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Title: Self-rated physical fitness and measured cardiorespiratory fitness, muscular strength, and body composition

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Abstract

The purpose was to examine the correlation and association between a single-item question of self-rated physical fitness and objective measures of fitness and cardiometabolic risk factors in a large population-based study. Participants were 3,441 men and women aged 18-85 years who filled in a questionnaire and participated in a clinical health examination in The Danish Health Examination Survey 2007-2008. Cardiorespiratory fitness was estimated by an indirect maximal exercise test. Muscle strength was measured by (1) sit-to-stand test (2) hand grip strength and (3) bent arm strength. Body Mass Index and fat percentage were used as measures for body composition. Associations were derived from regression analyses, correlations were calculated using the spearman's correlation test, and agreement was tested by kappa statistics. Within categories of self-rated physical fitness moving from lowest to highest, objectively measured cardiorespiratory fitness increased. Self-rated physical fitness was strongly correlated to cardiorespiratory fitness (r_{men}=0.69 and r_{women}=0.65) and moderately correlated to the sit-to-stand test (r_{men}=0.49 and r_{women}=0.48), bent arm strength and fat percentage among men ($r_{arm\ strength}$ =0.45; $r_{fat\ percentage}$=0.46) and hand grip strength among women (r_{women}=0.41). Mutually adjusted analysis showed a significant association between self-reported physical fitness and cardiorespiratory fitness for men and women and bent arm strength for women. The single-item question of physical fitness was correlated to both cardiorespiratory fitness, muscle strength and body composition. However, this study suggest that it mainly captures cardiorespiratory fitness. At the population level, the single-item question could be a useful tool to identify and monitor variation in fitness levels.

Introduction

High levels of cardiorespiratory fitness are associated with lower risk of cardiovascular disease and mortality (1-3). Globally, cardiovascular disease is the leading cause of death(6). Resent findings have indicated that cardiorespiratory fitness is comparable with other established cardiovascular risk factors (3). Although, cardiorespiratory fitness is a main component of physical fitness, also muscular strength and fat percentage are important physical fitness components related to health and in several prospective studies muscular strength has been shown to be inversely associated with cardiovascular and all-cause mortality (3-5).

Due to the role of physical fitness as a modifiable risk factor for cardiorespiratory disease and mortality monitoring both monitoring cardiorespiratory fitness and muscle strength is therefore of considerable importance for disease prevention, but it requires highly specialized equipment. Consequently, physical fitness is rarely measured at the population level due to time, budget and logistic limitations (2). An alternative to objective testing is to use self-rated measures obtained from questionnaires. However, little is known of the precision of self-rated physical fitness level and the existing evidence is hampered by heterogeneous definitions and measurement methods (7-16).

A single-item question of self-rated physical fitness is a simple and cost-effective method to estimate physical fitness. Only few studies have assessed the convergent validity of self-rated physical fitness. Previous studies testing the validity of a single-item question of physical fitness by comparing it to cardiorespiratory fitness showed heterogenous results (13-15) and indicated age and sex differences (13, 15).

Physical fitness is a complex multidimensional construct consisting of cardiorespiratory fitness as well as muscular strength, flexibility, and body composition (17) When using a single-item question, asking individuals to rate their own physical fitness, the respondent's own physical activity pattern (activity type and intensity) may influence the perception of physical fitness e.g. cardiorespiratory fitness and/or muscle strength. Therefore, in a large general population of men and women, we aimed to 1) examine the correlation between a single-item question of physical fitness and objective measured cardiorespiratory fitness and 2) examine how the single item question is associated to objective measures of fitness and cardiometabolic risk factors such as cardiorespiratory fitness, muscular strength and body composition.

Material and Methods

Study population

The study was based on the Danish Health Examination Survey (DANHES) which was conducted in 13 municipalities in Denmark in 2007 and 2008. The DANHES study design is described in detail elsewhere (18). In each municipality, all citizens aged 18 or more were invited by letter to fill in a self-reported internet-based questionnaire. Furthermore, a representative sample of the citizens was invited to participate in a clinical health examination including measurements of height, weight, fat percentage, waist and hip circumference, muscular strength and cardiorespiratory fitness. Overall, 180,103 persons were invited to the health examination and 18,065 participated (participation rate: 10%).

The question on self-rated physical fitness was only included in four of the 13 municipalities. Thus, complete and valid data on self-rated physical fitness and clinical health examination data were available for 4,311 participants. Of these, 3,441 individuals performed an indirect maximal exercise test. Written informed consent was obtained from all participants. The protocol was reviewed by the Scientific Ethical Committee B for the Capital Region of Denmark (H-B-2007-050).

