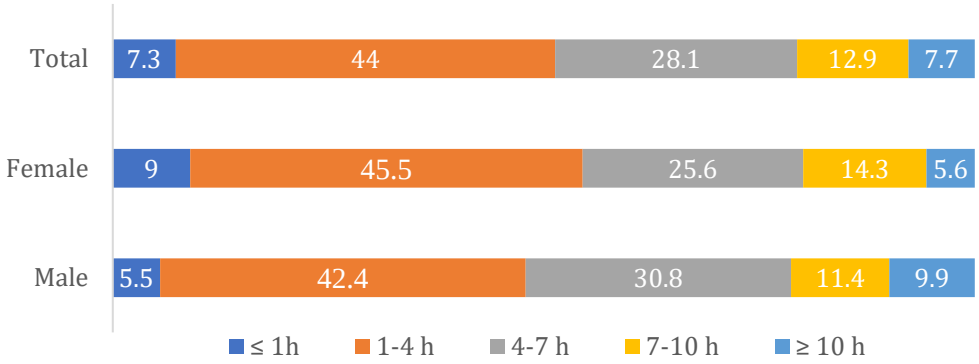
The PA and sedentary lifestyle by gender, age group, educational and socioeconomic levels are presented in table 3. A higher proportion of females spend sedentary time than males. Males spend more time in moderate- and high-intensity physical activities compared to females. The 50 to 69 yr. age group shown to be the most sedentary, and the 30 to 49 yr. age group was the less sedentary and the group with the highest moderate-intensity PA pattern. University educated people were the most sedentary group, and high-school educated people reported the highest levels of moderate-intensity PA. Sedentary lifestyle was similar between socioeconomic levels.

	Physical Activity Intensity			
Sociodemographic characteristics	**Sedentary**	**Moderate**	**High**	**Total**
Gender				
Male	58.1	30.1	11.8	100
Female	71.6	25.1	3.3	100
Age group (yr.)				
18-29	66.6	25.5	7.9	100
30-49	60.6	32.2	7.2	100
50-69	70.0	22.9	7.1	100
Education level				
Elementary or less	64.8	25.9	9.3	100
High-school	60.4	32.4	7.2	100
University	73.2	21.7	5.1	100
Socioeconomic level				
Low	66.7	24.6	8.7	100
Middle	63.7	31.2	5.1	100
High	66.5	21.4	12.0	100

Table 3: Percentual distribution of the reported physical activity levels in the Costa Rican population of adults aged 18 to 69 yr. by sociodemographic characteristics.

The self-reported daily sitting time (h·d^{-1}) by gender is presented in figure 1. A high proportion of males spend sitting 7 to 10 h·d^{-1}, while a high proportion of females spend sitting 1 to 4 h·d^{-1}. Only 5.5% and 9% of males and females spend sitting less than 1 h·d^{-1}, respectively. On the other side, almost 10% of males and 5.6% of females spend more than 10 h·d^{-1} sitting.

Figure 1: Self-reported daily sitting time (%) by gender in the Costa Rican population of adults aged 18 to 69 yr. Mean = 4.1, Mode=2.0, Median= 3.0.



The self-reported body weight and height was used to estimate BMI (Figure 2). In general, ~40% participants reported normal weight, and only less than 5% reported low weight. A smaller proportion of males reported obesity compared to females. More males reported being overweight compared to females.

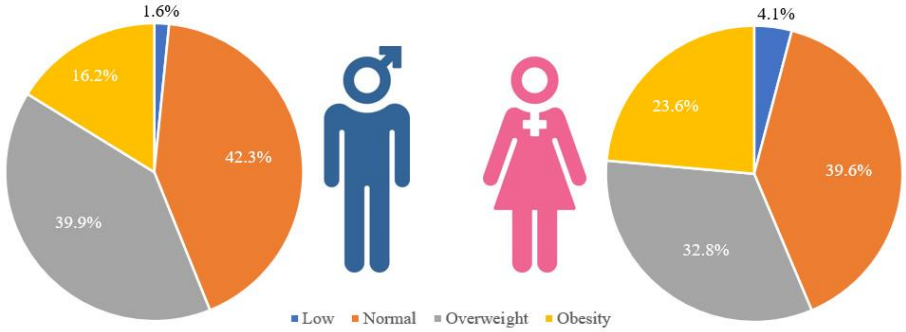


Figure 2: Body weight percentual categorization based on the self-reported body mass index (BMI) by gender in the Costa Rican population of adults aged 18 to 69 yr.

