Original Research

Sports participation and health care costs in older adults aged 50 years or more

Running title: Sports and costs

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Abstract

The objective of the study was to analyze the relationship between sports participation and health care costs in older adults. The sample was composed of 556 participants (145 men and 411 women) who were followed from 2010 to 2014. The engagement in sports considered three different components (intensity, volume and previous time). Health care costs were assessed annually through medical records. Structural Equation Modelling (SEM) (longitudinal relationship between sport and costs) and analysis of variance (ANOVA) for repeated measures (comparisons over time) were used. Health care costs increased significantly from 2010 to 2014 (ANOVA; p-value= 0.001). Higher baseline scores for intensity were related to lower health care costs (r= -0.223 [-0.404 to -0.042]). Similar results were found to volume (r= -0.216 [-0.396 to -0.036]) and time of engagement (r= -0.218 [-0.402 to -0.034]). In conclusion, higher sports participation is related to lower health care costs in older adults.

Keywords: sports medicine, Health Costs, sport.

Introduction

Population aging, physical inactivity and the increased occurrence of chronic diseases drive up public health care expenditures around the globe (Davis et al., 2014; Officer, 2009). Despite well-documented evidence on the significant health benefits of physical activity (PA), insufficient physical activity remains a global public health problem. World Health Organization reports that in 2010 approximately 23% of adults were insufficiently active (WHO, 2014), while insufficient physical activity was responsible for approximately 9% of early mortality worldwide in 2008 (Lee et al., 2012).

Sports participation is one of the most relevant manifestations of physical exercise, and is highly common during childhood and adolescence, but decreases in adulthood and it get even lower among older adults (Eime et al., 2016). Also, sports participation is the major contributor towards people achieving the minimum PA recommendations (Garber et al., 2011). Epidemiological surveys have identified the positive impact of sports participation on cardiovascular and metabolic outcomes, as well as improvements in mental health indicators among adults (Fernandes & Zanesco, 2010; Marlier et al., 2015).

Although sports participation among adults may play a role in the mitigation of health care costs due to its potential to prevent diseases, the nature of this relationship is not clear. The scarce evidence available is based on cross-sectional data (Codogno et al., 2015). In developed countries, evidence shows that between 1% and 2.6% of all health care costs are due to physical inactivity (Pratt, Norris, Lobelo, Roux, & Wang, 2014), while in emergent countries it is estimated that physical inactivity is responsible for 1% of overall costs in primary health care

(Codogno et al., 2015), and nearly 15% of inpatient costs (Bielemann, Silva, Coll, Xavier, & Silva, 2015).

While cross-sectional data identify a significant association between sports participation and lower expenditures on medication (Codogno et al., 2015), the methodological design does not offer support to longitudinal inferences (particularly when regular engagement in exercise routines is more beneficial to health than its erratic practice) (Shiroma, Sesso, Moorthy, Buring, & Lee, 2014). Moreover, it is not clear which component of sports participation (intensity, volume and the previous time of engagement) would have a more significant effect on health and mortality, leading to mitigation of health care costs. Drenowatz et al. (2016) (Drenowatz, Prasad, Hand, Shook, & Blair, 2016) show that, although moderate and vigorous activities can improve overall health, vigorous activities are more likely to increase cardiorespiratory fitness, while moderate activities have a favorable association with changes in body composition. On the other hand, although sports participation constitutes a relevant manifestation of exercise in the modern society (Blauwet et al., 2016; Freitas, Osorio-de-Castro, Shoaf, Silva, & Miranda, 2016; Sallis et al., 2016) and embraces moderate and vigorous PA, the influence of its components on mitigation of health care costs is still unclear.

Therefore, this study aimed to analyze the longitudinal relationship between sports participation (intensity, duration and the previous time of engagement) and health care costs in older adults aged 50 years or more.

The initial hypothesis of this study states that sports participation would mitigate health care costs in older adults over time, while its components would similarly affect health care costs.

