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Association between self-reported and objectively measured physical fitness level in a middle-aged population in primary care

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ABSTRACT

Aim. To investigate the association between self-reported physical fitness level obtained by a single-item question and objectively measured fitness level in 30- to 49-year-old men and women.

Methods. From the Danish 'Check Your Health Preventive Program' 2013–2014 fitness level was assessed in 2316 participants using the Aastrand test. Additionally, participants rated their physical fitness as high, good, average, fair or low. The association of self-reported- with objectively measured fitness level was analyzed by linear regression. Categories of self-reported- and objectively measured fitness level were cross-tabulated and agreement was quantified by Kappa statistics. Gender differences within categories were investigated by Poisson regression.

Results. Data from 996 men and 1017 women were analyzed (excluded, $n = 303$). In both men and women a higher self-reported fitness level was associated with a higher objectively measured fitness level ($R_{all} = 0.42$). Kappa agreement was 0.25. Poisson regression revealed that women rated their fitness level significantly lower than men ($p < 0.001$).

Conclusion. A single-item question is a cost-effective way of measuring physical fitness level, but the method has low association and fair agreement when compared to the Aastrand test. Men tend to overestimate physical fitness more than women, which should be accounted for if using the question in primary care settings.

Introduction

Low physical fitness level is strongly associated with major non-communicable diseases such as coronary heart disease, type 2 diabetes and breast- and colon cancers (Lee et al., 2012). Identifying at-risk individuals with low physical fitness level is therefore of considerable importance for public health.

Optimally, physical fitness is identified by measuring maximum oxygen uptake (VO_2max) directly using gas exchange respirometry at increasing workloads to exhaustion (gold standard) (Pescatello et al., 2014), but the extensive nature of this procedure makes it inappropriate for use in non-athletic at-risk individuals and in larger population-based samples (Pescatello et al., 2014). Consequently, indirect and less exhausting methods such as the Aastrand test can be used (Pescatello et al., 2014; Cink and Thomas, 1981). Both the direct and the indirect measurements, however, are often not feasible for use in daily clinical settings and other preventive services due to the need of trained personnel, special equipment and time.

To address this issue, methods such as prediction models that estimate physical fitness based on e.g. sex, Body Mass Index and self-reported physical activity have been developed but also, multiple- and single-item questionnaires on physical fitness have been used (Cardinal, 1996; Jackson et al., 1990; Jurca et al., 2005; Knapik et al., 1992; Ortega et al., 2013; Mikkelsson et al., 2005).

In daily clinical settings, where time is limited, single-item questionnaires may be the most efficient and cost-effective method to estimate physical fitness. Few studies have investigated the association between single-item questions and objectively measured physical fitness. Findings from these studies are heterogeneous and in general disagree on whether answers of the questions may be influenced by e.g. gender and age (Jurca et al., 2005). Young et al. found a negative association between a single-item question and fitness level estimated from a 600-yard run in 193 seventh to tenth grade girls ($r = -0.52$; -0.56) (Young, 1985) whereas, Lamb et al. found a positive association between a single-item question and fitness level estimated from the Aastrand test ($r_{all} = 0.52$) in 118 university employees and students

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(Lamb, 1992). Finally, Aadahl et al found that a single-item question reflected objectively measured fitness level using a graded bicycle test with increasing workload until exhaustion in a voluntary population of 102 people aged 35 to 65 years (p for trend <0.0001) (Aadahl et al., 2007).

However, to identify individuals with low fitness level in daily clinical settings, a single-item question must reflect physical fitness not only in people who are able to perform the direct tests but also in a general population. Therefore we aimed to establish whether the single-item question used by Aadahl et al. would reflect objectively measured fitness level in a large general population of 30-to-49-year-old men and women using the Aastrand test as objective measure. Additionally, we aimed to investigate whether men and women rate their physical fitness differently.

Materials and methods

Design

The association between self-reported fitness level obtained by a single-item-question and objectively measured physical fitness level was investigated in a cross-sectional design.

Study population

A total of 2316 men and women, aged 30–49 years, were selected consecutively from the ongoing Danish 'Check Your Health Preventive Program' (Maindal et al., 2014) in the period January 31th 2013 to January 31th 2014. The program is the result of a collaboration between a municipality, regional authorities and general practices and offers all citizens in the age group a health check including clinical- and behavioral measurements. In agreement with the Danish Health Law each participant provided written informed consent for data to be used for research purposes. The program was approved by The Danish Data Protection Agency (j.no: 2012-41-0183) and presented to the regional Scientific Ethics Committee which did not find approval of the program necessary since the study was deemed to not fall under the category biomedical research.

