

Journal of Physical Activity and Health, 2012, 9, 642-649
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Cardiorespiratory Fitness and Fatness Are Associated With Health Complaints and Health Risk Behaviors in Youth

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Background: We examined the association of cardiorespiratory fitness and fatness with health complaints and health risk behaviors in 691 (323 girls) Spanish children aged 6 to 17.9. **Methods:** Health complaints and health risk behaviors were self-reported using items of the Health Behavior in School-aged Children questionnaire. Weight and height were measured and body mass index was computed. Cardiorespiratory fitness was measured by the 20-m shuttle-run test, and youth categorized as fit/unfit. **Results:** Unfit youth were more likely to report health complaints sometime (OR: 2.556, 95% CI: 1.299–5.031; and OR: 1.997, 95% CI: 1.162–3.433, respectively) and health risk behaviors such as drinking alcohol sometime (OR: 5.142, 95% CI: 1.214–21.783; and OR: 2.413, 95% CI: 1.484–3.923) than their fit counterparts. Overweight-obese youth were more likely to report health complaints (OR: 1.732, 95% CI: 1.019–2.945; and OR: 1.983, 95% CI: 1.083–3.629, respectively). The analysis of the combined influence of fitness and fatness revealed that fit youth had lower health complaints index than the fat-unfit and unfat-unfit groups (all $P < .05$). **Conclusions:** Low fitness and overweight-obesity increased the risk of having health complaints in youth, yet high levels of cardiorespiratory fitness might overcome deleterious effects of overweight-obesity on health complaints.

Keywords: aerobic capacity, obesity, alcohol and tobacco, children, adolescents

Health complaints refer to somatic and psychological symptoms experienced by the individual with or without a defined diagnosis such as abdominal pain, headache, backache, nervousness, and sleeping difficulties. It constitutes a diverse set of symptoms where few are related to a defined diagnosis or disease.¹ Such symptoms constitute both everyday experiences and health problems, and are common causes of disability and sickness certificates in adults.² In youth, previous studies showed weekly health complaints, which likely influences on wellbeing and functional ability.³ Health complaints has also been considered as a negative outcome of the developmental processes.³

Health risk behaviors, especially smoking and drinking, are one of the major health concerns among west countries. Both are associated with the leading causes of mortality and morbidity, posing immediate risks to

health during adolescence and increasing the likelihood of excess preventable morbidity and death in adulthood.^{4,5}

Findings from cross-sectional and longitudinal studies showed that high cardiorespiratory fitness is associated with a healthier cardiovascular profile in youth.^{6–8} Less is known however whether cardiorespiratory fitness is associated with health complaints^{9,10} and health risk factors in youth.^{11–13} On the other way, physical activity is inversely related with health complaints^{14,15} and health risk behaviors such as smoking.^{14–16}

Studies examining the association of fatness with health complaints and health risk factors in youth are scarce and the results contradictory.^{17–20} The findings so far showed that overweight adolescents are more likely to describe themselves as having health problems compared with their nonoverweight peers.^{21–23} Moreover, previous studies suggest that compromising behaviors such as overweight/obesity, smoking or drinking may co-occur during adolescence.^{24–28}

The aim of the current study was to examine the association of cardiorespiratory fitness and fatness with health complaints and health risk behaviors in Spanish youth.

Methods

Subjects

A sample of 691 (368 boys and 323 girls) healthy Caucasian children (mean age \pm standard deviation: 9.3 \pm

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1.6 years; 6–11.9 years) and adolescents (14.8 ± 1.9 years; 12–17.9 years) participated in the study. Data collection took place from February to June 2006. The sample was randomly selected using a 2-phase, proportional cluster sampling using as a reference the database of the census of the province of Cádiz (South Spain), to establish a representative sample of the area. In the first phase, the school was selected from the stratum according to the geographical localization, by age and sex. A total of 9 urban and 9 rural governmental schools agreed to participate in the study. In the second phase, classes (at least 50% per level) from schools were randomly selected and used as the smallest sampling units. All the pupils of the selected classroom were invited to participate in the study. The participation was higher than 95%.

A comprehensive verbal description of the nature and purpose of the study was given to the children, adolescents, their parents and teachers. This information was also sent to parents or youth' supervisors by regular e-mail, and written consents from parents, children and adolescents were requested. The study was approved by the Review Committee for Research Involving Human Subjects at the University of Cádiz, Spain.