Methods

Sample

This is an ongoing cohort study carried out in Sao Paulo State (city of Bauru), Brazil, which started in August 2010. Bauru, a mid-sized Brazilian city (~367,000 inhabitants and high human development index= 0.801) located in the central region of São Paulo State (most industrialized Brazilian state). Participants were randomly selected in five basic health care units (BHU) (small-to-medium size healthcare facilities) under the administration of the Brazilian National Health Service (NHS). Initially, a list of all patients aged ≥50 years-old attended by these five BHU was provided by the local Department of Health. After that, a random selection process took place in order to select patients who would be invited by phone contact to participate (1,915 patients were randomly selected to be contacted by telephone [this overall number of potential participants was estimated considering that there would be one refusal per two subjects invited to take part in the study]). Random selection process was carried out using the statistical software Statistical Package for the Social Sciences version 13.0 (Select Cases > Random sample of cases > Sample > Inserted the number of cases to be randomly selected).

In the NHS, each BHU caters to people living in a specific geographical region of the city (neighborhoods around the BHU), providing access to several health professionals (e.g., dentist, general practitioner, gynecologist, obstetrician, pediatrician, and psychiatrist). BHUs also offer health services such as vaccinations, delivery of prescribed medication and management of patients with chronic diseases, such as arterial hypertension and diabetes mellitus (Codogno, Fernandes, Sarti, Freitas Junior, & Monteiro, 2011). Services are free of charge and focus exclusively on prevention (primary care services). Emergency cases, surgical procedures, and complex examinations are directed to hospitals linked to NHS.

At baseline (2010), the local Department of Health designated the five biggest BHU to host the cohort study. The city had 17 BHU in 2010, and the five units indicated by the local Department of Health were spread out in different geographical regions of the city (north, south, west, east and downtown).

Taking into account the list of 1,915 patients, all these potential participants were contacted by telephone to check inclusion criteria: age ≥50 years, registration for at least one year at the BHU and have at least one medical appointment in the past six months. Upon the telephone contact, trained staff interviewed participants every two years (first interview [2010] was performed at the BHU, while the subsequent interviews [2012 and 2014] were performed through telephone contact). All participants signed a written consent form before participation, while the Ethical Research Commit of the XXX XXXXX XXXXX XXXXXXXXXX, Bauru, has approved the research.

At baseline, 970 older adults (194 from each BHU) fulfilled all inclusion criteria and agreed to participate. From 2010 to 2014, 59 participants died and thus they were excluded, as well as 355 participants were excluded from the sample due to the absence of measures of PA either 2012 or 2014. Therefore, this study presents information from 556 participants tracked from 2010 to 2014 with no missing data. The minimum sample size of 147 participants was calculated considering a relationship between physical activity and health care costs in older adults of r = -0.23 (Codogno et al. 2011), statistical power of 80% and an alpha error of 5% (Z= 1.96) (Miot, 2011). Potential sample selection bias was assessed by examining systematic differences at baseline between the 556 participants who were followed from 2010 to 2014 and those 414 participants who were excluded for any reason (59 deaths and 355 missing data). The comparisons identified similarities to chronological age (Student t-test with *p*-value= 0.867), health care costs (Student t-test with *p*-value= 0.674), sports participation score (chi-squared with *p*-value= 0.217), obesity rate (chi-squared with *p*-value= 0.145) and sex (chi-squared with *p*-value= 0.961).

Sports participation

Sports participation was assessed in three different time points (2010, 2012 and 2014) by the same researchers following the same procedures to the interview. In this study, the participation in both collective (e.g. soccer, basketball, volleyball) and individual sports (e.g. tennis, running, swimming) was accounted and the presence of competition was not mandatory to characterize sports participation (e.g. swimming performed at the gym was identified as sports participation). A few participants reported engagement in more than one sport (less than 5% of the cases) and we collected data on the sport performed more often. The engagement in sports was assessed using three different indicators of Baecke's questionnaire (Baecke, Burema, & Frijters, 1982): (A) intensity (Sport $_{\text{Intensity}}$), (B) volume (Sport $_{\text{Volume}}$) and (C) previous time of engagement (Sport $_{\text{Previous time}}$).