Assessments

Self-rated physical fitness

Self-rated physical fitness was assessed by the question: "How do you rate your own physical fitness?" on a Likert-type scale with five response options: (1) very good, (2) good, (3) fair, (4) poor or (5) very poor. Similar questions have previously been used in national and international studies (14, 19, 20).

Cardiorespiratory fitness

Cardiorespiratory fitness was estimated by use of an indirect maximal or a submaximal cycle exercise test depending on the health state of the participant (21). One or more of the following conditions contraindicated participation in the maximal cycle test: any heart-related disease or condition, chest pain or pressure, moderate hypertension (≥ 160/100 mmHg), use of antihypertensives, heart or pulmonary medicine, pregnancy, or muscle, joint or skeletal problems. The submaximal test was contradicted in case of pacemaker, severe hypertension (≥ 180/110 mmHg), physical limitations precluding participating in an exercise test, and the use of certain medications affecting heart rate (e.g. beta blockers and peripheral vasodilators).

The indirect maximal exercise test was a progressive cycle test (Ergomedic 839E, Monark Exercise AB, Vansbro, Sweden). A maximal test is considered the most precise indirect test for asymptomatic participants. The test started with a 5-min warm-up at a load of 75 watt for women and 100 watts for men. After the warm-up, the workload was increased by 35 watt every 2 min until voluntary exhaustion. The participants were verbally encouraged to continue for as long as possible and the perceived exertion by the participants was evaluated using Borg's scale (22). Furthermore, maximal heart rate and secondary hyperventilation were observed to determine whether maximal oxygen consumption (VO_2max) was reached. If the participant or the instructor terminated the test before the participant reached maximal exhaustion due to safety reasons, the test results were calculated following the submaximal test procedure.

Cardiorespiratory fitness was estimated indirectly from a prediction model based on sex, body weight, and maximal power output, that is, the highest achieved workload obtained by participants adjusted for the proportion of the last stage completed (21).

The submaximal exercise test was a 5-min constant load (75 watt for women and 100 watt for men) cycle test (the warm-up of the maximal test) and cardiorespiratory fitness was estimated indirectly from a prediction model based on sex, gender, heart rate, age, body weight and height. The prediction models have been described in detail elsewhere (21). The tests were performed by scientific personnel who had been trained to perform these two cycle tests.

Muscular strength

Muscular strength was measured by three tests: (1) sit-to-stand, (2) hand grip, and (3) arm strength (bending of the arms). The sit-to-stand test is a proxy measure of lower body strength and function (23). In this test, participants were asked to fold their arms across their chest. In this position they should rise from a chair and return to the seated position for as many times as possible in 30 seconds. Hand grip and bent arm strength test are considered valid methods to assess overall muscle strength (24). Hand grip was measured with Takei TKK A5401 Digital Handgrip

Dynamometer, and bent arm strength was measured with Takei TKK 5402 Digital Back Strength Dynamometer (Takei Scientific Instruments Co. Ltd., Tokyo, Japan) using the dominant arm and hand. Both muscle strength tests were performed with maximal exertion. Hand grip was repeated twice and the higher of the two measurements was recorded. Bent arm strength was only measured once.

Body composition

Body weight and body fat percentage were measured by a Body Composition Analyzer (type BC-418 MA, Tanita Corp., Tokyo, Japan). BMI (kg/m^2) was calculated from height measured without shoes and body weight.

Statistical analyses

Individuals with missing data on self-rated fitness were excluded from analysis (n=443). Further, missing or non-valid data regarding cardiorespiratory fitness estimated by the maximal exercise test were excluded from analysis (n=1,003).

Frequency tables and the Cohen's quadratic weighted kappa analysis were used to assess the extent of agreement between self-rated physical fitness and categories of measured cardiorespiratory fitness. Cardiorespiratory fitness was categorised by diving data into gender and age specific quintiles and following categorise it into five categories reflecting the distribution of the self-rated physical fitness: (1) ≥95%, (2) 60-94%, (3) 15-59%, (4) 5-14% and (5) <5%. In secondary analysis, we also categorised cardiorespiratory fitness into cut-offs specified by Aastrand et al.: Low; Fair; Average; Good and High (25) (Supplementary materials, Table A1 and A2).

