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Tracking of physical activity from adolescence to adulthood: a population-based study

Continuidade na prática de atividade física da adolescência para a idade adulta: estudo de base populacional

ABSTRACT

OBJECTIVE: To assess the association between regular physical activity in adolescence and leisure-time physical activity in adulthood, with emphasis on gender differences.

METHODS: A population-based cross-sectional study was carried out in Pelotas, Southern Brazil, in 2003. A representative sample of households was selected in multiple stages and subjects aged 20-59 years were interviewed. Leisure-time physical activity was evaluated using the International Physical Activity Questionnaire. Data on adolescent physical activity were based on subjects' recall.

RESULTS: Of 2,577 subjects interviewed, 27.5% were classified as adequately active, and 54.9% reported regular physical activity in adolescence. Subjects who engaged in regular physical activity during adolescence were more likely to be adequately active in adulthood (adjusted prevalence ratio 1.42; 95% CI: 1.23; 1.65). This effect was stronger in women (adjusted prevalence ratio: 1.51; 95% CI: 1.22; 1.86) than men (adjusted prevalence ratio: 1.35; 95% CI: 1.10; 1.67).

CONCLUSIONS: Promoting physical activity in school age may be a successful intervention against the epidemic of adult inactivity. Although women were less likely to report regular physical activity in adolescence, the effect of this experience on adult behavior was stronger than in men.

KEYWORDS: Motor activity. Life style. Cross-sectional studies. Sedentary lifestyle. Physical inactivity. Tracking of physical activity.

RESUMO

OBJETIVO: Avaliar a associação entre a prática de atividades físicas sistematizadas na adolescência e o nível de atividade física no lazer na idade adulta, com ênfase nas diferenças quanto ao gênero.

MÉTODOS: Estudo transversal de base populacional foi realizado em Pelotas, Brasil, 2003. Amostra representativa de domicílios foi selecionada em múltiplos estágios. Indivíduos com idades entre 20 e 59 anos foram entrevistados. As atividades físicas de lazer foram investigadas por meio do Questionário Internacional de Atividades Físicas. Dados sobre atividade física na adolescência foram baseados em recordatório.

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RESULTADOS: Entre os 2.577 indivíduos entrevistados, 27,5% foram classificados como suficientemente ativos e 54,9% relataram participação em atividades físicas sistematizadas na adolescência. Indivíduos envolvidos com atividade física na adolescência apresentaram maior probabilidade de serem suficientemente ativos na idade adulta (razão de prevalências ajustada 1,42; IC 95%: 1,23; 1,65). Este efeito foi mais forte entre as mulheres (razão de prevalências 1,51; IC 95%: 1,22; 1,86) se comparado aos homens (razão de prevalências 1,35; IC 95%: 1,10; 1,67).

CONCLUSÕES: Estímulo à prática de atividade física na idade escolar pode ser uma intervenção importante contra a epidemia de inatividade física na idade adulta. Embora as mulheres tenham reportado menor atividade física na adolescência, o efeito desta experiência sobre o comportamento na idade adulta foi mais forte do que entre os homens.

DESCRITORES: Atividade motora. Estilo de vida. Estudos transversais. Sedentarismo. Inatividade física. Continuidade da atividade física.

INTRODUCTION

The benefits of physical activity over health are well-established.³ Conversely, the prevalence of physical inactivity remains high, particularly when leisure-time activities are considered alone. Even studies evaluating all domains of physical activity (leisure-time, occupational, commuting and housework) found proportions of inactivity above 40%.¹¹ Therefore, identifying determinants of physical activity is now a public health priority.²⁵

Several factors have been described as determinants of an active lifestyle in adulthood. These include demographic, biological, emotional and cultural variables, social attributes and environment factors.²¹ In addition, physical activity in adolescence has been studied as a possible predictor of levels of adult activity.^{4,10,12,13,19} The literature shows a non-consistent effect of adolescent physical activity on adult activity behavior. Most studies found weak but significant tracking values.^{1,5,22} It was also shown that being forced to exercise during childhood may have a negative impact on future physical activity.²⁰ Although a prospective design is ideal for evaluating this association, such studies require a long-term follow-up, and thus several studies on this issue used retrospective data on adolescent physical activity.^{1,12,13} In addition, most prospective cohort studies have followed-up subjects for less than 20 years.^{5,10,19}

Previous data indicate that tracking of physical activity may differ between males and females.^{5,12,19} The main objective of the present study was to evaluate the association between regular physical activity in adolescence and leisure-time physical

activity in adulthood, with special attention to gender differences.

