Associations of specific types of sports and exercise with all-cause and cardiovascular-disease mortality: a cohort study of 80 306 British adults

Pekka Oja,[1] Paul Kelly,[2] Zeljko Pedisic,[3] Sylvia Titze,[4] Adrian Bauman,[5] Charlie Foster,[6] Mark Hamer,[7] Melvyn Hillsdon,[8] Emmanuel Stamatakis[5]

► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bjsports-2016-096822).

[1]UKK Institute, Tampere, Finland
[2]Sport, Physical Education and Health Sciences, University of Edinburgh, Edinburgh, UK
[3]Institute of Sport, Exercise and Active Living, Victoria University, Melbourne, Victoria, Australia
[4]Institute of Sport Sciences, University of Graz, Graz, Austria
[5]Sydney Medical School, University of Sydney, Sydney, New South Wales, Australia
[6]Nuffield Department of Population Health, University of Oxford, Oxford, UK
[7]School of Sport, Exercise and Health Sciences, Loughborough University, Loughborough, UK
[8]Sport and Health Sciences, University of Exeter, Exeter, UK

Correspondence to
Dr Pekka Oja, UKK Institute, P.O. Box 30, Tampere 33501, Finland; pekka.oja@uta.fi

Accepted 11 October 2016
Published Online First 28 November 2016

► http://dx.doi.org/10.1136/bjsports-2016-097343

To cite: Oja P, Kelly P, Pedisic Z, *et al*. *Br J Sports Med* 2017;**51**:812–817.

ABSTRACT

Background/Aim Evidence for the long-term health effects of specific sport disciplines is scarce. Therefore, we examined the associations of six different types of sport/exercise with all-cause and cardiovascular disease (CVD) mortality risk in a large pooled Scottish and English population-based cohort.

Methods Cox proportional hazards regression was used to investigate the associations between each exposure and all-cause and CVD mortality with adjustment for potential confounders in 80 306 individuals (54% women; mean±SD age: 52±14 years).

Results Significant reductions in all-cause mortality were observed for participation in cycling (HR=0.85, 95% CI 0.76 to 0.95), swimming (HR=0.72, 95% CI 0.65 to 0.80), racquet sports (HR=0.53, 95% CI 0.40 to 0.69) and aerobics (HR=0.73, 95% CI 0.63 to 0.85). No significant associations were found for participation in football and running. A significant reduction in CVD mortality was observed for participation in swimming (HR=0.59, 95% CI 0.46 to 0.75), racquet sports (HR=0.44, 95% CI 0.24 to 0.83) and aerobics (HR=0.64, 95% CI 0.45 to 0.92), but there were no significant associations for cycling, running and football. Variable dose–response patterns between the exposure and the outcomes were found across the sport disciplines.

Conclusions These findings demonstrate that participation in specific sports may have significant benefits for public health. Future research should aim to further strengthen the sport-specific epidemiological evidence base and understanding of how to promote greater sports participation.

BACKGROUND

It is well established that physical activity (PA) has multiple cardiometabolic health benefits.[1] This evidence comes largely from studies focusing on leisure-time PAs and active travel.[2–5]

Epidemiological cohort studies have suggested that sports participation is associated with reduced mortality among middle-aged and older adults. Samitz *et al*[6] systematically reviewed 80 studies with 1 338 143 participants for associations between PA and risk of all-cause mortality. The domain 'vigorous exercise and sports' showed the largest reduction in risk of all-cause mortality (RR=0.78) followed by 'moderate and vigorous leisure-time activities' (RR 0.86), 'moderate activities of daily living' (RR=0.90), 'walking' (RR=0.93) and 'PA for transportation' (RR=0.92).

It has been suggested that vigorous-intensity PA, that is inherent to many types of sports and exercise, may have a higher impact on reducing all-cause mortality risk than nonvigorous activities.[7] Although sport is often cited as a contributor to public health, the nature and scope of this relationship remains unclear, particularly with regard to specific sport disciplines.

A recent systematic review of cross-sectional, cohort and intervention studies examined the health benefits of 26 specific sport disciplines.[8] The most commonly studied sport disciplines were jogging/running, football, gymnastics, recreational cycling and swimming. According to established criteria for assessing the strength of evidence,[9] there was moderate evidence for health benefits of jogging/running and recreational football and less than moderate evidence for all other sport disciplines. This review concluded that the existing evidence remains fragmentary and is compromised by weak study designs.

The aim of the present study was to examine: (1) the independent associations between participation in common types of sports and exercise and all-cause and cardiovascular disease (CVD) mortality; and (2) the graded exposure–response characteristics of these associations in a pooled analysis of 10 general population cohorts of adults in England and Scotland.

METHODS

Sample

The Health Survey for England (HSE) and the Scottish Health Survey (SHeS) are household-based general population studies recruiting independent samples annually since 1991 (HSE) and periodically (SHeS) since 1995. Sampling is based on a multistage, stratified probability design aimed at a nationally representative sample of individuals living in households.[10 11] Interviewers visited the sampled households and administered the study questionnaire and measured height and weight. Each baseline data collection was approved by the relevant Research Ethics Committees in England and Scotland. All participants provided written consent to have their names flagged by the NHS Central Mortality Register. The present analysis included individuals aged 30–98 years from the HSE 1994, 1997, 1998, 1999, 2003, 2004, 2006 and 2008 and from the SHeS 1995, 1998 and 2003, with corresponding linkage to mortality data. For details of data acquisition and linkage see ref. 12

Physical activity assessment

Non-occupational PA was assessed using an established questionnaire that inquired about the frequency and duration of participation in domestic PA (heavy manual housework, gardening and 'do-it-yourself' activities), walking and sports and exercise in the 4 weeks prior to the interview.[13] Prompt cards were employed for sports and exercises that contained a number of groupings, including cycling (for any purpose), swimming, aerobics/keep fit/gymnastics/dance for fitness, running/jogging, football/rugby, badminton/tennis and squash. For each positive response participants were asked to specify frequency ('*Can you tell me on how many separate days did you do [activity name] for at least 15 min a time during the past 4 weeks?*'), duration ('*How much time did you usually spend doing [activity name] on each day?*') and perceived relative intensity ('*Was the effort usually enough to make you out of breath or sweaty?*'). The convergent validity of the questionnaire has been examined against accelerometry in a study of over 2000 adults. Spearman's correlation between questionnaire and accelerometer-based estimates of MVPA was 0.42 in men (95% CI 0.36 to 0.48) and 0.38 in women (95% CI 0.32 to 0.45).[13]

Mortality outcomes

Surviving participants were censored on December 2009 (SHeS) or February 2011 (HSE). Primary causes of death were diagnosed according to the International Classification of Diseases (ICD) using the ninth (ICD-9) and tenth revisions (ICD-10). CVD codes recorded from the ICD were 390–459 and 101–199 from the ninth and tenth revision, respectively (for details see ref. 12).