The association between the self-rated physical fitness level and cardiorespiratory fitness was analysed by linear regression analysis with cardiorespiratory fitness (ml/min/kg) as the dependent variable and self-rated physical fitness as the independent variable. Results were presented as means with 95% confidence intervals. Rank-ordered correlation coefficients were derived using the Spearman's correlation test. In sensitivity analysis, we performed separate analysis for cardiorespiratory fitness estimated by the indirect maximal and a submaximal test. Data from the indirect maximal exercise test was predetermined as the primary analyses and secondary data analysis was conducted using the submaximal test (n=4,311) (Supplementary materials Table A2). We also performed stratified analysis by age-groups (Supplementary materials Table A3).

Associations and correlations between self-rated physical fitness and objective measurements of cardiorespiratory fitness, muscle strength (sit-to-stand, bent arm and hand grip) and body composition (fat percentage and BMI) were estimated by linear regression analysis and shown as mean values adjusted for age (Mean values were estimated for a 50-year-old person). Spearman's test for correlation was used. In supplementary analysis we also examined associations between self-rated physical fitness and measured blood pressure, blood lipids and self-rated health (Supplementary materials Table A4).

Because no appropriate cut-off value for determining the level of correlation exist, we interpreted our correlation coefficients and Kappa values based on Landis and Koch (26) with r values of 0.00-0.19, 0.20-0.39, 0.40-0.59, 0.60-0.79 and 0.80-1.0 representing very weak, weak, moderate, strong and very strong correlations, respectively.

The ordinal logistic regression (OLR) model was used to assess the odds of increasing one level in self-rated fitness (ordered categorical dependant variable) by one unit of measured cardiorespiratory fitness, muscle strength (sit-to-stand, bent arm and hand grip) and body composition (fat percentage and BMI). The analyses were run in three models (1) adjusted for age, (2) adjusted for age and cardiorespiratory fitness (3) mutually adjusted for cardiorespiratory fitness and muscle strength.

All analyses were performed separately for men and women.

Results

The baseline characteristic of the 3,441 participants included in the study is provided in Table 1. The median age was 46 years and 2,079 were women (60%) (Table 1). Approximately half of the study population reported a low physical activity level while 39% reported a moderate or vigorous physical activity level in leisure time. Mean cardiorespiratory fitness was 39 ml/min/kg (Standard deviation (SD)=5.7) for men and 32 ml/min/kg (SD=6.5) for women. In general, men had better mean muscle strength in the upper extremity (hand grip and bent arm strength) than women whereas they performed equally well at the sit-to-stand test. Mean BMI was 24 kg/m^2.

Self-rated physical fitness level in relation to objectively estimated cardiorespiratory fitness is shown in Figure 1. Among both men and women and for all age groups, there was a stepwise decrease in cardiorespiratory fitness by self-rated physical fitness moving from very good to very poor. The overall correlation coefficient was 0.40 ($r=0.43_{men}$ and $r=0.37_{women}$) (See Supplementary materials Table A3). The correlations were strongest for the 30-49-year-old men and women (r=0.52) and lowest for the 65+ year-old women (r=0.33) (See Supplementary materials Table A4). Adjustments for mean age in the age-interval did not change the estimates. A lower correlation between self-rated physical fitness level and cardiorespiratory fitness was seen when using cardiorespiratory fitness estimates by the submaximal test (r=0.20-0.43) (Supplementary materials Table A3).

The distribution and agreement between self-rated physical fitness and categories of measured cardiorespiratory fitness are shown in Table 2. A total of 661 men (49%) and 946 women (46%) rated their physical fitness in agreement with the categories of cardiorespiratory fitness when assuming the same distribution in both methods. In general, there was a fair agreement ($k_{men}=0.45$ and $k_{women}=0.42$). The agreement was lowest in 'very good' and 'very poor' categories and highest in the 'fair' category. Overall, more men than women overestimated their physical fitness level (31% and 24% for men and women, respectively) and more women than men underestimated their physical fitness level (21% and 31% for men and women, respectively).

Table 3 presents self-rated physical fitness in relation to mean values of and correlations to objective measures of cardiorespiratory fitness, muscle strength measures and body composition. Self-rated physical fitness was strongly correlated to cardiorespiratory fitness ($r_{men}=0.69$ and $r_{women}=0.65$), moderately to the sit-to-stand test ($r_{men}=0.49$ and $r_{women}=0.48$), bent arm strength and fat percentage among men ($r_{arm\ strength}=0.45$; $r_{fat\ percentage}=0.46$) and hand grip strength among women ($r_{women}=0.41$). Supplementary analyses showed week correlations between measures of blood pressure, and blood lipids with the expectation for cholesterol levels among men (r=0.49). Also, self-rated health showed moderate correlations ($r_{men}=0.46$; $r_{women}=0.40$) (Supplementary table A5). Among both men and women, self-rated physical fitness was moderately correlated to physical activity level in leisure time ($r_{men}=0.41$; $r_{women}=0.41$) (data not shown).