The BMI categorization by gender and age group is presented in table 4. For males, similar normal weight percentages are reported for age groups 30-49 and 50-69 yr. For females, similar overweight percentages are reported for all age groups. Obesity percentages were lower in males compared to females in all age groups. Overall, females showed a higher proportion of obesity and low weight than males. Also, males showed a higher proportion of overweight and normal weight than females.

		Body Mass Index Category				
Gender	**Age group (yr.)**	**Low**	**Normal**	**Overweight**	**Obesity**	**Total**
Male	18-29	4.0	60.0	27.6	8.4	100
	30-49	0.0	33.8	42.9	23.4	100
	50-69	0.8	31.0	52.6	15.6	100
	Total	1.6	42.3	39.9	16.2	100
Female	18-29	11.1	48.5	30.8	9.6	100
	30-49	0.7	37.2	35.2	27.0	100
	50-69	0.5	32.1	31.6	35.8	100
	Total	4.1	39.6	32.8	23.6	100

Table 4: Percentual distribution of estimated body mass index (BMI) by gender and age group in the Costa Rican population of adults aged 18 to 69 yr.

For the regression analysis, the dependent variable for the model was PA (MET-min/week). However, it was necessary to log-transform it to fulfill the normality of the residual's assumption. Other assumptions were adequately met; both, the tolerance and the variance inflation factor (VIF) indicated that there was no multicollinearity between variables. The R coefficient resulted in 24.7% and the coefficient of determination R^2 was 6.1% (Table 5).

Model	Unstandardized Coefficients		Standardized Coefficients	t	p ≤	$CI_{95\%}$ for β		Collinearity Statistics	
	β	Std. Error	β			Lower Bound	Upper Bound	Tolerance	VIF
(Constant)	6.73	0.15		46.1	0.0001	6.4	7.0		
Male	0.51	0.08	0.20	6.1	0.0001	0.3	0.7	1.0	1.0
AG: 18 to 29 yr.	0.06	0.11	0.02	0.5	0.609	-0.2	0.3	0.6	1.7
AG: 30 to 49 yr.	0.23	0.11	0.09	2.2	0.031	0.0	0.4	0.6	1.6
ED: Elementary	0.17	0.12	0.06	1.4	0.168	-0.1	0.4	0.5	2.0
ED: High-school	0.28	0.11	0.11	2.7	0.008	0.1	0.5	0.6	1.6
SEL: High	0.19	0.14	0.06	1.4	0.170	-0.1	0.5	0.6	1.7
SEL: Medium	0.18	0.10	0.07	1.8	0.073	-0.0	0.4	0.7	1.5

Table 5: Multiple linear regression coefficients on sociodemographic predictors of physical activity (MET-min/week) (n = 843).

The regression analysis indicated that being male predicted higher levels of PA than being female (p ≤ 0.0001). Individuals aged 30 to 49 yr. predicted higher levels of PA (p = 0.031) than their counterparts aged 18-29 and 50 to 69 yr. Having high-school education predicted higher levels of PA (p = 0-008) than having elementary and university education. Finally, socioeconomic level did not predict PA.

Discussion

The purpose of this study was to determine sedentary behavior, sitting time, levels of PA, and adiposity as determined by the BMI in Costa Rican population from 18 to 69 yr. The results from the IPAQ showed high amounts of sedentary behavior across the country in both, adult males and females, with females showing higher percentages of time spent in this deleterious behavior. Groups of individuals between 50 to 69 and 30 to 48 yr. showed the highest and lowest amount of sedentary time, respectively. Men spent more time on MVPA than females. In addition, overweight and obesity appear to have an important impact on the measured groups, with males and females showing 56.1% and 56.4%, respectively on this condition, and females reported higher amounts of obesity and males more overweight. Finally, self-reported sitting time showed that almost 93% of the sample spend more than one hour per day sitting and, more importantly, individuals spent excessive time in this harmful behavior.

Sedentary behavior is considered the fourth cause of death worldwide [21] and its deleterious effects are related to high amounts of all known chronic diseases [22]. New evidence has shown that sedentary behavior impacts mostly adult populations producing negative effects in overall health [23, 24] and quality of life [25]. Even if we do not analyze the direct impact on health outcomes in this study, the high amount of sedentary behavior reported by Costa Rican adult population be considered as a dangerous situation that impacts or can impact negatively over people's health in this country. Several studies indicate that high amounts of sedentary behavior are related to chronic diseases, overweight, obesity and other negative conditions [26-29], and these results, related to the present findings, are an alarm for Costa Rican authorities to pay attention to this particular condition and promote interventions that can ameliorate the participation of adults in daily PA to reduce sedentary behavior and to prevent the appearance of chronic diseases and early mortality.