METHODS

A population-based cross-sectional study was carried out in Pelotas, a medium-sized (320,000 inhabitants) southern Brazilian city, in the last trimester of 2003. A representative sample of urban households was selected in multiple stages. Brazilian cities are divided into census tracts by the national demographic census and the last one was carried out in 2000. According to the sampling strategy, all these tracts (N=408) were initially sorted by the average monthly income of family heads, and thereafter, 144 were systematically selected, providing stratification by socioeconomic level. In each sampled tract, all households were listed, and an average number of 10 was selected per tract following a systematic strategy taking the size of the tract (number of households) into account.

Adults aged 20-59 years and living in the sampled households were selected. To investigate the association between physical activity in adolescence and leisure-time physical activity in adulthood, the actual sample size obtained (N=2,577) allowed us to detect significant odds ratios of 1.35 or higher in the gender stratified analysis. Power was greater for the analysis combining both sexes.

Physical activity in adulthood was evaluated using the leisure-time section of the International Physical Activity Questionnaire (IPAQ).^{*} A physical activity score was constructed as the weekly time spent in moderate activities (including walking) plus twice the weekly time spent in vigorous activities.^{7,11} A cut-

*Long version IPAQ, previous seven-day recall; Portuguese version available at www.celafiscs.org.br

off value of 150 min per week was used to classify individuals as adequately active or not, following current physical activity guidelines.^{17,23} The IPAQ does not take into account activities performed for less than 10 consecutive minutes, and the intensity is based on self-report;⁷ activities that moderately alter the respiration rate and require some physical strength are defined as moderate, whereas those producing strong increases in the same variables are classified as vigorous.

The main independent variable used was regular physical activity in adolescence (10-19 years of age). This variable was based on subjects' recall. Activities performed in health clubs, join clubs, and at school were considered. Engaging in physical activities without supervision (walking, jogging) was also taken into account. Only activities performed for at least six consecutive months were included. This strategy minimizes the risk of recall bias, which would be the case if data had been collected on a weekly basis, intensity and duration.⁹

Other variables included in the analyses were as follows: sex, age, skin color (white or black/mulatto according to the interviewers' perception), and economic condition.* Those reporting to have engaged in physical activity in adolescence were asked to indicate the main reason for this practice: (a) "because I enjoyed it" or (b) "I was somehow forced".

Data were collected during household visits through face-to-face interviews. Those who were not able to answer the questionnaire by themselves (hearing and mentally impaired and multiple sclerosis individuals) were excluded. The questionnaire was tested in a pilot study carried out in a census tract not included in the final sample. Interviewers comprised 32 women with at least secondary education, selected after an evaluation of theory and practice. A random sample of 10% of the interviewees was revisited by a field supervisor approximately 10 days after the first visit. Subjects answered a short version of the questionnaire for quality control purposes. The question about engaging in regular physical activity in adolescence was used in this second visit in order to evaluate its reliability.

Data were entered twice with automatic checks for consistency and range. Then a search for impossible or improbable combinations of answers was carried out. After descriptive analyses (means, standard deviations, proportions, 95% confidence intervals), the

prevalence of adequate physical activity in adulthood was compared between subjects who reported regular physical activity in adolescence and those who did not report it. The adjusted analysis was carried out using Poisson regression.² All analyses were carried out for the whole sample and then separately for men and women, and took the clustering of the sample into account. Kappa statistics was used to calculate agreement between the first visit and the (second) quality control one. Analyses were carried out using Stata 8.0.

The Ethics Committee of Faculdade de Medicina of Universidade Federal de Pelotas approved the study protocol. Informed consents were obtained from each subject.

RESULTS

Within 144 census tracts sampled, 1,530 households were visited, resulting in 2,675 eligible individuals. Of them, 98 were not interviewed (non-response rate: 3.7%). Out of the 2,577 subjects interviewed, seven did not provide all information necessary to calculate the physical activity score. The mean of age was 37.8 (SD: 11.4) years. Table 1 describes the sample in terms of age, skin color and economic condition, stratified by gender. The sample distribution of these variables was similar to recent census data, minimizing the likelihood of selection bias. As for current leisure-time physical activity level, the proportion of adequately active subjects was 27.5% (95% CI: 25.7; 29.2). Men were more likely to be adequately active than women (33.4% vs 22.8%; $p < 0.001$).