Associations of self-rated physical fitness by measurements of cardiorespiratory fitness, muscle strength, and body composition are shown in Table 4. The unadjusted results showed a significant higher odds ratio of a higher self-rated physical fitness for cardiorespiratory fitness and muscle strength, except from hand grip strength among men. The odds ratio (OR) for cardiorespiratory fitness was 1.23, 95% Confidence interval (95% CI): 1.20-1.26) for men and OR=1.22, (95% CI: 1.20-1.24) for women). Meaning that for each increase in one-unit of cardiorespiratory fitness (ml/min/kg) the estimated odds for increasing one level in self-rated fitness increased by 23%. Further, unadjusted results showed a significant lower odds ratio for measurements of body composition. When adjusting for cardiorespiratory fitness, the association remained significant for bent arm strength and BMI among both men and women, for fat percentage among men, and hand grip strength among women. In multiple adjusted analyses, only cardiorespiratory fitness was significantly associated to self-rated physical fitness among men while among women also bent arm strength, and BMI showed significant associations.

Discussion

The results of this study demonstrate that a single-item question asking participants to rate their own physical fitness correlates strongly to objectively estimated cardiorespiratory fitness among both men and women in this large population of Danish adults. Also, it was moderately correlated to the sit-to-stand test, bent arm strength and fat percentage among men and hand grip strength among women. However, mutually adjusted results showed that only cardiorespiratory fitness for men and women and bent arm strength for women were significantly associated with self-rated physical fitness.

In correspondence to our findings, Obling et al. examined correlations between a single-item question of self-rated physical fitness and objectively measured fitness level in 30-49-year-old men and women and found that higher self-rated fitness level was associated to higher measured cardiorespiratory fitness (13). Also, in another recent Danish study a moderate, positive correlations between self-rated physical fitness and watt-max estimated cardiorespiratory fitness was found (14). To our knowledge, this is the first study to examine associations between a single-item question of self-rated physical fitness and measurements of both cardiorespiratory fitness, muscle strength and body composition in a large population-based sample of adult men and women. Previous studies have assessed the relation between self-rated physical fitness measured by a multiple-item questionnaire and several measured fitness components (9, 11, 19, 27-29). These studies support our findings by indicating that separately and combined, different dimensions of physical fitness such as muscle strength, flexibility, cardiorespiratory fitness, endurance and balance are components of self-rated physical fitness. However, they showed differences in associations depending on age, gender and the individual's physical condition (9, 19).

Our findings provide an important contribution to the current literature about self-perceived physical fitness, by showing that in general, the study participants recognise cardiorespiratory fitness as the principal aspect of physical fitness. However, also muscle strength and body composition were found to be correlated to the construct of physical fitness. This is in line with previous studies also showing stronger associations for cardiorespiratory fitness than for flexibility, muscle strength, balance and endurance (9, 19, 27). Also, results showed only week correlations between self-rated physical fitness level and blood pressure as well as blood lipids.

In this study, cardiorespiratory fitness seems to be a main component of perceived physical fitness. Physical activity is the principal determinant of physical fitness although there is also a genetic component (30). Thus, high volumes of moderate to vigorous physcial activity are expected to be associated to a better perceived physcial fitness. In the present study, self-rated fitness showed modest assocations to physcial activity in leisure time (data not shown). In correspondance with this, most studies find a modest correlation between physical actvity (the behaviour) and measured cardiorespiratory fitness (14-16, 31, 32). In Denmark, aerobic exercise activities such as running and cycling, are popular leisure time activities which may explain why self-rated physical fitness is mostly correlated to cardiorespiratory fitness and muscle strength in the legs in our study.

The results also indicate variations by gender. We found that overestimation was more prevalent among men than women and underestimation more prevalent among women. This is in correspondence with some previous studies showing that men have higher perceived fitness than women (33, 34), whereas others have found no gender differences (35). The observed gender-specific variation in the perceptions of physical fitness may be because men have a more positive perception of fitness compared to women, as it is often related to masculinity and therefore, men tend to exaggerate in a positive direction (36).