Sports $_{\text{Intensity}}$ was based in the participant's subjective self-perception of effort. Considering the sport in which the participant is engaged in, the questionnaire offers three options in terms of subjective perception of effort (light [score= 0.76], moderate [score= 1.26] and vigorous [score= 1.76]). Sport $_{\text{Volume}}$ considered the amount of hours per week dedicated to sports participation (<1h [score= 0.5], 1-2h [score= 1.5], 2-3h [score= 2.5], 3-4h [score= 3.5] and >4h [score= 4.5]). $\text{Sport}_{\text{Previous time}}$ is the amount of time engaged in sports during the last 12 months (<1 month [score= 0.04], 1-3 months [score= 0.17], 4-6 months [score= 0.42], 7-9 months [score= 0.67] and ≥9 months [score= 0.92]). All sports components were treated as continuous variables, while participants who were not engaged in any sports received the score zero to all three sport's dimensions analyzed (intensity, volume and duration).

Health care costs

Primary care health care costs paid by the NHS were assessed. Since 2010, the local Department of Health has granted the researchers full access to the medical records of the participants of the cohort study. Researchers have registered data about number and type of medical appointments, tests (e.g., blood tests, scan densitometry and ultrasonography) and medication prescribed. The financial office of the local Department of Health provided the prices paid for all services (medical consultations, medicines released and exams) and the amount of money was computed annually in 2010, 2011, 2012, 2013 and 2014 (any health care service that happened from January 1st to December 31st were considered in the same calendar year). Costs with medical consultations were calculated as: [number of consultations x price paid per each appointment by NHS]. Costs with exams were calculated as: [number of exams x price paid per each procedure by NHS]. Costs related to medicines were calculated as: [number of medicines prescribed and released to the patient x price paid by NHS]. The costs related to medication were divided by the dosage delivered to the patient (e.g. if the price paid for one box of antihypertensive was US$ 2.00, but the patient received a half box, the cost spent with the patient was US$ 1.00). Prices were expressed in US dollars and adjusted using inflation rates observed in the Brazilian economy in 2015, 2016 and 2017. Calculations followed standard methods, as described in the previous studies (Codogno et al., 2011; Codogno et al., 2015).

Covariates

The covariates were defined as biological (sex [male and female], and chronological age [the difference between birthday and date of measurement at baseline]) and health variables (body mass index ([BMI]). BMI was estimated as body weight divided by squared height (expressed as kg/m^2). Body weight and height were measured by the researchers in a reserved room in the BHU.

Statistical analyses

Descriptive statistics for continuous variables were expressed as mean and median, 95% confidence interval (95%CI), 25th and 75th percentiles. Categorical variables were presented as rates and 95%CI. Comparisons of mean values across years were based on ANOVA for repeated measures (when ANOVA was statistically significant, Bonferroni`s post-hoc test was used). Mauchly's test of sphericity was used to assess how fitted the models were and, when necessary (sphericity assumption violated), the Greenhouse-Geisser correction was used. ANOVA models were adjusted by sex, age, BMI and economic condition. Eta-squared values were adopted as measures of effect-size in ANOVA models (small [<0.060], moderate [0.060 to 0.139] and large magnitude [≥0.140]).

The effect of changes in sports participation on health care costs from 2010 to 2014 was assessed using General SEM, estimated as Latent Growth Curve Analysis (LGCA). LGCA estimates two parameters “intercept” (fixed at “1”, denoting the baseline) and “slope” (started at “0” and increases according to the unit of time of the variable [1 year for health care costs and 2 years for sports participation]) fitted for both endogenous (health care costs) and exogenous variables (components of sport participation). Intercept denotes the baseline values, while slope denotes the rate of longitudinal modifications over time. Therefore, the effect of any "sports intercept" on "health care costs intercept" (Intercept --> Intercept) represents the relationship between both variables at baseline. The effect of any "sports intercept" on "health care costs slope" (Intercept --> Slope) represents the relationship between baseline scores of sports participation and changes in health care costs over time. The effect of any "sports slope" on "health care costs slope" (Slope --> Slope) represents the relationship between changes in sport and health care changes over time. In our LGCA models, sports participation was measured at three-time points (2010, 2012 and 2014), while health care costs were assessed annually from 2010 to 2014. We have ran a new LGCA model in which both sport participation and health care costs were measured at three-time points (2010, 2012 and 2014). The results generated by this model were similar.