Anthropometric- and questionnaire data

Information on Body weight; Height; Body Mass Index (BMI); Waist circumference and VO_2max were obtained from the health examination at the Check Your Health Preventive Program. Body weight (Seca 769 measuring station) and height (Seca 222 Mechanical telescopic measuring rod) were measured without shoes to the nearest 0.1 kg and 0.5 cm, respectively. BMI was calculated dividing weight by height^2. Waist circumference (seca 203 Ergonomic circumference measuring tape) was measured to the nearest 0.5 cm between anterior superior iliac spine and the lower rib.

VO_2max was estimated using the Aastrand sub-maximal cycle test (Aastrand and Rodahl, 1986) carried out by using a Monark 939 E Pendulum Ergometer cycle with an initial constant workload of 75 watt for women and 100 watt for men. Pedaling frequency was set between 60–70 rounds per minute. Heart rate was measured continuously (polar T31 coded transmitter, Polar, Denmark) and recorded after six minutes, if participants achieved a steady state pulse within a target interval of 120–170 beats/min. If the target interval was not reached after two minutes of cycling, the workload was increased with 35 and 50 watt for women and men, respectively. The test proceeded until a steady-state was reached. Fitness level was estimated from the recorded heart rate and workload standardized to age and sex (Aastrand and Rodahl, 1986) (Monark 939 E Analysis Software, Version 3.0.12, Monark Exercise AB, Sweden) and in absolute (L/min) terms (Pescatello et al., 2014). The clinical examinations were standardized, administered by health professionals and took place in a local health care centre.

Prior to the health examination participants were asked to answer a web-based questionnaire regarding e.g. self-reported fitness level, smoking habits and alcohol use. Data concerning self-reported physical fitness was obtained by the question: 'How do you rate your own physical fitness?' Participants were asked to rate their own physical fitness as high, good, average, fair or low. Similar questions have previously been used in national and international studies (Mikkelsson et al., 2005; Jorgensen et al., 2003). Questions on smoking habits and alcohol use were based on items from the Danish National Health Profile (Christensen et al., 2010).

Statistical analyses

Individuals with missing data on self-reported physical fitness level and missing or non-valid data regarding VO_2max were excluded from analysis. Characteristics of the study population are presented as means and standard deviations for continuous normally distributed data, and numbers (n) and proportions (%) for categorical variables.

The association between categories of self-reported fitness level and VO_2max (ml/kg/min) was explored separately for men and women using linear regression analysis with smoking status as a covariate, self-reported physical fitness as the independent variable and VO_2max (ml/kg/min) as the dependent variable. Results are presented as means with 95% confidence intervals and correlation coefficients (r) derived from the linear regression analyses. To display the frequency distribution of self-reported fitness level in relation to objectively measured fitness level, VO_2max (ml/kg/min) was divided into cut-offs specified by Aastrand et al. (Table 1): Low; Fair; Average; Good and high(Aastrand and Rodahl, 1986). Self-reported fitness level and objectively measured physical fitness level was then cross-tabulated separately for men and women. Cohen's quadratic weighted kappa was used to assess the extent of agreement between self-reported physical fitness and VO_2max (ml/kg/min) in the cross-tabulation. The correlation coefficients and the Kappa values were interpreted based on Mukaka and Viera et al. respectively (Mukaka, 2012; Viera and Garrett, 2005). P-values less than 0.05 were considered statistically significant.

Finally, whether men and women rated their fitness level differently within categories was explored in a Poisson regression model based on count data for all combinations of sex, self-reported fitness level and VO_2max. The counts were regressed on all main effects and all pairwise interactions of the three variables. The interaction term for sex and self-reported fitness was the basis for the test.

Data was analyzed using STATA version 12 (Stata Statistical Software).

Results

A total of 2316 participants were included in the study. Data from 201 participants was excluded from the analysis due to missing VO_2max values ($n = 159$), missing self-reported fitness level ($n = 31$) or invalid test results ($n = 11$). Another 102 tests were declared invalid due to pulse values below 120 or above 170 beats per minute

Table 1
Standard cut-offs in VO_2max (ml/kg/min) relative to gender and 30-to-49-year-old Scandinavian non-athletic men and women specified by Aastrand et al.(Aastrand and Rodahl, 1986).

		VO_2max (ml/kg/min)			
	Low	Fair	Average	Good	High
Men, years					
30–39	<35	≥35 – <40	≥40 – <48	≥48 – <52	≥52
40–49	<31	≥31 – <36	≥36 – <44	≥44 – <48	≥48
Women, years					
30–39	<28	≥28 – <34	≥34 – <42	≥42 – <48	≥48
40–49	<26	≥26 – <32	≥32 – <41	≥41 – <46	≥46