Measures

Health complaints and health risk behaviors (tobacco and alcohol use, and drunk) were assessed by the Health Behavior in School-aged Children (HBSC) questionnaire.^{29,30} Participants completed the questionnaire in school classroom with trained investigators. All the questions used in the HBSC questionnaire showed a good reliability and validity in youth.^{31,32}

Health Complaints. Participants indicated how frequently [5-point scale: rarely or never (1), almost every month (2), almost every week (3), more than once a week (4), and almost every day (5)] they had each of the following symptoms: headache, stomach-ache, backache, feeling low, irritability or bad temper, feeling nervous, difficulties getting to sleep, feeling dizzy. A mean of the responses represented subjective health complaints index.¹⁴ The index was dichotomized as never (rarely or never) or sometime (almost every month, almost every week, more than once a week, and almost every day). The internal consistency of the items of the health complaints index was acceptable (Cronbach's $\alpha = .714$).

Tobacco Use. We used a single item to assess cigarette smoking: "How often do you smoke tobacco at present?" Possible answers were I do not smoke (1), less than once a week (2), at least once a week but not every day (3), and every day (4). The responses were dichotomized as never (I do not smoke) or sometime (less than once a week, at least once a week but not every day, and every day).

Alcohol Use. Participants indicated how frequently [converted to days/week: never (0), rarely (.1), every month (.25), every week (1), and every day (7)] they

drunk each of 3 beverages (beer, wine, combined liquors). A mean of the responses represented alcohol use.¹⁴ The responses were dichotomized as never (never), and sometime (rarely, every month, every week, and every day). The internal consistency of the items of alcohol use was high (Cronbach's $\alpha = .937$).

Drunk. A single item, asking "Have you ever got drunk any time?" [5-point scale: never (0), once (1), 2 to 3 times (2), 4 to 10 times (3), and more than 10 times (4)], indicated how frequently they get drunk. The responses were dichotomized as never (never) or sometime (once, 2 to 3 times, 4 to 10 times, and more than 10 times).

Cardiorespiratory Fitness. Cardiorespiratory fitness was assessed by means of the 20-m shuttle run test as described by Léger et al.³³ In brief, participants were required to run between 2 lines 20 m apart, while keeping the pace with audio signals emitted from a prerecorded compact disk (CD). The initial speed was 8.5 km/h, which was increased by 0.5 km/h per minute (1 minute equals 1 stage). The CD used was calibrated over 1 minute of duration. Participants were instructed to run in a straight line, to pivot on completing a shuttle, and to pace themselves in accordance with the audio signals. The participants were encouraged to keep running as long as possible throughout the course of the test. The test was finished when the participant failed to reach the end lines concurrent with the audio signals on 2 consecutive occasions. Otherwise, the test ended when the subject stopped because of fatigue. All measurements were carried out under standardized conditions on an indoor rubber floored gymnasium. The last stage completed was scored (precision of 0.5 steps).

Participants were classified in low and high cardiorespiratory fitness level according to the FITNESSGRAM standards for Healthy Fitness Zone.³⁴ All participants received a comprehensive instruction of the test after which they also practiced it. They were instructed to abstain from strenuous exercises 48 hours before the test.

Body Fatness. Height and weight were measured with physical education clothing (shorts and t-shirt) and with barefoot. Height was measured to the nearest 0.1 cm using stadiometer (Holtain Ltd, Crymmych, Pembrokeshire, United Kingdom). Weight was measured to the nearest 0.1 kg using a Seca scale (Seca, Hamburg, Germany). Instruments were calibrated to ensure the acceptable accuracy. Body mass index (BMI) was calculated as weight/height squared (kg/m^2). Participants were categorized according to the BMI international cut-off values as nonoverweight and overweight plus obese.³⁵

Body fat percentage was calculated by the equations reported by Slaughter et al using triceps and calf skinfolds.³⁶ Skinfolds were measured to the nearest 0.1 with a skinfold caliper (Slim guide Tom Kit Roscraft 1, Canada). Triceps skinfold was measured on the right side of the body at the following site: a vertical fold halfway between the acromion process and the superior head of the radius, in the posterior aspect of the arm. Calf skinfold

was measured on the inside of the right leg at the level of maximal calf girth. The right foot was placed flat on an elevated surface with the knee flexed at a 90° angle. The vertical skinfold should be grasped just above the level of maximal girth and the measurement made below the grasp.

Participants were categorized in low and high body fat percentage, according to the FITNESSGRAM standards for Healthy Fitness Zone.³⁴

BMI and skinfold thickness were used as indicators of body fat because of 1) the results on the association between positive health and obesity in children and adolescents is inconclusive,^{37–40} which might be due to the fact that the adiposity indicator used varies among studies; 2) to make our data comparable with other studies using mainly BMI; and 3) because it could be argued that BMI is not a valid indicator of body fat in children and adolescents,⁴¹ and it could be also argued that skinfold thickness is not a valid indicator of body fat in obese children and adolescents (due to the fact that the measurement error increases in these individuals).⁴¹

Statistical Analysis

Data are presented as mean and standard deviation, unless otherwise indicated. Analyses were performed using the PASW (v. 18.0 for WINDOWS, Chicago), and the level of significance was set to 0.05.