Covariates

Height and weight were measured using standard protocols that have been previously described;[12] body mass index (BMI) was calculated as weight (in kilograms) divided by height (in metres) squared. Additional questions assessed education level (age finished education), weekly frequency of alcohol consumption, psychological distress/depression (12-item General Health Questionnaire score–GHQ-12), smoking status (current, ex, never), presence of limiting long-standing illness and existing doctor-diagnosed CVD (angina, stroke, coronary heart disease) and cancer.

Data handling and statistical analyses

The exposure measures were participation in cycling for any purpose (termed 'cycling'); swimming; aerobics/keep fit/gymnastics/dance for fitness (termed 'aerobics'); running/jogging (termed 'running'); football/rugby (termed 'football') and badminton/tennis/squash combined (termed 'racquet sports'). Other sports were considered but were not included in analysis, because of insufficient statistical power resulting from low participation rates. The associations between each exposure and mortality were examined in terms of:

A. overall participation (none/any);
B. relative perceived intensity (none/lower intensity/higher intensity) with the responses to the questions '*Was the effort usually enough to make you out of breath or sweaty?*' determining lower versus higher intensity;
C. weekly duration (none/low/high) using the sex-specific medians of weekly times reported by participators for each exposure as cut-offs that denote low versus high duration (see online supplementary table S1 for cut-off values);
D. weekly intensity-weighted volume (metabolic equivalent (MET)-hours/week) calculated using the PA Compendium[14] to assign a MET of activity and considering reported information on frequency, duration and relative intensity. Sex-specific medians of weekly volumes (MET-hours/week) were used as cut-offs that denote low versus high volume for each sport (see online supplementary table S1).

Baseline characteristics were summarised by sex. Cox proportional hazards regression was used to investigate the association between each exposure and all-cause and CVD mortality. Log-minus-log plots were used to examine proportional hazards assumptions. Selection of covariates was guided by previous literature and multivariate analyses were adjusted for age and sex (Model 1), and additionally adjusted for long-standing illness, alcohol drinking frequency, psychological distress (GHQ-12 score >3), BMI, smoking status, education level, doctor-diagnosed CVD (all-cause mortality analyses only) and weekly PA volume (MET-hours/week excluding the volume of the sport that was the main exposure in the corresponding model). Participants who had doctor-diagnosed CVD at baseline (angina, stroke, IHD) were excluded from the analyses with CVD mortality as outcome. The linear and quadratic trend p values were reported for each model. In sensitivity analyses, participants who experienced events occurring in the first 24 months of follow-up were excluded. Sensitivity analyses were also conducted to check the possible 'overadjustment' by BMI in Model 2. As no appreciable differences were found BMI was retained in the main analyses. No participation was always used as the reference category. Analyses were carried out with SPSS V.22 (SPSS, Chicago, Illinois, USA), with the level of statistical significance set at $p<0.05$.

RESULTS

The baseline characteristics are shown in table 1. In total, our analysis included 80 306 individuals with 43 705 women (mean age=52±15 years) and 36 601 men (mean age=52±14 years).

Overall, 44.3% of the participants (43.1% of women and 45.6% of men) met national PA guidelines. The most common sport/exercise activity was swimming, followed by cycling, aerobics, running, racquet sports and football.

Over an average follow-up of 9.2±4.3 years (corresponding to 736 463 person-years), 8790 deaths from any cause occurred. Among the 75 014 participants who did not report doctor-diagnosed CVD at the baseline and were therefore entered in the CVD mortality analyses (9.2±4.5 years of follow-up/693 757 person-years), there were 1909 CVD deaths.

All-cause mortality

Table 2 shows multivariate analyses of the association between exposure to specific sports and risk of all-cause mortality.

In the most adjusted model compared with no participation in each activity: cycling participation was associated with a significantly reduced risk of all-cause mortality of 15% (HR=0.85, 95% CI 0.76 to 0.95). Swimming participation was associated with a significantly reduced risk of all-cause mortality of 28% (HR=0.72, 95% CI 0.65 to 0.80). Running participation was not associated with a significant reduction in risk of all-cause mortality (HR=0.87, 95% CI 0.68 to 1.11). Likewise, football participation was not associated with a significantly reduced risk for all-cause mortality (HR=0.82, 95% CI 0.61 to 1.11). Racquet sports participation was associated with a significant reduced risk of all-cause mortality of 47% (HR=0.53, 95% CI 0.40 to 0.69). Aerobics participation was associated with a significant reduced risk for all-cause mortality of 27% (HR=0.73, 95% CI 0.63 to 0.85).

Table 1 Baseline characteristics of the sample by sex

	Women (n=43 705)	Men (n=36 601)	All (n=80 306)	p value for sex Δ *
Age, mean±SD (years)	52.0±14.7	51.9±14.3	51.9±14.5	0.285
Body mass index, mean±SD (kg/m^2)	27.1±5.3	27.3±4.0	27.2±4.8	<0.001
Long-standing illness† (%)	47.7	47.7	47.7	0.909
Smoking (% current)‡	24.3	25.5	24.9	<0.001
Alcohol frequency (%≥5 times/week)§	14.7	25.3	19.5	<0.001
Psychological distress (% with GHQ score ≥4)¶	16.8	12.5	14.9	<0.001
Age finished education (age 19+)	16.3	20.2	18.1	<0.001
Total physical activity volume, median (MET**-hours/week)	12.1	14.5	13.1	<0.001
Meeting physical activity recommendations (%)	43.1	45.6	44.3	<0.001
Cycling—any intensity (% participated)	7.3	13.0	9.9	<0.001
Swimming—any intensity (% participated)	14.7	11.9	13.4	<0.001
Running—any intensity (% participated)	3.1	7.3	5.0	<0.001
Football—any intensity (% participated)	0.3	6.4	3.1	<0.001
Racquet—any intensity (% participated)	2.7	4.8	3.6	<0.001
Aerobics—any intensity (% participated)	9.8	2.3	6.4	<0.001
CVD prevalence at baseline (%)	5.3	8.2	6.6	<0.001

The Health Survey for England and Scottish Health Survey.
*p value calculated using t-test for continuous or—due to the skewed distribution—the non-parametric Mann–Whitney U-test and likelihood ratio χ^2 test for categorical variables.
†Dichotomous variable derived from responses to a series of questions (yes/no) on illness within eight listed body systems (eg, nervous system, digestive system, heart and circulatory system, etc), at least one illness required to have long-standing illness.
‡Based on one question about smoking status with the options being: never, ex-regular smoker; ex-occasional smoker and current smoker.
§Derived from the question 'on how many days in the last 7 days did you have an alcoholic drink'.
¶General Health Questionnaire comprises 12 questions related to psychological health (eg, concentration, feeling depressed, etc) with the categories: 0, 1–3 and ≥4.
**MET, metabolic equivalent.
CVD, cardiovascular disease; GHQ, General Health Questionnaire.