Table 1 - Description of sociodemographic variables (n=2,577) in the sample. Pelotas, Southern Brazil, 2003.

Variable	Men % (N)*	Women % (N)**
Skin color		
White	79.9 (908)	80.8 (1,164)
Black/Mulatto	20.1 (229)	19.2 (276)
Age (years)		
20-29	30.1 (342)	29.0 (417)
30-39	24.5 (279)	25.4 (366)
40-49	26.7 (303)	26.2 (377)
50-59	18.7 (213)	19.4 (280)
Economic condition		
A (wealthiest)	5.5 (62)	5.1 (73)
B	20.6 (233)	20.6 (296)
C	33.4 (378)	34.3 (493)
D	33.1 (374)	34.7 (498)
E	7.4 (83)	5.3 (76)
Overall	100 (1,137)	100 (1,440)

*The maximum number of missing values was 7 (economic condition)

**The maximum number of missing values was 4 (economic condition)

*Brazilian Criterion of Economic Classification, which considers both education of the family head and household assets, and classifies families into five groups, from A - wealthiest - to E - poorest. Available from http://www.abep.org/codigosguais/ABEP_CCEB.pdf [accessed in 2006 jun 26]

Table 2 - Participation in selected activities in adolescence for the whole sample and stratified by gender. Pelotas, Southern Brazil, 2003.

Activity	Proportion		
	Overall N=1,551	Men N=881	Women N=670
Soccer	52.3%	82.5%	14.5%
Volleyball	30.6%	18.2%	46.3%
Dance	13.4%	3.8%	25.4%
Handball	14.1%	9.2%	20.3%
Athletics	11.9%	10.7%	13.4%
Basketball	9.3%	8.8%	10.1%
Gym classes at fitness clubs	9.3%	2.3%	18.2%
Swimming	8.4%	7.4%	9.6%
Weight lifting	9.0%	10.8%	6.7%
Combat sports*	5.6%	8.5%	1.9%
Gymnastics	5.3%	1.8%	9.7%
Cycling	5.0%	4.5%	5.6%
Walking	4.5%	2.5%	6.9%
Jogging	3.4%	5.7%	1.3%
Others	7.3%	7.4%	7.2%

*Activities such as judo, karate, boxing, capoeira, jiu-jitsu, taekwondo and kung-fu

The study design effect associated with the level of physical activity in adults was 2.2 (intra-group correlation coefficient: 0.07; 95% CI: 0.04; 0.10). The Kappa value for the reliability of the question about engaging in regular physical activities in adolescence was 0.62, with an agreement of 81.1%.

In regard to physical activities in adolescence, the most frequent activities reported were soccer (52.3%) and volleyball (30.6%). Analyzing the most common types of activities according to gender, soccer (83.5%) and volleyball (18.2%) were the most common activities among men. Among women, volleyball (46.3%) and dance (25.4%) were the most frequent ones. Table 2 describes all activities reported stratified by gender. Only subjects who engaged in any activity in adolescence were included in this analysis (n=1,414; men=787; women=627). It is also important to note that the percentages do not add up to

100% since some reported practicing more than one regular activity in adolescence.

Regular physical activity in adolescence was reported by 54.9% of the subjects. Table 3 describes the prevalence of engaging in regular physical activities during adolescence according to sociodemographic variables, stratified by gender. The prevalence was higher among men (69.2%) than women (43.5%; $p<0.001$).

The reason "because I was somehow forced to do it" was reported by 3.2% of the subjects who engaged in physical activity during adolescence. There was no association between being forced to a physical activity in adolescence and the level of activity in adulthood, although one should note that the power was lower for this specific analysis.

Table 4 shows the crude and adjusted analysis for the whole sample and stratified by gender. Subjects who were engaged in regular physical activity during adolescence were more likely to be adequately active in adulthood (prevalence ratio 1.75; 95% CI: 1.51; 2.03) in the crude analysis. After adjusting for gender, age, skin color and economic condition, subjects who engaged in physical activity in adolescence were still more likely to be adequately active (prevalence ratio 1.42; 95% CI: 1.23; 1.65). The effect of adolescent physical activity on the level of activity during adult life was higher in women than men. The adjusted prevalence ratios for those who engaged in physical activity in adolescence were 1.51 ($p<0.001$) for women and 1.35 ($p=0.004$) for men.