Furthermore, self-reported sitting time has to be seen as part of sedentary behavior; however, sitting time is a harmful activity by itself and it is a predictor of cardiovascular diseases, obesity, diabetes, and death [4]. The higher amount of time spent sitting, the higher possibilities of facing negative health outcomes [30-32]. Independently of the nature of the sitting time like watching TV, driving, resting, computing, etc., as part of sedentary behavior, it can lead to several detrimental results [33]; total time sitting and the low energy expenditure during this time can lead to a myriad of diseases including overweight and obesity [34]. The prevalence of overweight and obesity have increased over the years, and nowadays, almost the third part of the world's population is facing these conditions [35]. According to the information above, in our study, we found that around 56% of the polled population reported being overweight or obese condition, which is a situation to be considered by local authorities. It is important to develop programs to fight against the circumstances and to promote a healthier life style that must include higher time spent in PA, less time sitting, and overall, paying attention to the insufficient PA that the Costa Rican is having.

In a study that surveyed 1.9 million people from 168 countries, researchers reported that insufficient PA is a condition that has a higher impact in high-income countries with a prevalence of almost 37%. In addition, the highest amount of insufficient PA was found in Latin America and Caribbean women (43.7%) [36]. In the present study, 65% of the adults reported insufficient PA or otherwise called sedentary behavior for this self-reported data (Females = 71.6%, Males = 58.1%). If we add here the reported sitting time, shown in figure 3, then, all conditions together show that Costa Rica is facing even a higher risk of having sicker people and a bigger concern for early mortality.

In addition, considering the facts shown above and putting all together, the self-reported amounts of PA from the Costa Rican population seem to be not enough to meet the global recommendations [37], and this is a big concern if combined with the amounts of sitting time/sedentary behavior and overweight and obesity that our participants reported. To counteract this damaging situation, PA has proven to have a positive direct impact over human health, even small amounts per day, or performed as short breaks, it produces important benefits to prevent or to ameliorate the effect of diseases like obesity and diabetes [12], hypertension [38], and other chronic diseases [39]. It is concerning that in our

study, adults not only self-reported lack of PA, but also reported low amounts of MVPA, a situation that can lead to develop chronic diseases and early mortality in the population. Moreover, males are predicted to perform more PA and perform MVPA than females, which also could explain the higher levels of obesity self-reported by women. Scientists consider that adding MVPA to daily routines is an important factor to positively impact human health and quality of life [40]. Not performing enough MVPA during the day may result later in some health disparities [41,42]; however, it is important to keep in mind that some MVPA that people can perform would be good to improve health or stay away from increased risk of developing chronic diseases and early mortality [41]. A previous study showed an inverse dose-response relationship between MVPA and health and all-cause mortality, meaning that performing higher amounts of MVPA lead to more of energy expenditure and this is an important variable to ameliorate the deleterious impact of physical inactivity and sedentary behavior over human health [43].

The present study has some limitations. We reached a large sample to provide more reliability on results that can explain how Costa Rican adult population behave in terms of sedentary behavior, PA, sitting time, and overall adiposity. Self-reported measures lead to subjective results; however, it has been documented that, self-reports for sedentary behavior, PA, sitting time and similar variables can be used for epidemiological studies that include large samples [44]. IPAQ has an acceptable reliability (r = 0.80) and evidence of criterion validity (r = 0.30), and this questionnaire is known to show important outcomes to picture these behaviors in adult populations [18].

In conclusion, the Costa Rican adult population from 18 to 69 yr. are at an increased risk of developing chronic diseases due to the lack of adequate levels of PA, low volume of MVPA, high amounts of sitting time and a high prevalence of overweight and obesity. These findings should be a major concern for local authorities to establish public health guidelines and interventions to ameliorate these disparities.

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The results of this study are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation, and the results obtained in this study do not constitute any endorsement.

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Conflicts of Interest
All contributing authors declare no conflicts of interest.

Practical implications

- The negative combination of too much sitting time and sedentary behavior would increase the appearance of chronic diseases and impact directly on Costa Rican adult´s health.
- More MVPA could be performed by Costa Rican adult population to ameliorate the overweight and obesity negative impact on health.

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