The effect size of these relationships was presented as unstandardized and standardized (as correlations “*r*”) scores. GSEM fits different models (logistic, probit, Poisson, multinomial logistic, ordered logit, ordered probit), dismissing the need for fit indexes. All analyses were performed using Stata (version 13.0), and the significance level was set at p-value <0.05.

Results

The final sample was composed of 556 older adults of both sexes (145 men and 411 women), and ages ranged from 50 to 91 years old at baseline. At baseline, ~36% of the sample reported any engagement in sports, while 30% of those maintained sports participation for more than nine months (**Table 1**).

The overall amount of money spent with these 556 subjects from 2010 to 2014 was US$ 706,196.42 (US$ 98,089.26 in 2010; US$ 130,760.92 in 2011; US$ 144,467.15 in 2012; US$ 168,532.84 in 2013; US$ 164,346.23 in 2014). Health care costs increased significantly from 2010 to 2013 (77.4%) and remained stable from 2013 to 2014. The results of the models with or without covariate adjustments were consistent and covariates did not affect health care cost modifications over time; sex (p-value= 0.388), age (p-value= 0.308) and BMI (p-value= 0.374). The models created were adequately fitted according to the parameters provided by the Mauchly's test of sphericity (health care costs, Sports $_{Intensity}$, Sports $_{Volume}$ and Sports $_{Previous\ time}$). In general, time affected in small magnitude changes in health care costs and components of sports participation (**Table 2**).

LGCA identified that there was no significant relationship between baseline scores of sports participation and baseline health care costs (standardized coefficients ranging from r= -0.083 to r= -0.081). There was no significant relationship between changes in sports participation and changes in health care costs (**Table 3**). On the other hand, higher baseline scores for intensity (standardized coefficient: r= -0.223 [-0.404 to -0.042] and unstandardized coefficient: US$ -6.67 per unit of intensity increased) were related to lower health care costs. Similar results were found to volume (standardized coefficient: r= -0.216 [-0.396 to -0.036] and unstandardized coefficient: US$ -2.18 per unit of volume increased) and previous time of engagement (standardized coefficient: r= -0.218 [-0.402 to -0.034] and unstandardized coefficient: US$ -9.12 per unit of time increased). In general, the models identified that intensity (4.97%), volume (4.66%) and previous time of engagement (4.75%) explained ~5% of all changes in health care costs over time, denoting mitigation of US$ 35,309.82 from 2010 to 2014 among these older adults.

Independently of potential confounders, participants with higher sports participation presented lower health care costs over the follow-up period (**Figure 1**), mainly when the previous time of engagement was considered (**Figure 1, Panel C**).

Discussion

This study investigated the relationship between sports participation (intensity, volume and previous time of engagement) and primary health care costs among older adults. We found that older adults engaged in sports presented lower health care costs over a 4-year follow-up period, denoting mitigation of US$ 35,000.00 from 2010 to 2014.