Cardiovascular disease mortality

Table 3 shows multivariate analyses of the association between participation in specific sports and risk for CVD mortality.

In the most adjusted model compared with no participation in each activity: cycling participation was not associated with a reduced risk for CVD mortality (HR=0.93, 95% CI 0.76 to 1.16). Swimming participation was associated with a significant reduced risk of CVD mortality of 41% (HR=0.59, 95% CI 0.46 to 0.75). Running participation (HR=0.81, 95% CI 0.47 to 1.39) and football participation (HR=0.90, 95% CI 0.49 to 1.64) were not associated with a significantly reduced risk of CVD. Racquet sports participation was associated with a significant reduced risk of CVD mortality of 56% (HR=0.44, 95% CI 0.24 to 0.83). Aerobics participation was associated with a significant reduced risk of CVD mortality of 36% (HR=0.64, 95% CI 0.45 to 0.92).

Dose–response analysis

Online supplementary tables S2 and S3 show the results of the dose–response analyses for all-cause and CVD mortality, respectively. Mixed dose response relationships were obtained for different sport disciplines. Some showed a significant linear trend (indicating that reduction in mortality risk increased with higher intensity, duration and/or volume of sport participation), some showed a significant U-shaped relationship (indicating that lower intensity is more beneficial than high intensity or no participation), while some provided no indication of dose–response relationship. Fewer significant dose–response associations were found for CVD mortality compared with all-cause mortality.

DISCUSSION

In the present large population-based pooled cohort study, we examined the independent associations of the six most commonly practiced types of sport or exercise in Scotland and England with all-cause and CVD mortality. Swimming, aerobics and racquet sports were associated with significantly reduced risk of all-cause and CVD mortality. Cycling was associated with significantly reduced risk of all-cause mortality, but not CVD mortality. Our data did not show evidence of significant association with mortality risk for participation in running or football.

As noted, we conducted these analyses in response to a limited number of previous findings for specific sports/exercise.[8] This limited the number of comparisons we could make.

Considering some notable results, at a specific activity level, our cycling and all-cause mortality result compares well with a 2014 systematic review and meta-analysis of eight studies that yielded a 10% risk reduction (95% CI 6% to 13%) for cycling at a standardised dose of 11.25 MET-hours per week.[5] We would suggest our result further confirms the likely magnitude of effect for cycling.

For swimming, a previous systematic review[8] identified three cohort studies and one intervention study, but the evidence for all-cause mortality, CVD mortality and adiposity was inconclusive. In contrast, in the present study, swimming participation showed large and significant associations with all-cause and CVD mortality; 28% and 41% risk reduction, respectively.

The association between jogging/running and all-cause mortality among healthy adults has previously been addressed by four large-scale population-based cohort studies.[15–18] The findings have been consistent in showing a significant risk reduction in all-cause and/or CVD mortality. The found significant reductions in all-cause mortality were 39%,[15] 30%,[16] 44%[17] and 27% and in CVD mortality 45%.[16] Our results showed a significant 43% (95% CI 27% to 55%) reduction in all-cause mortality risk among runners compared with non-runners according to the age/sex-adjusted model, but a non-significant 13% reduction in the fully adjusted model. A similar pattern was shown for CVD mortality. The fully adjusted associations in the present study are smaller than those reported in the previous studies,

Table 2 Associations between sports participation and all-cause mortality in adults aged ≥30 years (n=80 306)

	Median age at death	Deaths/n	Model 1* HR (95% CI)	Model 2† HR (95% CI)
Cycling ‡				
None	77.0	8419/72 373	1.00	1.00
Any	69.6	371/7933	0.69 (0.62 to 0.77)	0.85 (0.76 to 0.95)
p value			***<0.001***	***0.003***
Swimming				
None	77.0	8395/69 525	1.00	1.00
Any	69.6	395/10 781	0.58 (0.53 to 0.65)	0.72 (0.65 to 0.80)
p value			***<0.001***	***<0.001***
Running§				
None	77.0	8722/76 294	1.00	1.00
Any	55.5	68/4012	0.57 (0.45 to 0.73)	0.87 (0.68 to 1.11)
p value			***<0.001***	*0.252*
Football¶				
None	77.0	8747/77 830	1.00	1.00
Any	54.0	43/2476	0.63 (0.47 to 0.86)	0.82 (0.61 to 1.11)
p value			***0.003***	*0.175*
Racquet sports**				
None	77.0	8736/77 391	1.00	1.00
Any	66.0	54/2917	0.38 (0.29 to 0.49)	0.53 (0.40 to 0.69)
p value			***<0.001***	***<0.001***
Aerobics††				
None	77.0	8618/75 165	1.00	1.00
Any	73.4	172/5141	0.60 (0.52 to 0.70)	0.73 (0.63 to 0.85)
p value			***<0.001***	***<0.001***

*Model adjusted for age and sex.
†Model also adjusted for long-standing illness, alcohol drinking frequency, psychological distress (GHQ score), BMI, smoking status, education level, doctor-diagnosed cardiovascular disease (IHD, angina, stroke) or cancer, and weekly volume of other physical activity (MET-hours, excluding the volume of the sport that was the main exposure in the corresponding model).
‡For any purpose.
§Running/jogging.
¶Football/rugby.
**Badminton, tennis, squash.
††Aerobics/keep fit/gymnastics/dance for fitness.
BMI, body mass index; GHQ, General Health Questionnaire; MET, metabolic equivalent.

and also statistically non-significant. This was a surprising finding, and we have considered a number of possible explanations. In our data, there were a relatively low number of mortality events in the exposure group which contributed to wide CIs and perhaps the non-significant HRs. Previous studies have also assessed running participation over longer recall periods[16–18] than the current study. It might be that the recall period of 4 weeks used in the current study was not long enough to differentiate long-term and transient behaviour possibly resulting in misclassification of participants. It seems therefore that while not significant, our result adds to the body of evidence supporting beneficial effects of jogging/running on all-cause and CVD mortality rather than contradicting it.