We compared health complaints index and health risk behaviors between children and adolescents using the Mann-Whitney *U* test. The association of fitness and fatness with health complaints index and health risk factors was examined using regression analysis. Further, we performed binary logistic regression analysis to examine the association of low fitness and overweight-obesity with health complaints and health risk behaviors. Since there were no sex*health complaints index or sex*health risk behaviors interactions with cardiorespiratory fitness and fatness, all the analyses were performed jointly for boys and girls and the models adjusted for sex. Skewed distributions for health complaints, tobacco use and the 2 alcohol questions were modified using log transformations; however to simplify the interpretation, the means shown in Table 1 are before transformation.

Finally, we examined the combined effects of cardiorespiratory fitness and fatness (based on BMI cut-off points) on health complaints index using 1-way analysis of covariance after adjusting for age and sex. For this analysis, we created 4 fat-fit combination categories: 1) fat and unfit (overweight+obese and low fitness); 2) fat and fit (overweight+obese and high fitness); 3) unfat and unfit (nonoverweight and low fitness); and 4) unfat and fit (nonoverweight and high fitness). Pair group comparisons were performed with Bonferroni test. We repeated the analyses further adjusting for school and the results did not change (data not shown).

Results

Adolescents had significantly higher values of health complaints index and health risk behaviors than children (Table 1).

Cardiorespiratory fitness was inversely associated with health complaints index in children and adolescents, and inversely associated with tobacco use only in children (Table 2). BMI was positively associated with health complaints index in both children and adolescents, whereas it was positively associated with alcohol use only in children. Similar results were observed when body fatness was expressed as body fat percentage.

Children and adolescents with low cardiorespiratory fitness had significantly higher odds ratio (OR) of having health complaints and drinking alcohol sometime (Table 3). Likewise, adolescents with low cardiorespiratory fitness had significantly higher OR of getting drunk sometime. Overweight-obese children and those with high body fat percentage had higher OR of having health complaints sometime.

The association between health complaints index and fat-fit categories is presented in Figure 1. Children and adolescents who were fit had lower health complaints index than their unfit counterparts, independently of their weight status. Furthermore, the multinomial logistic regression analysis indicated that fat-unfit and unfat-unfit youth were more likely to report health complaints sometime (OR: 2.593, 95% CI: 1.458–4.610; and OR: 2.654, 95% CI: 1.586–4.458, respectively) compared with the unfat-fit group (reference group). We repeated the analyses using body fat groups according to the

Table 1 Mean (M) and Standard Deviation (SD) for Health Complaints Index and Health Risk Behaviors by Age Group

	Children (6–11.9 y)		Adolescents (12–17 y)	
	N	Mean ± SD	N	Mean ± SD
Health complaints index (1–5)	365	1.570 ± 0.588	300	1.761 ± 0.610
Tobacco use (1–4)	381	1.000 ± 0.051	306	1.242 ± 0.772
Alcohol use (days/week)	385	0.019 ± 0.359	303	0.080 ± 0.159
Drunk (0–4)	383	0.020 ± 0.250	306	0.480 ± 0.996

Note. All *P* < .001 age group differences.

Table 2 Standardized Regression Coefficients (β) Showing the Association of Cardiorespiratory Fitness (Expressed as ml/kg/min), Body Mass Index (kg/m²), and Body Fat Percentage With Negative Health Indicators in Children and Adolescents

	Children (6–11.9 y)			Adolescents (12–17 y)		
	N	β	P	N	β	P
Cardiorespiratory fitness						
Health complaints index	354	-0.149	0.005	285	-0.176	0.002
Tobacco use	370	-0.066	0.202	291	-0.108	0.048
Alcohol use	369	-0.037	0.469	288	-0.078	0.152
Drunk	372	0.039	0.449	291	-0.080	0.144
Body mass index						
Health complaints index	354	0.108	0.044	290	0.128	0.029
Tobacco use	369	-0.018	0.726	296	0.006	0.915
Alcohol use	369	0.118	0.024	293	0.073	0.202
Drunk	371	-0.014	0.794	296	0.068	0.234
Body fat percentage						
Health complaints index	353	0.113	0.033	288	0.054	0.501
Tobacco use	368	-0.031	0.555	294	0.021	0.715
Alcohol use	367	0.112	0.032	291	-0.049	0.388
Drunk	370	0.027	0.601	294	-0.088	0.119

Note. All analyses were controlled for sex.