Prevalence data on sports participation is limited, particularly in developing countries, unlike data on overall PA (Hallal et al., 2012; Marques, Sarmento, Martins, & Saboga Nunes, 2015). Approximately 36% of the sample (≥50 years) self-reported being engaged in any sports during leisure time. Previous Brazilian surveys have reported similar rates of sports participation among adults aged 50-64.9 years old and ≥65 years old (37.9% and 27.2%, respectively) (Fernandes & Zanesco, 2010). However, the rate in developed countries is lower. For example, an Australian survey reported that less than 10% of adults aged ≥50 years are engaged in sports (Eime et al., 2016). While age is known to be negatively associated with PA (Balish, Rainham, & Blanchard, 2015; Eime et al., 2016; Fernandes & Zanesco, 2010); we found no evidence of a decrease in sports participation over the follow-up period. Due to the organization of the World Cup and the Olympic Games in Brazil, a plausible explanation is that during the period of data collection there was an increase in public health campaigns targeting promotion and improvement of recreational sports participation in Brazil (Aoyagi & Shephard, 2011; Turi, Codogno, Fernandes, & Monteiro, 2015). Moreover, the high rate of sports participation in this sample could be partially explained by the fact that soccer (the most popular sport in

Brazil) is widely played in public places and does not require large personal investments regarding equipment.

Although with a higher rate than previous studies, sports participation did not change over the follow-up period. On the other hand, at the same time, overall health care cost increased >70% in the sample. Some deductions could justify this finding. First, there is expected an increase in the occurrence of chronic diseases among older adults (Fernandes & Zanesco, 2015). This sort of disease has a significant impact on health care costs due to their continuous treatment (Li, Blume, Huang, Hammer, & Ganz, 2015). Second, we found a significant annual increase in medication use among adults aged ≥65 years (Narayan, Tordoff, & Nishtala, 2016), and medication discharge was responsible for 49% of the overall health care costs in our sample. In a general view, health care costs are a thorny issue due to its trend to increase over time among older adults (mainly due to aging), raising budget concerns about how to maintain the assistance of the population. In this problematic scenario, the potential effect of behavioral interventions (e.g., physical exercise) on mitigation of health care costs gains attention, which would be cheaper than medical interventions, and with fewer side effects.

Regarding mitigation costs attributed to leisure-time sports participation, baseline values of intensity, volume, and previous time of engagement in sports were determinants on the time trend observed to health care costs, explaining approximately 5% of the changes in health care costs during the follow-up. Similarly, a study conducted in Minnesota found that each additional active day per week was associated with a 4.7% decrease in health care costs. Thus, five days of activity would represent about a 23.5% cost reduction compared with no days of physical activity (Pronk, Goodman, O'Connor, & Martinson, 1999). Although the impact of sports participation seems of low magnitude, sports participation affected more health care costs than general physical inactivity (responsible by 1% to 2.6% of health care costs) (Codogno et al., 2015; Katzmarzyk, Gledhill, & Shephard, 2000; Pratt et al., 2014). Regarding practical applications, whether considered the overall amount of money spent with these older adults from 2010 to 2014 (US$ 706,196.42) and discounted 5%, the cost-saving would be US$ 35,309.82, an amount of money enough to pay all the health care costs of 121 of our patients during 12 months (US$ 291.39 in 2014 as reference).

Regarding pathways linking sports participation and mitigation of health care costs, this phenomenon probably happens due to its role in the prevention and treatment of comorbidities whose treatments tend to occur in the secondary or tertiary level, such as cardiovascular and metabolic diseases (Lee et al., 2012). Moreover, the absence of changes over time in sports participation (components) would explain its non-significant relationship with changes in health care costs, denoting the relevance of governmental campaigns targeting the promotion and improvement of recreational sports practice among older adults.

The effect of the components of sports participation on health care costs is unclear in the scientific literature, although there is evidence with overall PA. In cross-sectional surveys, the combination of intensity and weekly the volume of PA have shown to be related to lower medicine use in adults (Bertoldi, Hallal, & Barros, 2006). Evidence of the positive relationship between high-intensity PA (alone) and health outcomes is growing (Drenowatz et al., 2016; Fussenich et al., 2016). The impact of the previous time of engagement in sports on health care outcomes is relatively less investigated, but it has been explored that the effects of intensity on health outcomes are maximized when maintained for longer periods (Fernandes & Zanesco, 2015).