Football showed a non-significant reduction in risk of all-cause and CVD mortality. These non-significant associations were somewhat unexpected, as the evidence from controlled intervention studies in a systematic review indicates that participation in recreational football improves aerobic fitness and cardiovascular function at rest and reduces adiposity among previously inactive adults.[8] Our finding may reflect the low prevalence of football in the study population (0.3% among women, 6.4% among men) and the consequent weaker statistical power in the analyses. We did additional analyses including only men and the HR (Model 2) remained non-significant for all-cause and CVD mortality (see online supplementary table S4).

Participation in racquet sports (including badminton, tennis and squash) showed significant risk reduction of 47% in all-cause mortality and 59% reduction in CVD mortality. To the best of our knowledge little comparable data are available. A previous systematic review[8] identified two studies on tennis and two on squash. One on tennis was a prospective cohort study,[19] which showed decreased CVD risk among tennis players but no effect among racquetball players.

Strong and significant associations were found for all-cause and CVD mortality with aerobics participation (including aerobics, keep fit, gymnastics and dance for fitness). Additional analysis including only women indicated more marked reduction in CVD mortality compared with combined group analysis (50% versus 36%) (see online supplementary table S4) Aerobic dance has been shown to be associated with improved cardiorespiratory fitness[20] and this in turn with reduced mortality risk.[21] However, the direct link between participation in aerobic dance and mortality has not been previously investigated.

In order to place these observations in the context of overall PA, we have adjusted the analyses for meeting versus not meeting PA recommendations and for doing any sport versus doing no sport. The adjusted HRs for all-cause mortality were

Table 3 Associations between sports participation and CVD mortality in adults aged ≥30 years (excluding those with CVD at baseline, n=75 014)

	Median age at death	Events/n	Model 1* HR (95% CI)	Model 2† HR (95% CI)
Cycling ‡				
None	76.0	1818/67 261	1.00	1.00
Any	69.0	91/7753	0.78 (0.63 to 0.97)	0.93 (0.76 to 1.16)
p value			***0.023***	*0.533*
Swimming				
None	76.1	1837/64 486	1.00	1.00
Any	69.0	72/10 528	0.48 (0.37 to 0.60)	0.59 (0.46 to 0.75)
p value			***<0.001***	***<0.001***
Running§				
None	76.0	1896/71 026	1.00	1.00
Any	56.0	13/3988	0.55 (0.32 to 0.93)	0.81 (0.47 to 1.39)
p Value			***0.026***	*0.451*
Football¶				
None	76.0	1899/72 558	1.00	1.00
Any	54.0	10/2456	0.74 (0.41 to 1.35)	0.90 (0.49 to 1.64)
p value			*0.325*	*0.736*
Racquet sports**				
None	76.0	1900/72 131	1.00	1.00
Any	66.0	9/2883	0.32 (0.17 to 0.60)	0.44 (0.24 to 0.83)
p value			***<0.001***	***0.011***
Aerobic††				
None	76.0	1878/70 011	1.00	1.00
Any	73.0	31/5003	0.52 (0.36 to 0.74)	0.64 (0.45 to 0.92)
p value			***<0.001***	***0.015***

*Model adjusted for age and sex.
†Model also adjusted for long-standing illness, alcohol drinking frequency, psychological distress (GHQ score), BMI, smoking status, education level, doctor-diagnosed cardiovascular disease (IHD, angina, stroke) or cancer, and weekly volume of other physical activity (MET-hours, excluding the volume of the sport that was the main exposure in the corresponding model).
‡For any purpose.
§Running/jogging.
¶Football/rugby.
**Badminton/tennis/squash.
††Aerobics/keep fit/gymnastics/dance for fitness.
BMI, body mass index; GHQ, General Health Questionnaire; MET, metabolic equivalent.

0.73 (0.69–0.77, p<0.01) and 0.72 (0.68–0.76, p<0.001), respectively, and the corresponding HRs for CVD mortality 0.73 (0.66–0.82, p<0.001) and 0.72 (0.64–0.80, p<0.001). These results suggest that compared with meeting the generic PA guidelines (which also consider walking), doing any sport appears to be equally protective for all-cause and CVD mortality.

We tested for interaction by age (year 50 as cut-point), sex and PA level (meeting the PA recommendations versus not meeting them) of each sport participation by entering an interaction term in each fully adjusted model. With the exception of aerobics (sex interaction p=0.022) and cycling (PA level interaction p=0.036 for all-cause mortality and p=0.012 for CVD mortality), there were no interactions by age (p≥0.155), sex (p≥0.101) or adherence to PA recommendations (p≥0.211). Cycling appears to be more beneficial among inactive people for ACM and CVD (data available on request).

Mixed results were obtained for the dose–response relationship between participation in different types of sports and exercise and mortality. For running, we observed no significant dose–response gradient, which is in accordance with some previous findings.[16] There was some indication of 'U'-shaped dose–response relationships between cycling, swimming and racquet sports participation and mortality, similar as in, for example, Schnohr *et al*[17] and Wang *et al*.[18] There is an ongoing scientific debate about the shape of the dose–response relationship between PA and mortality, with strong arguments supporting both opposing views. Some contend that the relationship is 'U' shaped,[22 23] while others argue it is linear.[24 25] Our results indicate variable patterns between the dose (intensity, weekly duration, weekly volume) of sport participation and the outcomes and highlight the need for further investigation.

It should be noted from tables 2 and 3 that the median age at death in groups with 'any' sport participation is considerably lower than in the 'none' groups. This could initially signal that participation leads to earlier death. However, we offer an alternative explanation of this phenomenon. At baseline, the median age for the 'any participation' groups is considerably lower than the 'none' groups. This means that after 10-year follow-up, the 'any' group is still considerably younger. This drives the phenomenon that the median age at deaths in the 'any' group is lower as it is derived from a younger sample.

The strengths of the present study include the large population representative sample with genders and a wide age range. To the best of our knowledge this is the largest existing data set reporting sport and exercise-specific associations with mortality risk. We used extensive national register-based mortality follow-up assessed independently. For the exposure assessment a validated questionnaire was used. The analyses controlled for a comprehensive set of covariates, although we cannot discount the possibility of residual confounding.

This study was not without limitations. First, the small number of events impaired the statistical power in some analyses. There were relatively few deaths due to all causes among runners and football players, which may explain the wide CIs in the final adjusted model. The number of CVD deaths was rather small among all sport/exercise participants and may reflect the weaker associations especially in the maximally adjusted model results. Nevertheless, the associations remained robust for swimming, racquet sports and aerobics. Second, seasonality remains an important issue in PA research, and particularly in our case investigating sports that may have defined on and off seasons. The surveys that we used employed sampling over a 12-month period to account for this issue, but some misclassification and resulting regression dilution may have reduced the strength of associations observed. Third, the relatively short recall period used for the assessment of the sport participation may have led to additional misclassification in terms of the long-term stability of the participation. Fourth, the repeat cross-sectional nature of the survey data available meant we could not assess or account for changes in participation within individuals. Finally, using mortality as an outcome may miss social and mental health benefits or reductions in morbidity conferred by sports participation.