DISCUSSION

The proportion of adequately active individuals in leisure time found in the present study (27.5%) was

Table 3 - Prevalence of regular physical activity during adolescence according to sociodemographic variables, stratified by gender. Pelotas, Southern Brazil, 2003.

Variable	Men		Women	
	%	p-value	%	p-value
Skin color		<0.001*		<0.001*
White	70.3		45.8	
Black/Mulatto	65.1		34.1	
Age (years)		<0.001**		<0.001**
20-29	74.0		56.8	
30-39	68.8		44.5	
40-49	67.7		39.3	
50-59	64.3		28.2	
Economic condition		<0.001**		<0.001**
A (wealthiest)	82.4		67.9	
B	75.6		56.2	
C	69.4		40.8	
D	57.4		26.1	
E	45.8		14.6	
Overall***	69.2		43.5	

*Wald test for heterogeneity

**Wald test for linear trend

***p-value <0.001 for gender differences (Wald test for heterogeneity)

Table 4 - Crude and adjusted analysis of tracking of physical activity from adolescence to adulthood. Pelotas, Southern Brazil, 2003.

Regular physical activity in adolescence	Adequate physical activity in leisure time in adulthood					
	Overall PR (95% CI)	p-value	Men PR (95% CI)	p-value	Women PR (95% CI)	p-value
Crude analysis	1.75 (1.51; 2.03)	<0.001*	1.49 (1.21; 1.84)	<0.001*	1.77 (1.44; 2.17)	<0.001*
Adjusted for gender	1.64 (1.41; 1.91)	<0.001*	—	—	—	—
Adjusted for skin color	1.75 (1.51; 2.03)	<0.001*	1.49 (1.21; 1.84)	<0.001*	1.75 (1.42; 2.15)	<0.001*
Adjusted for age	1.70 (1.47; 1.98)	<0.001*	1.43 (1.17; 1.76)	0.001*	1.83 (1.48; 2.25)	<0.001*
Adjusted for economic condition	1.61 (1.39; 1.86)	<0.001*	1.43 (1.16; 1.77)	0.001*	1.48 (1.20; 1.82)	<0.001*
Adjusted for skin color, age and economic condition	1.42 (1.23; 1.65)	<0.001**	1.35 (1.10; 1.67)	0.004*	1.51 (1.22; 1.86)	<0.001*

*Wald test for heterogeneity

**Also adjusted for gender

PR: Prevalence ratio

similar to other studies, although the instruments and cut-off points were not exactly consistent. In Brazil, another survey carried out in the same city, in 1999, found a prevalence of adequate physical activity ($\geq 1,000$ kcal/wk) of 19.4%.⁸ In other countries, the prevalence of physical activity was 32.3% in an Australian study,⁶ and ranged from 12.2% to 56.7% in European countries.²⁴ However, the use of inconsistent instruments and criteria for defining levels of activity may partially explain these differences.

Relevant differences were found in the types of activities women and men engaged in adolescence. Among men, the high prevalence of soccer was expected, given the strength of this sport in the Brazilian culture. On the other hand, since there is no physical contact in volleyball, it was labeled as an advisable sport for women in the past, explaining its high frequency among older women.

The prevalence of regular physical activity in adolescence was negatively related to current age. This pattern was observed in both genders. This finding can be explained by the wide knowledge spread since the 1980's about health benefits of physical activity, resulting in the search for activities other than sports (for instance, walking, lift weighting, and gym classes).

Some methodological differences across studies investigating the association between physical activity in adolescence and adulthood make it difficult comparisons. The main sources of inconsistency are related to the definitions of adolescent and adult physical activity. In regard to adult physical activity, the lack of comparability across studies was previously discussed.¹⁴ It was opted for the use of the leisure-time section of the long IPAQ. This questionnaire was designed with the purpose of decreasing the lack of comparability across studies, and its utilization in the present study aimed at allowing comparisons with future studies. As for the definition of adolescent physical activity, it was chosen to include ac-

tivities performed for at least six months, and to include only those activities performed regularly. The six-month time is also about a regular sports season in this age group, both in clubs and schools. In the present study, having a trainer was not required to characterize regular participation in physical activity during adolescence, because walking, jogging and cycling are activities that would be excluded if the analysis were limited to those having a trainer.