However, some limitations of this study justify caution when interpreting the findings. While the research staff has been trained to perform the interviews, the use of the questionnaire to estimate subjective variables, such as intensity of sports, is prone to bias. Moreover, intensity and volume would be more accurate if assessed through objective measurements (e.g., accelerometers). On the other hand, accelerometers capture daily physical activity, but do not take into account in which context this physical activity happened, such as sports participation. The Likert scale used to categorize both weekly volume and previous time of engagement is a limitation because of gathers at the same group subjects with large differences in terms of time (e.g. category ≥9 months put together participants with 1 year and 5 years in the group). Finally, in our manuscript, only primary care costs were considered (secondary and tertiary health care costs were not analyzed), while other economic components were not considered (e.g. money spent with health facility maintenance, payment for nurses and administrative staff). Therefore, the mitigation in health care costs attributed to sports participation tends to be underestimated.

This study adds important findings to the scientific literature suggesting that higher engagement in sports mitigates health care costs among adults. Regarding applicability for professionals, these findings are useful to plan interventions, particularly for older adults, taking into account sports participation. Moreover, it supports exercise science professionals inserted in NHS to encourage sports participation among older adults as an important method to reduce health care costs.

Existing limited evidence, however, suggest that interventions with sports component for older adults (aged over 50) are cost-effective (Peels et al., 2014). The potential impact of these findings is relevant to support public health actions toward physical activity promotion, because sports participation is a behavior of low frequency among older adults, mainly because people believe sports participation increases the risk of injuries (Reichert, Barros, Domingues & Hallal, 2007).

In summary, the present findings hint that sports intensity, volume and previous time of engagement affect health care costs significantly in older adults.

Disclosure statement

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Figures

Figure 1. Health care costs accounted from 2010 to 2014 according to sport intensity (Panel A), volume (Panel B) and previous time of engagement (Panel C).

Table 1. Summary information of the sample at baseline (Bauru, Brazil; 2010-2014 [n= 556]).

Variables	Descriptive statistics Mean (95%CI)	Median (P25-P75)
Numerical		
Age (years) $_{2010}$	64.6 (63.9 to 65.4)	64.09 (57.8 – 79.9)
Body weight (kg) $_{2010}$	73.5 (72.3 to 74.7)	72.30 (63.1 – 99.8)
Height (cm) $_{2010}$	157.2 (156.6 to 158.1)	156.3 (150.8 to 173.5)
BMI (kg/m^2) $_{2010}$	29.71 (29.2 to 30.1)	29.01 (25.9 – 40.3)
Health care costs $_{2010\text{-}2014}$ (US$)	1,252.12 (1,134.01 to 1,370.23)	803.51 (453.32 – 1,375.37)
Categorical	*n* (%)	(95%CI)
Sport $_{\text{Intensity 2010}}$		
None	353 (63.5)	(59.4 to 67.4)
Light	49 (8.8)	(6.3 to 10.9)
Moderate	147 (26.4)	(22.7 to 30.1)
Vigorous	7 (1.3)	(1.0 to 2.2)
Sports $_{\text{Volume 2010}}$		
None	353 (63.5)	(59.4 to 67.4)
< 1 hour/week	12 (2.2)	(1.0 to 3.3)
1 - 2 hours/week	36 (6.5)	(4.4 to 8.5)
2 -3 hours/week	38 (6.8)	(4.7 to 8.9)
3 - 4 hours/week	46 (8.3)	(5.9 to 10.5)
> 4 hours/week	71 (12.8)	(10.1 to 15.5)
Sport $_{\text{Previous time 2010}}$		
None	353 (63.5)	(59.4 to 67.4)
≤ 1 month	13 (2.3)	(1.1 to 3.6)
1 - 4 months	11 (2.0)	(0.8 to 3.1)
4 - 7 months	8 (1.4)	(0.4 to 2.4)
7 - 9 months	1 (0.2)	(0.1 to 0.5)
≥ 9 months	170 (30.6)	(26.7 to 34.4)

Notes: 95%CI= 95% confidence interval; BMI= body mass index; WC= waist circumference.