The findings add to the existing body of knowledge suggesting that sport participation is likely to have important potential to promote public health. Future research should use well-designed cohort studies to strengthen the evidence based on the associations between sport participation and mortality and morbidity, and also consider longitudinal changes in participation behaviour; conduct intervention studies to investigate if health benefits of these and other sport disciplines are truly causal in nature and find more effective ways of increasing population-level sports participation if the benefits are confirmed.

CONCLUSIONS

We found robust associations between participation in certain types of sport and exercise and mortality, indicating substantial reductions in all-cause and CVD mortality for swimming, racquet sports and aerobics and in all-cause mortality for cycling. The growing evidence should support the sport community to develop and promote health-enhancing sport programmes to reach more people and contribute to greater proportion of population meeting the PA guidelines for health.

What are the findings?

We found robust evidence that adults' participation in swimming, basketball and aerobics is associated with reduced all-cause and cardiovascular mortality and participation in cycling with that of all-cause mortality.

How might it impact on clinical practice in the future?

These new observations with other existing evidence should support the clinicians to consider sports participation as an effective form of health-enhancing physical activity.

Contributors PO and ZP conceived the idea for the study. PO and ES made a study plan. ES, PK, PO, ST and ZP contributed to the development of the data analysis design. ES processed and analysed the data. PO, PK, ST, ES and ZP drafted the manuscript. AB, CF, MHa, MHi contributed to the writing of the manuscript. All authors contributed to drafting the rebuttal and revising the final draft of the manuscript.

Competing interests None declared.

Ethics approval Ethical approval was granted for all aspects of these studies by the following Ethics Committees prior to each survey year data collection: HSE 1994 was approved by the Medical Ethics Committee of the British Medical Association; HSE 1998/99 were approved by North Thames Multi Centre Research Ethics Committee; HSE 2003/2004 were approved by the London Multi-Centre Research Ethics Committee; SHS 1998 was approved by the Research Ethics Committees for All Health Boards for Scotland; SHS 2003 was approved by the Multi Research Ethics Committee for Scotland.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

1 Lee IM, Shiroma EJ, Lobelo F, *et al*. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet* 2012;380:219–29.
2 Hamer M, Chida Y. Walking and primary prevention: a meta-analysis of prospective cohort studies. *Br J Sports Med* 2008;42:238–43.
3 Woodcock J, Franco OH, Orsini N, *et al*. Non-vigorous physical activity and all-cause mortality: systematic review and meta-analysis of cohort studies. *Int J Epidemiol* 2011;40:121–38.
4 Saunders LE, Green JM, Petticrew MP, *et al*. What are the health benefits of active travel? asystematic review of trials and cohort studies. *PLoS One* 2013;8:e69912.
5 Kelly P, Kahlmeier S, Götschi T, *et al*. Systematic review and meta-analysis of reduction in all-cause mortality from walking and cycling and shape of dose response relationship. *Int J Behav Nutr Phys Act* 2014;11:132.
6 Samitz G, Egger M, Zwahlen M. Domains of physical activity and all-cause mortality: systematic review and dose-response meta-analysis of cohort studies. *Int J Epidemiol* 2011;40:1382–400.
7 US Department of Health and Human Services. Physical Activity Guidelines Advisory Committee. Physical Activity Guidelines Advisory Committee Report. Washington, DC: 2008:683.
8 Oja P, Titze S, Kokko S, *et al*. Health benefits of different sport disciplines for adults: systematic review of observational and intervention studies with meta-analysis. *Br J Sports Med* 2015;49:434–40.
9 De Bourdeaudhuij I, Van Cauwenberghe E, Spittaels H, *et al*. School-based interventions promoting both physical activity and healthy eating in Europe: a systematic review within the HOPE project. *Obes Rev* 2011;12:205–16.
10 Mindell J, Biddulph JP, Hirani V, *et al*. Cohort profile: the health survey for England. *Int J Epidemiol* 2012;41:1585–93.
11 Gray L, Batty GD, Craig P, *et al*. Cohort profile: the Scottish health surveys cohort: linkage of study participants to routinely collected records for mortality, hospital discharge, cancer and offspring birth characteristics in three nationwide studies. *Int J Epidemiol* 2010;39:345–50.
12 Stamatakis E, Chau JY, Pedisic Z, *et al*. Are sitting occupations associated with increased all-cause, cancer, and cardiovascular disease mortality risk? a pooled analysis of seven British population cohorts. *PLoS One* 2013;8:26.
13 Scholes S, Coombs N, Pedisic Z, *et al*. Age- and sex-specific criterion validity of the health survey for England physical activity and sedentary behavior assessment questionnaire as compared with accelerometry. *Am J Epidemiol* 2014;179:1493–502.
14 Ainsworth BE, Haskell WL, Herrmann SD, *et al*. 2011 Compendium of physical activity: a second update of codes and MET values. *Med Sci Sports Exerc* 2011;43:1575–81.
15 Chakravarty EF, Hubert HB, Lingala VB, *et al*. Reduced disability and mortality among aging runners. A 21-year longitudinal study. *Arch Intern Med* 2008;168:1638–46.

16 Lee DC, Pate RR, Lavie CJ, *et al*. Leisure-time running reduces all-cause and cardiovascular mortality risk. *J Am Coll Cardiol* 2014;64:472–81.
17 Schnohr P, Marott JL, Lange P, *et al*. Longevity in male and female joggers. The Copenhagen city heart study. *Am J Epidemiol* 2013;177:683–9.
18 Wang N, Zhang X, Xiang Y-B, *et al*. Associations of Tai Chi, walking, and jogging with mortality in Chinese men. *Am J Epidemiol* 2013;178:791–6.
19 Chomistek AK, Cook NR, Flint AJ, *et al*. Vigorous-intensity leisure-time physical activity and risk of major chronic disease in men. *Med Sci Sports Exerc* 2012;44:1898–905.
20 Stofan JR, DiPietro L, Davis D, *et al*. Physical activity patterns associated with cardiorespiratory fitness and reduced mortality: the aerobics center longitudinal study. *Am J Public Health* 1998;88:1807–13.
21 Lee DC, Sui X, Ortega FB, *et al*. Comparisons of leisure-time physical activity and cardiorespiratory fitness as predictors of all-cause mortality in men and women. *Br J Sports Med* 2011;45:504–10.
22 O'Keefe JH, Schnohr P, Lavie CJ. The dose of running that best confers longevity. *Heart* 2013;99:588–90.
23 O'Keefe JH, Lavie CJ. Run for your life··· at a comfortable speed and not too far. *Heart* 2013;99:516–19.
24 Arem H, Moore SC, Patel A, *et al*. Leisure time physical activity and mortality: A detailed pooled analysis of the dose-response relationship. *JAMA Intern Med* 2015;175:959–67.
25 Gebel K, Ding D, Chey T, *et al*. Effect of moderate to vigorous physical activity on all-cause mortality in middle-aged and older Australians. *JAMA Intern Med* 2015;175:970–7.