Table 3 Association of Low Cardiorespiratory Fitness Level, Being Overweight and Obese, and Having a High Body Fat Percentage (FITNESSGRAM Standards for Healthy Fitness Zone) With Negative Health Indices in Children and Adolescents

		Children (6–11.9 years)			Adolescents (12–17 years)		
		N	OR	95%CI	N	OR	95%CI
Cardiorespiratory fitness							
Health complaints index	Never	303	1	Referent	173	1	Referent
	Sometime	51	2.556	1.299–5.031	112	1.997	1.162–3.433
Tobacco use	Never	318	1	Referent	177	1	Referent
	Sometime	52	–	–	114	1.720	0.782–3.783
Alcohol use	Never	318	1	Referent	175	1	Referent
	Sometime	51	5.142	1.214–21.783	113	2.413	1.484–3.923
Drunk	Never	320	1	Referent	177	1	Referent
	Sometime	52	–	–	114	1.952	1.137–3.351
Overweight/Obese							
Health complaints index	Never	250	1	Referent	218	1	Referent
	Sometime	104	1.732	1.019–2.945	72	1.218	0.664–2.236
Tobacco use	Never	261	1	Referent	223	1	Referent
	Sometime	108	–	–	73	0.661	0.240–1823
Alcohol use	Never	262	1	Referent	220	1	Referent
	Sometime	107	3.247	0.857–12.370	73	1.409	0.821–2.418
Drunk	Never	262	1	Referent	223	1	Referent
	Sometime	109	1.160	0.104–12.978	73	1.054	0.565–1.968
Body fat percentage							
Health complaints index	Never	280	1	Referent	238	1	Referent
	Sometime	73	1.983	1.083–3.629	50	1.224	0.605–2.477
Tobacco use	Never	290	1	Referent	242	1	Referent
	Sometime	78	–	–	52	0.813	0.266–2.486
Alcohol use	Never	290	1	Referent	240	1	Referent
	Sometime	77	1.725	0.405–7.348	51	0.692	0.372–1.287
Drunk	Never	291	1	Referent	242	1	Referent
	Sometime	79	2.479	0.203–30.336	52	0.334	0.135–0.823

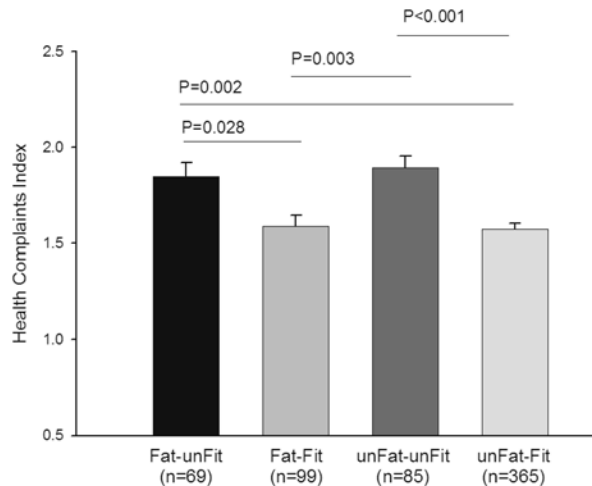


Figure 1 — Health complaints index by fat-fit categories. Values express mean and SEM.

FITNESSGRAM standards instead of BMI groups and results did not change (data not shown).

Discussion

The main finding of the current study is that cardiorespiratory fitness is negatively associated with health complaints in youth. In contrast, fatness is positively associated with health complaints index. Moreover, having a low cardiorespiratory fitness level increases the likelihood of having health complaints and risk behaviors such as drinking alcohol sometime. We also showed that fit youth had significantly lower values of health complaints index than their unfit counterparts regardless of their weight status.

Cardiorespiratory Fitness and Health Complaints

Only 2 studies examined the relationship between cardiorespiratory fitness and health complaints in youth, with contradictory results. Crews et al⁹ observed that high levels of cardiorespiratory fitness were associated with lower depression, whereas no association was observed between fitness and anxiety. In contrast, Bonhauser et al¹⁰ observed that cardiorespiratory fitness was inversely associated with anxiety but not with depression. In our study, we computed a health complaints index^{14,42} because subjective health complaints such as headache, stomach-ache, backache, feeling low, irritability or bad temper, feeling nervous, difficulties getting to sleep, and feeling dizzy tend to occur in cluster rather than as single symptoms.⁴³ We observed a negative association between cardiorespiratory fitness and health complaints index in both children and adolescents. In addition, our data showed that youth with low cardiorespiratory fitness had ~2.5 higher likelihood of reporting health complaints sometime than their fit counterparts.