Table 2. Sports participation and economic variables at each moment of assessment from 2010 to 2014 (Bauru, Brazil [n= 556]).

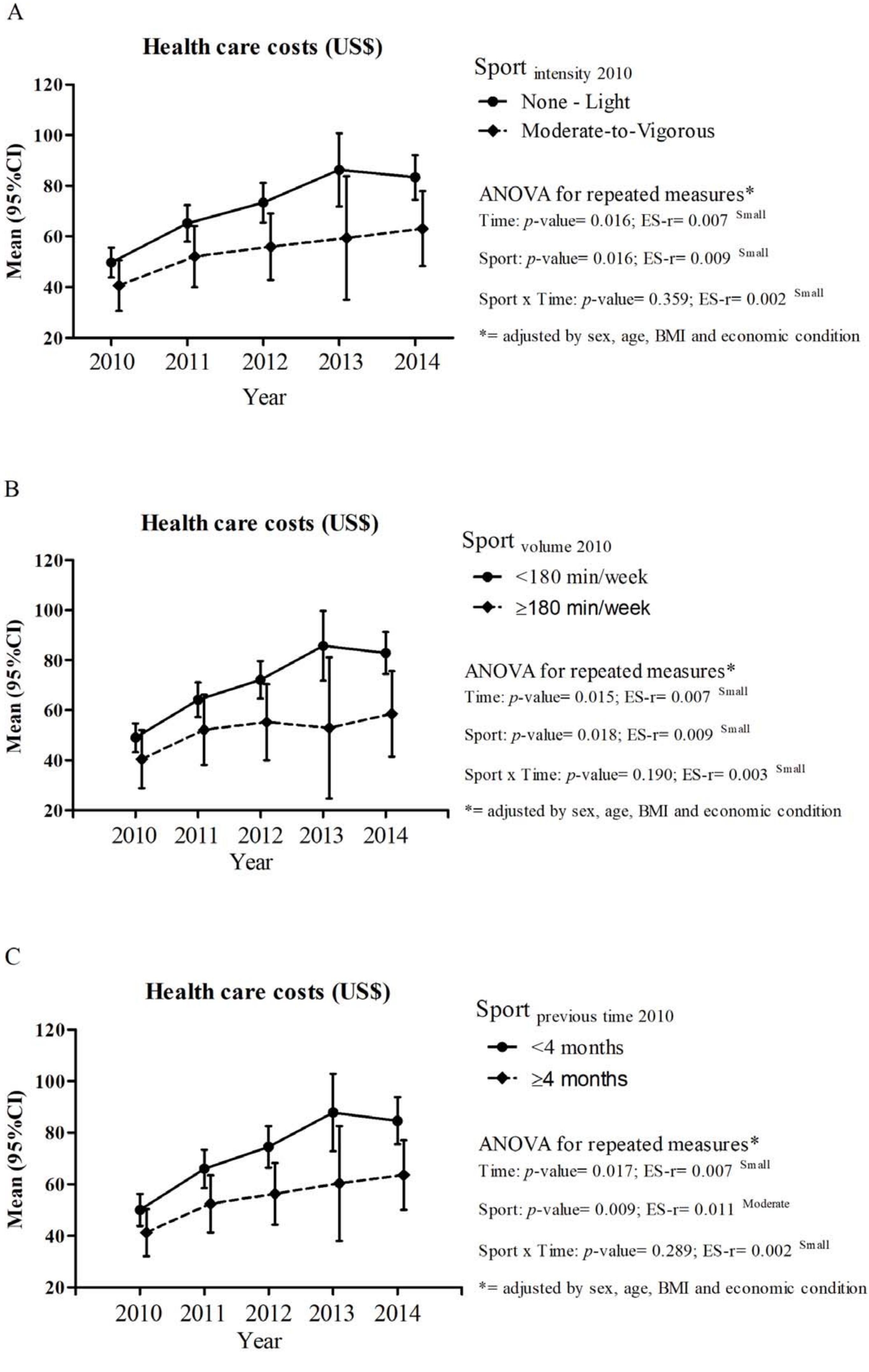
Year/assessment	Health care costs Mean (95%CI)	Sport $_{Intensity}$ Mean (95%CI)	Sport $_{Volume}$ Mean (95%CI)	Sport $_{Previous\ time}$ Mean (95%CI)
2010	173.91 (154.34 to 193.49)	0.42 (0.37 to 0.46)	1.14 (1.00 to 1.28)	0.29 (0.25 to 0.32)
2011	231.84 (207.67 to 256.02) [a]	---	---	---
2012	256.14 (230.62 to 281.66) [a,b]	0.39 (0.35 to 0.44)	1.01 (0.87 to 1.13)	0.28 (0.24 to 0.31)
2013	298.81 (249.48 to 348.14) [a,b]	---	---	---
2014	291.39 (262.30 to 320.48) [a,b,c]	0.42 (0.37 to 0.47)	1.09 (0.95 to 1.23)	0.27 (0.24 to 0.30)
ANOVA				
F	18.756	0.566	1.993	0.536
p-value	0.001	0.568	0.137	0.583
Eta-squared	0.032	0.001	0.004	0.002
Qualitative	Small magnitude	Small magnitude	Small magnitude	Small magnitude