We also observed an age differences in the correlation coefficients between self-rated physical fitness and cardiorespiratory fitness. They were lowest for men and women above 65 years of age although they were still considered moderate. In line with this, a meta-analysis from 2006 concluded that although both men and women seem to be relatively accurate in the perception of physical fitness throughout the lifespan, it become less accurate by age (36). When asked to rate their own physical fitness level, it is possible that while some people compare their physical fitness level to people of the same age others compare it to the population in general. The observed age-difference may be explained by the fact that young people have a higher physical fitness level than older people. Thus, some studies validating self-rated physical fitness have asked participants to rate their physical fitness level relative to someone their own age in order to reduce age differences in accuracy (15, 27). Moreover, other dimensions of physiological and psychological well-being possibly influence the self-perception of fitness among older compared to younger people. The modest correlation between self-rated fitness and self-rated health may indicate that people perceive health and fitness in much the same way or that those who feel physically fit also have a better health. On the other hand, the results also show that people do distinguish between being ‘healthy’ and being ‘fit’. E.g. a person can perceive their health as very good but their physical fitness level as low.

Among older people, low muscular strength is related to functional limitations, risk of falls and overall mortality (37). Ortega et al. have shown a dose-response association between self-reported muscular fitness and muscular fitness tests (9). Among 40-year old men and women, Mikkelsson et al. found that muscle strength was moderately correlated to the sit-to-stand test (r_{men}=0.45; r_{women}=0.46) while for the hand grip strength, they found a moderate correlation for women (r_{women}=0.41) but a weak correlation for men (r_{men}=0.13) (19). Correspondingly, we also show stronger associations with the sit-to-stand test than the hand grip and bent arm test.

An advantage of the present study is that it includes a broad sample of Danish adults. However, only 10% of the invited individuals participated and thus results may not be representative of the entire Danish population (18). In general, participants in this cohort were healthier and more physically active than non-participants and thus results may differ from what is observed in other cohorts. Self-rated fitness is known to be affected by lifestyle and health related factors. Thus, the perception of poor physical fitness could be affected by e.g. general wellbeing, smoking behavior or chronic disease. However, given the design of the study, selection bias should not affect the internal validity.

The precision of estimating cardiorespiratory fitness depends on the applied method and exercise protocol. An advantage of this study is the use of the indirect maximal exercise test, which has been shown to be a valid method for estimating cardiorespiratory fitness (21). However, for some participants cardiorespiratory fitness was estimated by use of a submaximal cycle exercise test. This was done to include as many participants as possible in the study. The observed correlation in the present study between self-rated physical fitness and cardiorespiratory fitness is slightly higher than reported by others (13, 31) but in line with findings by Lamb et al. (27) and Young et al.(29). The difference between previous findings and the present study may be due to the fact that the submaximal exercise test used in previous studies is less accurate and tends to underestimate cardiorespiratory fitness compared to the maximal tests (39). In support of this hypothesis, we find a lower correlation with self-rated physical fitness when measuring cardiorespiratory fitness by the submaximal test compared to the maximal test.Physical activity and exercise are being promoted as a means of chronic disease prevention. Resent findings have indicated that cardiovascular fitness may provide additional prognostic value beyond established risk factors and therefore has, important implication for public health and disease prevention but objective measurements of physical fitness at the population level are rarely possible because it is highly resource demanding. Information from questionnaires may result in greater misclassification of physical fitness than information from objective fitness tests, but the questionnaires are easier and less expensive to administer in large study populations (41). A single-item question of physical fitness is the simplest way to estimate physical fitness. Compared to measuring cardiorespiratory fitness and muscular strength, self-rated fitness offers a simple alternative and should be considered a useful tool for assessing physical fitness at the population level. In clinical practice, a single item question could also be a valuable preventive tool to identify high risk individuals (42) although, it cannot substitute individual cardiorespiratory fitness testing in the clinic or when evaluating effects of an intervention.

Further, the perception of physical fitness is likely to depend on social and cultural norms such as differences in physical activity behaviours. In cultures where aerobic physical activities are popular, physical fitness may relate more to cardiorespiratory fitness than to other physical fitness indicators. Thus, there is a need for replication studies in various population to affirm the inclusion of a single-item question of physical fitness in future health-monitoring surveys.

Perspectives

In this large population-based study of Danish adults, we found that a single-item question of self-rated physical fitness was strongly correlated to measured cardiorespiratory fitness. Although, also correlated to muscle strength and body composition, self-rated physical fitness appears to mainly capture cardiorespiratory fitness. The physical fitness level is related to health and thus, also to public health. However, previously, self-rated fitness has rarely been included in large population-based surveys. Our study suggests, that at the population level, a single-item question may be a useful and cost-effective tool in surveys assessing the physical fitness level.

Conflict of interest:

None.

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Table 1. Baseline Characteristics of the Study Population (n=3,441).