Various Leisure-Time Physical Activities Associated With Widely Divergent Life Expectancies: The Copenhagen City Heart Study

Peter Schnohr, MD, DMSc; James H. O'Keefe, MD; Andreas Holtermann, PhD; Carl J. Lavie, MD; Peter Lange, MD, DMSc; Gorm Boje Jensen, MD, DMSc; and Jacob Louis Marott, MSc

Abstract

Objective: To evaluate the differential improvements in life expectancy associated with participation in various sports.

Patients and Methods: The Copenhagen City Heart Study (CCHS) is a prospective population study that included detailed questionnaires regarding participation in different types of sports and leisure-time physical activity. The 8577 participants were followed for up to 25 years for all-cause mortality from their examination between October 10, 1991, and September 16, 1994, until March 22, 2017. Relative risks were calculated using Cox proportional hazards models with full adjustment for confounding variables.

Results: Multivariable-adjusted life expectancy gains compared with the sedentary group for different sports were as follows: tennis, 9.7 years; badminton, 6.2 years; soccer, 4.7 years; cycling, 3.7 years; swimming, 3.4 years; jogging, 3.2 years; calisthenics, 3.1 years; and health club activities, 1.5 years.

Conclusion: Various sports are associated with markedly different improvements in life expectancy. Because this is an observational study, it remains uncertain whether this relationship is causal. Interestingly, the leisure-time sports that inherently involve more social interaction were associated with the best longevity—a finding that warrants further investigation.

© 2018 Mayo Foundation for Medical Education and Research ■ Mayo Clin Proc. 2018;93(12):1775-1785

Substantial evidence over the past 60 years has shown that physical activity (PA) reduces risks for both coronary heart disease (CHD) and all-cause mortality.[1-20] The Copenhagen City Heart Study (CCHS), a prospective cohort study of approximately 20,000 men and women aged 20 to 98 years, reported associations between mortality and walking,[21] cycling,[22] and jogging.[23-26] Both walking and cycling were found to be associated with lower risks for multivariable-adjusted mortality. For joggers, we found a multivariable-adjusted increase in survival, with a U-shaped association between dose of jogging (calibrated by pace, quantity, and frequency of jogging) and all-cause mortality.[25] The dose of running that was most favorable for reducing mortality was jogging 1 to 2.4 h/wk, with no more than 3 running days a week, at a slow or average pace.[26] Several other reports on running or jogging have supported the concept that a moderate dose of exercise is better at conferring longevity and cardiovascular health than minimal or extreme doses of exercise.[2,27-32]

However, the relationship between different leisure-time sports and life expectancy has not been definitively addressed in previous studies.[33,34] Because various sports require markedly different intensities and durations of exercise, muscle groups used, types of muscle contractions (dynamic vs static), and social interactions, they are likely to confer different effects on longevity. The purpose of this study was to evaluate whether the longevity benefit conferred by exercise

From the Copenhagen City Heart Study, Frederiksberg Hospital, Copenhagen, Denmark (P.S., P.L., G.B.J., J.L.M.); Saint Luke's Mid America Heart Institute and University of Missouri-Kansas, Kansas City, MO (J.H.O.); National Research Centre for the Working Environment, Copenhagen, Denmark (A.H.); Department of Cardiovascular Diseases, John Ochsner Heart and Vascular Institute, Ochsner Clinical School, The University of Queensland School of Medicine, New

Affiliations continued at the end of this article.

varies depending on the type of PA in leisure-time (LTPA). The specific sports studied were tennis, badminton, soccer, jogging, cycling, calisthenics, swimming, and health club activities.

PATIENTS AND METHODS

Study Population

The CCHS is a prospective population cohort study initiated in 1976 comprising a random sample from the Copenhagen Population Register of 19,329 white men and women with an age-span of 20 to 93 years. The current study used the third examination from October 10, 1991, to September 16, 1994 (n=10,135). The sampling background and methods have previously been described.[35] Participants were excluded if they had a history of CHD (n=615), stroke (n=362), cancer (n=606), or missing information about LTPA (n=145), leaving 8577 healthy men and women for analyses. All participants gave written informed consent. The study, since its inception, has been independently funded via the Danish Heart Foundation.

Survey Methods

Established procedures and examinations for CHD epidemiological surveys were used.[36] A comprehensive self-administered questionnaire including information about PA levels (eg, sedentary, light activity, moderate activity, and high activity)[35] was completed and checked by the staff. Participation and duration per week regarding 8 different types of exercise were included in the examination from 1991 to 1994 for each of the following sports: tennis, badminton, soccer, jogging, cycling, low-intensity calisthenics (referred to as gymnastics among the Danes), swimming, and health club activities (eg, treadmill, elliptical trainer, and weights). Furthermore, information about alcohol intake, socioeconomic status, diabetes mellitus, self-rated cardiorespiratory fitness (CRF), self-rated muscle strength, self-rated health, social network, and vital exhaustion was reported. Height, weight, and blood pressure measurements (sitting position after a 5-minute rest, using a London School of Hygiene sphygmomanometer) were obtained, as well as an electrocardiogram and comprehensive laboratory blood tests.

End Points

The participants were followed with end point of all-cause mortality from the third examination in 1991-1994 to March 22, 2017, by using the unique personal identification number in the National Central Person Register. Of the 8577 participants, none were lost to follow-up, but 111 (1.3%) were censored at the date of their emigration out of Denmark.

Statistical Analyses

For each of the 8 sports, a Cox proportional hazards regression analysis with age as time-scale and delayed entry was performed with sedentary individuals as the reference group. Participants reporting not being sedentary and not participating in a sport were included in all Cox regression analyses, but results were not reported for this group. Adjustment was done in 2 steps. Model A included adjustment for age, sex, and weekly volume (total duration) of all LTPA; model B included adjustment for age, sex, weekly volume of all LTPA, smoking, education, income, alcohol drinking habits, and diabetes mellitus. In an additional analysis, social network was added to model B as a potential confounder. A sensitivity analysis with stratification on educational level was performed to eliminate potential social status confounding between the sports.