Notes: ANOVA= analysis of variance; 95%CI= 95% confidence interval; a= *p*-value <0.05 compared to 2010; b= *p*-value <0.05 compared to 2011; c= *p*-value <0.05 compared to 2012.

Table 3. Standardized coefficients of the relationship between sports participation components and health care costs from 2010 to 2014 (Bauru, Brazil [n= 556]).

Variables	Health Care Costs $_{Intercept}$ *r* (95%CI)	Health Care Costs $_{Slope}$ *r* (95%CI)
LGCA - Intercept		
Sport $_{Intensity}$	-0.083 (-0.192 to 0.025)	**-0.223 (-0.404 to -0.042)**
Sport $_{Volume}$	-0.081 (-0.186 to 0.024)	**-0.216 (-0.396 to -0.036)**
Sport $_{Duration}$	-0.083 (-0.191 to 0.025)	**-0.218 (-0.402 to -0.034)**
LGCA - Slope		
Sport $_{Intensity}$	---	0.300 (-0.116 to 0.716)
Sport $_{Volume}$	---	0.388 (-0.561 to 1.00)
Sport $_{Duration}$	---	0.342 (-0.091 to 0.774)

Notes: LGCA= latent growth curve analysis; 95%CI= 95% confidence interval.



A
Health care costs (US$)
Mean (95%CI)
120
100
80
60
40
20
2010
2011
2012
2013
2014
Year
Sport intensity 2010
None - Light
Moderate-to-Vigorous
ANOVA for repeated measures*
Time: p-value= 0.016; ES-r= 0.007 Small
Sport: p-value= 0.016; ES-r= 0.009 Small
Sport x Time: p-value= 0.359; ES-r= 0.002 Small
*= adjusted by sex, age, BMI and economic condition
B
Health care costs (US$)
Mean (95%CI)
120
100
80
60
40
20
2010
2011
2012
2013
2014
Year
Sport volume 2010
<180 min/week
≥180 min/week
ANOVA for repeated measures*
Time: p-value= 0.015; ES-r= 0.007 Small
Sport: p-value= 0.018; ES-r= 0.009 Small
Sport x Time: p-value= 0.190; ES-r= 0.003 Small
*= adjusted by sex, age, BMI and economic condition
C
Health care costs (US$)
Mean (95%CI)
120
100
80
60
40
20
2010
2011
2012
2013
2014
Year
Sport previous time 2010
<4 months
≥4 months
ANOVA for repeated measures*
Time: p-value= 0.017; ES-r= 0.007 Small
Sport: p-value= 0.009; ES-r= 0.011 Moderate
Sport x Time: p-value= 0.289; ES-r= 0.002 Small
*= adjusted by sex, age, BMI and economic condition