Characteristics	Men † (n=1,362)	Women † (n=2,079)
Age		
18-29 years	55 (4)	108 (5)
30-49 years	520 (38)	863 (42)
50-64 years	621 (46)	934 (45)
65+ years	166 (12)	174 (8)
Educational level	407 (30)	431 (21)
< 12 years	301 (22)	522 (25)
13-14 years	645 (48)	1108 (54)
15+ years		
Daily smoking (%)	149 (11)	180 (9)
Alcohol intake, mean drinks/week, (SD)	10 (9)	6 (6)
Self-rated fitness level (%)		
Very good	77 (6)	49 (2)
Good	543 (40)	736 (35)
Fair	592 (44)	936 (45)
Poor	120 (9)	288 (14)
Very poor	30 (2)	70 (3)
Self-reported physical activity in leisure time		
Vigorous	101 (7)	63 (3)
Moderate	540 (40)	615 (29)
Low	597 (44)	1239 (60)
Inactive	120 (9)	153 (7)
Self-rated health		
Very good	249 (18)	401 (19)
Good	920 (68)	1350 (65)
Fair	178 (13)	301 (15)
Poor	14 (1)	22 (1)
Very poor	0 (0.1)	2 (0.1)
Cardiorespiratory fitness, mean ml/min/kg (SD)	39 (7.0)	32 (6.2)

Hand grip strength (kg), mean (SD)	46 (7.1)	30 (4.7)
Arm strength (kg), mean (SD)	40 (7.6)	21 (4.9)
Sit-to-stand chair test, mean number/30 sec (SD)	21 (5.4)	20 (5.2)
BMI>30 (obese) (%)	106 (7.8)	108 (5.2)
Fat percentage, mean (SD)	21 (5.4)	32 (6.5)

† Shown numbers are proportions (%) for categorical variables and means for continuous variables

Table 2. Cross tabulation of self-rated physical fitness level and cardiorespiratory fitness (ml/min/kg) estimated by indirect maximal exercise test categorized in age- and gender-specific quintiles (n=3,441). Values are numbers (%).

Men						
Cardiorespiratory fitness	Self-rated physical fitness level category					
	Very good	Good	Fair	Poor	Very poor	Total
≥95 %	17 (26)	41 (63)	7 (11)	0 (0)	0 (0)	65 (100)
60-94%	39 (8)	273 (57)	149 (31)	17 (4)	0 (0)	478 (100)
15-59%	20(3)	200 (33)	328 (54)	53 (9)	11 (1.8)	612 (100)
5-14 %	1 (0.7)	20 (14.7)	77 (57)	31 (23)	7 (5)	136 (100)
<5%	0 (0)	9 (13)	31 (44)	19 (27)	12 (17)	88 (100)
Total	77 (5.7)	543 (39.9)	592 (43.5)	120 (8.8)	30 (2.2)	1.362(100)

Cohen's kappa coefficient (κ) = 0.45 (fair agreement), estimated by a weighted kappa calculation.

Women						
Cardiorespiratory fitness	Self-rated physical fitness level category					
	Very good	Good	Fair	Poor	Very poor	Total
95+ %	12 (12)	70 (69)	17 (17)	2 (2)	0 (0)	101 (100)
60-94%	22 (3)	370 (51)	287 (40)	45 (6)	4 (1)	728 (100)
15-59%	12 (1)	257 (27)	479 (53)	150 (16)	19 (2)	935 (100)
5-14 %	1 (<1)	25 (12)	105 (49)	59 (28)	21 (10)	208 (100)
<5%	2 (1.9)	14 (13)	33 (31)	32 (30)	26 (24)	107 (100)
Total	49 (2.4)	736 (35.4)	936 (45.0)	288 (13.9)	70 (3.4)	2.079 (100)

Cohen's kappa coefficient (κ) = 0.42 (fair agreement), estimated by a weighted kappa calculation.