The assumption of proportionality in the Cox regression models was tested with the Lin, Wei, and Ying score process test.[37] Misspecification of the functional form of total volume was tested by plotting this continuous covariate against the cumulative residual and comparing it to random realizations under the model.

The differences in survival between the different sports were estimated by integrating the model-adjusted mean survival curves. These Makuch-Ghali curves are the average of survival curves based on multivariable Cox models calculated 1 individual at a time for the entire population.[38] Bias-corrected bootstrap resampling with 10,000 samples was performed to estimate the survival differences and their 95% CIs. A *P* value below .05 was considered statistically significant.

Mayo Clin Proc. ■ December 2018;93(12):1775-1785 ■ https://doi.org/10.1016/j.mayocp.2018.06.025
www.mayoclinicproceedings.org

TABLE 1. Characteristics According to Different Types of Sports in Leisure-Time for the 5674 Individuals Engaging in At Least 1 Sport[a,b,c]

Characteristic	Sedentary physical activity (N=1042)	Health club activities (N=206)	Swimming (N=936)	Calisthenics (N=1533)	Cycling (N=4833)	Jogging (N=504)	Soccer (N=184)	Badminton (N=388)	Tennis (N=167)	Other activities (N=755)
Age (y)	61±15	45±14	53±15	57±16	52±15	40±12	39±12	44±14	43±14	49±16
Men	45	46	35	20	47	62	95	65	65	48
Smoking										
Never	22	34	28	33	27	39	39	35	33	31
Former	22	29	27	29	25	29	17	21	26	27
Current	56	38	45	38	47	33	44	44	41	43
Alcohol intake										
Never	32	14	15	19	15	9	5	8	4	15
1-14/1-21 drinks/wk	51	76	72	70	69	80	77	74	77	71
>14/>21 drinks/wk	17	10	13	10	16	11	17	18	19	14
Education										
<Middle school	45	14	23	25	26	7	11	8	4	18
Middle school	35	36	38	39	37	25	37	42	22	37
High school	11	25	18	17	17	31	27	24	27	23
University	8	26	21	19	20	37	25	27	48	22
Househod income										
Low	54	26	36	37	31	23	18	23	30	30
Moderate	30	35	36	39	38	37	42	32	23	38
High	16	39	28	24	31	40	39	44	47	32
Diabetes	6	0	3	2	2	1	1	2	1	2
Body mass index (kg/m^2)	27±5	25±3	25±4	24±4	25±4	24±3	25±3	25±3	24±3	25±4
Resting heart rate (bpm)	76±13	69±12	70±12	71±12	72±12	66±12	68±14	69±12	68±12	69±12
Systolic BP (mm Hg)	141±23	128±18	133±21	135±23	134±21	126±15	128±15	130±19	128±16	131±19
BP medication, %	12	4	7	8	7	1	1	5	2	5
Total cholesterol ≥6 mmol/L, %	56	36	47	51	47	26	38	39	30	40

Continued on next page

TABLE 1. Continued

Characteristic	Sedentary physical activity (N=1042)	Health club activities (N=206)	Swimming (N=936)	Calisthenics (N=1533)	Cycling (N=4833)	Jogging (N=504)	Soccer (N=184)	Badminton (N=388)	Tennis (N=167)	Other activities (N=755)
Self-rated cardiorespiratory fitness										
Worse than peers	39	8	8	7	10	4	4	8	4	10
Same as peers	51	45	52	51	58	37	49	53	43	45
Better than peers	10	48	40	42	32	59	48	39	52	44
Self-rated muscle strength										
Worse than peers	35	8	9	10	10	4	4	6	5	7
Same as peers	55	43	59	58	64	52	58	65	55	53
Better than peers	10	49	32	32	26	44	38	29	39	39
Self-rated health										
Terrible/not so good	45	17	17	20	18	10	6	10	6	15
Good	51	65	70	66	72	72	81	77	73	71
Outstanding	4	18	13	14	11	17	13	13	21	14
Vital exhaustion										
Score 0	21	31	33	33	33	34	43	36	40	35
Score 1-4	40	47	46	44	47	49	44	48	52	44
Score 5-9	22	18	16	17	16	13	11	14	5	15
Score 10-17	17	4	4	6	5	4	2	2	2	5
Social network										
0 contact	4	0	1	1	1	1	0	0	0	1
1-2 contacts	41	17	21	26	25	15	14	15	17	23
3-4 contacts	46	54	55	55	54	54	54	57	53	55
≥5 contacts	9	28	23	18	20	30	32	28	30	21

[a]BP = blood pressure; bpm = beats per minute.
[b]Values are presented as mean ± SD or %. Sex-specific cutoff points are used regarding alcohol intake (men: 21 and women: 14).
[c]The first column shows the physical inactive in leisure-time.

All statistical analyses were performed with the free software environment *R* version 3.2.0 (http://cran.r-project.org/).

RESULTS

Baseline characteristics are presented in Table 1. The sedentary participants were older and had characteristics associated with a higher risk of all-cause mortality compared with subjects who participated in at least 1 sport. The characteristics among the physically active individuals also showed some notable differences. For example, tennis players and joggers were more likely to have a university degree, a better self-rated CRF compared with peers, and an outstanding self-rated health.

Out of the 8577 participants, 1042 (12%) reported being sedentary and 5674 (66%) engaged in at least 1 sport. The average weekly volume of all sports was 411 minutes (almost 7 hours), but very large differences were seen between the sports, ranging from 58 minutes among swimmers to 386 min/wk among cyclists. Cyclists spent more than twice the time on their activity compared with the other sports, and cycling was also the most prevalent activity of 56%. Remarkably, 73% of the cyclists spent more than 4 h/wk riding the bike. However, the health club activities group had the longest total duration of all the sports combined, at 599 min/wk (Table 2).