Cardiorespiratory Fitness and Health Risk Behaviors

We observed that cardiorespiratory fitness was inversely associated with smoking in adolescents, which is in line with prior studies.^{11–13} On the other hand we did not observe an association between cardiorespiratory fitness and alcohol use, which confirms the findings reported by Montoye et al.¹¹ They showed, in a 16 to 20 years old group, that nondrinkers and the heaviest drinkers had the lowest cardiorespiratory fitness levels, whereas moderate drinkers had the highest cardiorespiratory fitness levels. We found that youth with low cardiorespiratory fitness were more likely of drinking sometime. Likewise, unfit adolescents had higher risk of getting drunk sometimes. From a public health perspective, this observation is particularly important given the negative consequences of drinking. Despite many studies have been conducted on alcohol ingestion and physical performance in adults, no consensus has been achieved.⁴⁴

Fatness and Health Complaints

The association between overweight-obesity and psychological health symptoms (eg, depression) has been widely addressed in youth.^{17,18,45–48} In contrast, less is known regarding the association between overweight-obesity and psychosomatic symptoms (eg, health complaints). We observed that overweight-obese children or those with high body fat percentage had ~2 times higher risk of reporting health complaints than their normal weight peers. This finding is consistent with another study conducted in Palestinian adolescents.²⁰ However, we did not observe an association between overweight-obesity and health complaints in adolescents. This findings might suggest that the association between overweight-obese and health complaints in childhood does not track into adolescence. Further longitudinal studies may also clarify these associations.

Fatness and Health Risk Behaviors

The association between weight status and smoking and alcohol remains unclear.^{17–19} We observed that overweight-obesity was positively associated with alcohol use in children but not in adolescents. Pasch et al¹⁸ found that joined alcohol, tobacco and other drug use in seventh grade predicted BMI in eighth grade, but not separated. Recently, Farhat et al⁴⁹ showed that overweight and obesity was significantly associated with frequent smoking and drinking in adolescent girls but not in adolescent boys. These findings are alarming as the confluence of being overweight and drinking alcohol and smoking might have profound impact on youth' overall current and long-term health. Future studies are needed to clarify which role of potential confounding factors, such as peer and family relationship, socioeconomic status and parental education in the relationship of BMI with smoking and drinking.

Fatness-Fitness and Health Complaints

We also analyzed the combined influence of fitness and fatness on health complaints. We observed that fit youth had significantly lower values of health complaints index than their unfit group counterparts (ie, fat-unfit and unfat-unfit) regardless of the weight status. This indicates that high levels of cardiorespiratory fitness might overcome the deleterious effects of overweight-obesity. This finding is consistent with other studies that examined the combined influence of fitness and fatness on other health outcomes such as insulin resistance,⁵⁰ blood pressure,⁵¹ and metabolic risk.^{7,52} This implies that interventions to prevent states of unfavorable health profiles should focus not only on weight reduction but also on enhancing cardiorespiratory fitness.

Limitations of the Study

A limitation of this study is its cross-sectional nature, which does not permit inferences about causality to any of the associated factors in the study. In addition, as health complaints index and health risk behaviors are based on self-report, it is possible that some study participants may have misreported either intentionally or inadvertently on any question asked. However, intentional misreporting was probably minimized by the fact that study participants completed the questionnaires anonymously, and the questions used in this study, belonging to HBSC questionnaire, are reliable and valid.^{31,32} It should also be recognized that the studied sample is not representative of the Spanish children and adolescent population; yet, our data are fully comparable with nationally representative data obtained from the AVENA study^{53,54} and the HBSC 2005/2006 survey.⁵⁵ In addition, cardiorespiratory fitness and fatness were assessed by objective measures.

Conclusions

The current study suggests that cardiorespiratory fitness is inversely associated with health complaints index in youth. Having a low cardiorespiratory fitness level increases the risk of having health complaints and drinking sometime. It also shows that fatness is positively associated with health complaints, mainly in children. These findings suggest the need to increase cardiorespiratory fitness and prevent body weight and fat gain early during development. However, the deleterious consequences ascribed to overweight-obesity may be attenuated with high levels of cardiorespiratory fitness.

Acknowledgments

The study was funded by Centro Andaluz de Medicina del Deporte, Junta de Andalucía, Orden 4/02/05, BOJA n° 37 (Ref. JA-CTD2005-01), the Swedish Council for Working Life and Social Research (FAS) and the Spanish Ministry of Science and Innovation (RYC-2010-05957, RYC-2011-09011).

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