Table 3. Means of objective measures of cardiorespiratory fitness, muscle strength (sit-to-stand, bent arm and hand grip) and body composition (fat percentage and BMI) by self-rated physical fitness estimated from linear regression models (n=3,441)‡

Men

	Self-rated physical fitness						
	Very good	Good	Fair	Poor	Very poor	P for trend	*r*†
Cardiorespiratory fitness (ml/min/kg) §	44.2 (ref)	40.4 (<0.01)	36.3 (<0.01)	33.5 (<0.01)	29.6 (<0.01)	<0.01	0.69
Sit-to-stand test (n/30 sec)	23.6 (ref)	21.4 (<0.01)	20.2 (<0.01)	19.6 (<0.01)	18.4 (<0.01)	<0.01	0.49
Arm strength (kg)	38.3 (ref)	27.4 (0.01)	26.8 (<0.01)	27.3 (0.03)	24.8 (0.02)	0.02	0.45
Hand grip strength (kg)	45.0 (ref)	45.6 (0.49)	45.8 (0.29)	45.4 (0.68)	43.2 (0.16)	0.78	0.38
Fat percentage	18.8 (ref)	21.1 (<0.01)	22.8 (<0.01)	24.4 (<0.01)	27.2 (<0.01)	<0.01	0.46
BMI (kg/m^2)	23.7 (ref)	24.9 (<0.01)	25.8 (<0.01)	26.7 (<0.01)	28.5 (<0.01)	<0.01	0.31

Women

	Self-rated physical fitness						
	Very good	Good	Fair	Poor	Very poor	P for trend	*r*†
Cardiorespiratory fitness (ml/min/kg) §	35.5 (ref)	33.4 (<0.01)	30.2 (<0.01)	27.6 (<0.01)	24.3 (<0.01)	<0.01	0.65
Sit-to-stand test (n/30 sec)	21.9 (ref)	20.1 (<0.01)	19.3 (<0.01)	18.1 (<0.01)	16.6 (<0.01)	<0.01	0.48
Arm strength (kg)	33.6 (ref)	31.6 (0.68)	24.0 (0.09)	25.9 (0.20)	16.2 (0.05)	0.01	0.39
Hand grip strength (kg)	29.3 (ref)	29.1 (0.80)	28.6 (0.19)	28.1 (0.05)	27.9 (0.05)	<0.01	0.41
Fat percentage	30.3 (ref)	31.3 (0.42)	33.6 (<0.01)	35.1 (<0.01)	38.6 (<0.01)	<0.01	0.37
BMI (kg/m^2)	23.1 (ref)	23.2 (0.76)	24.1 (0.02)	25.0 (<0.01)	27.1 (<0.01)	<0.01	0.30

† Correlations were calculated using the spearman's correlation test.

‡ Adjusted for age. Mean values are for a 50-year-old person.

§ Predicted by an indirect maximal exercise test.

Table 4. Odds ratios of self-rated physical fitness by objective measures of cardiorespiratory fitness, muscle strength (sit-to-stand, bent arm and hand grip) and body composition (fat percentage and BMI) estimated from an ordinal logistic regression model.

	Men					
	OR† CI (95%)	**P-value**	**OR‡ CI (95%)**	**P-value**	**OR§ CI (95%)**	**P-value**
Cardiorespiratory fitness (ml/min/kg (SD)	1.23 (1.20-1.26)	<0.01	1.23 (1.20-1.26)	<0.01	1.27 (1.23-1.31)	<0.01
Hand grip strength (kg)	1.00 (1.00-1.02)	0.66	1.02(1.00-1.03)	0.16	1.00 (0.99-1.03)	0.74
Bent arm strength (kg)	1.01 (1.00-1.04)	0.08	1.01(1.00-1.03)	0.02	1.01 (0.99-1.04)	0.18
Sit-to-stand test (number/30 sec)	1.07 (1.05-1.10)	<0.01	1.00 (1.00-1.00)	0.59	1.00 (1.00-1.00)	0.95
Fat percentage	0.91 (0.89-0.93)	<0.01	1.06 (1.03-1.09)	<0.01	1.04 (0.99-1.10)	0.15
BMI (kg/m^2)	0.87 (0.84-0.90)	<0.01	1.09 (1.04-1.14)	<0.01	1.03 (0.95-1.16)	0.45
	Women					
Cardiorespiratory fitness (ml/min/kg (SD)	1.22 (1.20-1.24)	<0.01	1.22 (1.20-1.24)	<0.01	1.24 (1.21-1.27)	<0.01
Hand grip strength (kg)	1.04 (1.02-1.06)	<0.01	1.02 (1.00-1.04)	0.02	1.00 (0.97-1.05)	0.83
Bent arm strength (kg)	1.05 (1.03-1.07)	<0.01	1.04 (1.02-1.05)	<0.01	1.03 (1.00-1.06)	0.02
Sit-to-stand test (number/30 sec)	1.06 (1.04-1.08)	<0.01	1.00 (1.00-1.00)	0.56	0.99 (0.97-1.00)	0.27
Fat percentage	0.92 (0.91-0.94)	<0.01	1.01 (1.00-1.03)	0.12	0.96 (0.91-1.00)	0.07
BMI (kg/m^2)	0.89 (0.87-0.91)	<0.01	1.04 (1.01-1.07)	<0.01	1.11(1.02-1.20)	0.01