Previous studies from high-income countries showed that adolescent participation in physical activity was associated with greater likelihood of leisure-time physical activity in adulthood, although not all were consistent, and the magnitude of the evidence was only weak to moderate. The present study adds to the current knowledge by showing that this effect can also be seen in middle-income settings. In the present study, the adjusted prevalence ratio of 1.42 for those who engaged in regular physical activity in adolescence versus those who did not was lower than that reported by Hirvensalo et al in Finland.¹² However, their study was restricted to individuals aged 65-84 years, and only competitive sports practice in adolescence was significantly associated with adult physical activity.¹² In the Finnish study, the adjusted odds ratio was 1.86 (95% CI: 1.00; 3.45) for men and 2.31 (95% CI: 1.16; 4.80) for women. In a cohort of male workers in Israel, Kraut et al found an odds ratio of 3.55 (95% CI: 2.97; 4.23) for those engaged in organized school age sport activities compared with those who did not.¹³ The different magnitude of the relative risks between the present study and Kraut's can be explained by the fact that their definition of physical activity in adolescence required at least 12 months of practice, while the present study used a six-month period. It is reasonable to believe that the longer the minimum period established to consider individuals as active in adolescence, the higher the effect on the level of physical activity in adulthood.

The effect of physical activity in adolescence on cur-

rent level of physical activity was stronger in women than men. This finding was observed in previous studies,^{12,19} but so far it was rarely discussed. One hypothesis for this finding is based on different personal reasons motivating women and men to engage in physical activity. Entertainment has been shown to be the main reason for physical activity among men, while among women, the belief it is important for health and esthetics reasons were more frequently reported.¹⁵ The different activities women and men engaged in can also explain this gender-dependent effect. One study in Finland showed different effects of physical activity in adolescence on adult physical activity depending on the type of activity they engaged in earlier in life.¹⁹ The present study data showed that women and men reported different types of activities during adolescence (Table 2), however, the effect of each activity on current level of physical activity was not explored due to sample size limitations.

Taylor et al²⁰ proposed that being forced to exercise during childhood can have a negative impact on future physical activity. In the present study, only 3.2% of the subjects reported being forced to engage in physical activity in adolescence, with no differences among adequately and inadequately active individuals. These findings should be interpreted with caution due to their small size.

Some methodological strengths of the present study should be considered. First, the use of a random population-based sample minimizes the likelihood of selection bias. The high response rate should also be highlighted. In addition, this is one of the first studies conducted outside high-income countries to examine tracking of physical activity from adolescence to adulthood. Finally, the use of appropriate multivariable approaches makes the study findings powerful.

Recall bias is a key methodological aspect to be considered. If active individuals reported differently their adolescent experience of physical activity in compari-

son to those inadequately active, this bias would be of concern. Between 1992 and 1996, Falkner et al⁹ studied 137 survivors of the Buffalo Health Study, for whom energy expenditure was collected in 1960-1962. More active adults overestimated their energy expenditure in adolescence and young adulthood. In spite of this single study comprising a small sample size, examination of the current literature does not indicate that studies based on recall^{1,12,13} find results different from prospective ones.^{4,5,10,19,22} Furthermore, recent studies have used the same approach for evaluating adolescent physical activity.¹⁶ The simple definition of physical activity in adolescence used in the present study may be criticized, but it avoids the need of quantifying the levels of activity several years ago. In fact, evidence of recall bias in the literature is available only when quantification is collected.⁹ It is believed that this study strategy is not likely to produce recall bias. Actually, the study estimates may be even conservative because the study simple definition of physical activity in adolescence was more sensitive than specific. Furthermore, if recall bias was present, the association should be stronger among older adults than among younger ones, but analyses stratified by age did not show this effect (data not shown).

The study data reinforce that regular physical activity in adolescence protects against physical inactivity in adulthood. Promoting physical activity at school age can be a successful intervention against the epidemic of adult inactivity seen both in high and low-income countries. Unfortunately, there is evidence the levels of physical activity are declining in adolescents,¹⁸ and this reduction may affect adult activity levels in the long term.

Although women were less active than men both in adolescence and adulthood, tracking of physical activity was stronger in women than men. Physical activity promotion programs should give special attention to children and adolescents, and take gender differences into account.

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