All predictors at their mean values

† Adjusted for age

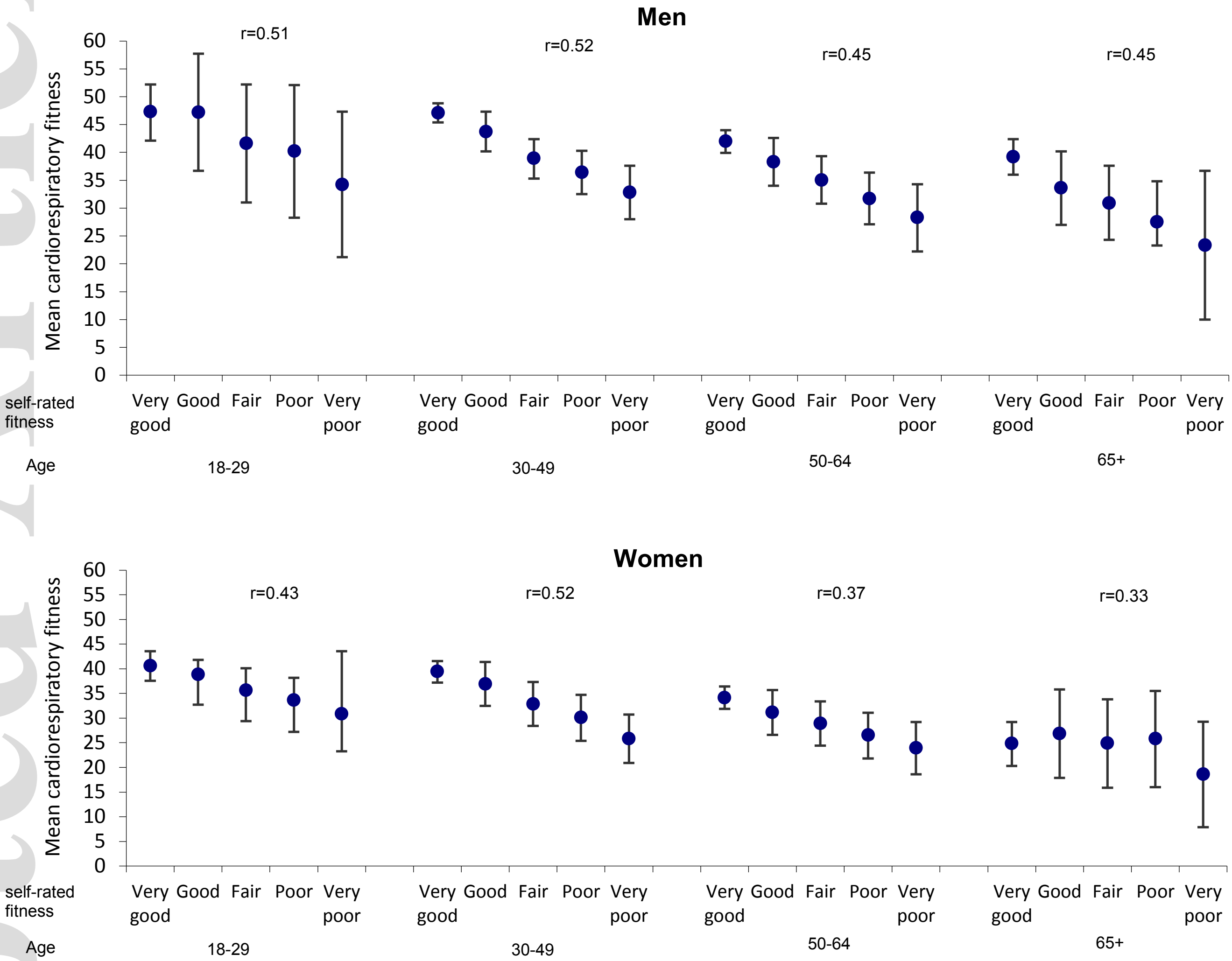
‡ Adjusted for age and VO_2max

§ Adjusted for age, VO_2max, hand grip strength, bent arm strength, sit-to-stand test

Figure legends

Figure 1. Self-rated physcal fitness level in relation to cardiorespiratory fitness (ml/min/kg) estimated by indirect maximal exercise test in 3,411 participants in the DANHES study 2007-2008 for men and women stratified by age-groups.

Figure 1.



Associations were derived from regression analyses and correlations were calculated using the spearman's correlation test.