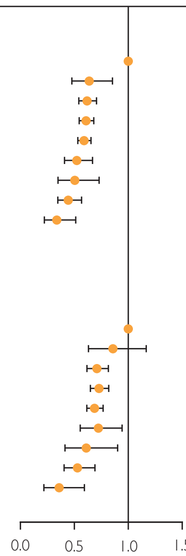
During the follow-up period of 25 years, we registered 4448 deaths. The Figure shows the adjusted all-cause mortality and the survival increase associated with the 8 different sports. The following multivariable-adjusted life expectancy gains were found compared with sedentary lifestyle: tennis, 9.7 years; badminton, 6.2 years; soccer, 4.7 years; cycling, 3.7 years; swimming, 3.4 years; jogging, 3.2 years; calisthenics, 3.1 years; and health club activities, 1.5 years. The hazard ratios (HRs) for other sport activities were 0.66 (95% CI, 0.57-0.77) and 0.76 (95% CI, 0.65-0.89) in model A and B, respectively. Low social network was a risk factor for all-cause mortality, but did not attenuate the association between the different sports and mortality. When we restricted the analysis to only individuals with a university degree, the ranking of various sports according to HRs remained largely unchanged, although the 95% CIs were wider due to smaller

TABLE 2. Dose of Physical Activity According to Different Types of Sports in Leisure-Time for the 5674 Individuals Participating in At Least 1 Sport

Characteristic	Health club activities (N=206)	Swimming (N=936)	Calisthenics (N=1533)	Cycling (N=4833)	Jogging (N=504)	Soccer (N=184)	Badminton (N=388)	Tennis (N=167)	Other activities (N=755)
Number of other activities									
Mean	3±1	3±1	2±1	2±1	3±1	3±1	3±1	3±1	3±1
0	0	0	0	0	0	0	0	0	0
1	13	10	23	50	4	8	10	3	15
2	26	42	44	31	27	39	37	23	40
3	33	34	24	13	36	26	34	37	28
≥4	29	15	9	5	33	28	20	37	17
Duration (min/wk)									
Current activity	148±123	58±50	95±78	386±244	96±88	126±100	92±71	103±87	173±162
All other activities	451±382	414±313	323±303	74±131	453±300	393±331	379±308	419±336	374±325
Total	599±404	472±322	418±323	460±282	549±326	519±352	471±320	521±344	546±370
Duration >4 h/wk	21	1	4	73	7	15	6	11	26
Total duration >4 h/wk	80	71	61	77	84	78	71	79	77

Values are presented as mean ± SD or %.

Covariates	No. of participants	Duration min/wk	All-cause mortality: Events	HR (95% CI)	Bias-corrected survival difference (95% CI)
A. Adjusted for age, sex, and weekly volume of all LTPAs					
Sedentary (reference)	1042	–	680	1.00 (reference)	0.0 (reference)
Health club activities	206	148	50	0.64 (0.48-0.85)**	4.4 (1.6-7.2)**
Swimming	936	58	359	0.62 (0.54-0.71)***	4.7 (3.4-6.0)***
Calisthenics	1533	95	701	0.61 (0.54-0.68)***	4.9 (3.8-5.9)***
Cycling	4833	386	1878	0.59 (0.53-0.65)***	5.2 (4.1-6.3)***
Jogging	504	96	74	0.52 (0.41-0.67)***	6.4 (4.1-8.6)***
Soccer	184	126	30	0.50 (0.35-0.73)***	6.6 (3.2-10.0)***
Badminton	388	92	72	0.44 (0.35-0.57)***	7.9 (5.6-10.3)***
Tennis	167	103	23	0.34 (0.22-0.51)***	10.4 (6.8-14.0)***
B. Adjusted for age, sex, weekly volume of all LTPAs, smoking, education, income, drinking habits, and diabetes					
Sedentary (reference)	926	–	629	1.00 (reference)	0.0 (reference)
Health club activities	167	148	45	0.86 (0.63-1.17)	1.5 (−1.3-4.3)
Swimming	804	57	331	0.71 (0.62-0.82)***	3.4 (1.9-4.8)***
Calisthenics	1354	94	670	0.73 (0.65-0.82)***	3.1 (1.9-4.3)***
Cycling	4203	397	1732	0.69 (0.62-0.77)***	3.7 (2.6-4.9)***
Jogging	399	101	64	0.72 (0.55-0.94)*	3.2 (0.6-5.8)*
Soccer	156	132	27	0.61 (0.41-0.90)*	4.7 (1.4-8.1)**
Badminton	314	93	61	0.53 (0.41-0.69)***	6.2 (3.3-9.1)***
Tennis	111	104	16	0.36 (0.22-0.59)***	9.7 (5.6-13.7)***



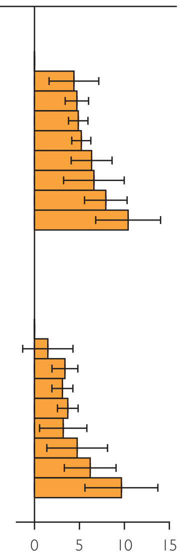


FIGURE. Risk of all-cause mortality in multivariable Cox proportional hazards regression analysis with multivariable-adjusted survival differences for the 5674 individuals engaging in at least 1 sport compared with the 1042 sedentary individuals. The number of individuals engaging in sports sums to more than 5674 because participation in more than 1 sport was common and these different LTPAs were analyzed separately. HR = hazard ratio; LTPA = leisure-time physical activity. *$P<.05$; **$P<.01$; ***$P<.001$.

numbers of individuals. In this subgroup analysis of only individuals with a university degree, tennis (HR, 0.26; 95% CI, 0.10-0.69) and badminton (HR, 0.46; 95% CI, 0.19-1.12) players had the lowest multivariable-adjusted risk of mortality compared with sedentary individuals.

Table 3 presents the pattern of PA according to different types of sports in leisure-time. Cycling is the most frequent activity within each sport and by far the one with the longest duration followed by the sport itself (eg, among tennis players the duration of tennis exceeds the duration of badminton, soccer, etc). Cycling represents 55% to 71% of the total duration in each of the other sports, and the sport itself accounts for approximately 20%.

DISCUSSION

Surprisingly, we found that tennis players had the longest expected lifetime among the 8 different sports. They were followed by badminton players, soccer players, and joggers. By far the smallest improvement in life expectancy was noted in people who predominantly did health club activities (eg, treadmill, elliptical, stair-climber, stationary bikes, and weightlifting). The large differences in life expectancy gains were not accounted for by the wide differences in duration of the various sports, as highlighted by the finding that the cohort of people who spent the most time exercising—health club activities group—was the one that showed the smallest improvement in longevity.

Possibly, the observed differences in mortality benefits were due to the differing social aspects of the various sports studied. Interestingly, sports that require 2 or more individuals to play together and socially interact—tennis, badminton, and soccer—were the sports that were associated with the best improvements in longevity, whereas the less inherently interactive forms of PA, such as jogging, swimming, cycling, and health club activities, were associated with less impressive longevity benefits. This is in line with previous studies consistently showing that social isolation is among the strongest predictors of reduced life expectancy.[39] Sports such as badminton

Mayo Clin Proc. ■ December 2018;93(12):1775-1785 ■ https://doi.org/10.1016/j.mayocp.2018.06.025
www.mayoclinicproceedings.org

TABLE 3. Distribution of Physical Activity According to Different Types of Sports in Leisure-Time for the 5674 Individuals Participating in At Least 1 Sport

Characteristic	Health club activities (N=206)	Swimming (N=936)	Calisthenics (N=1533)	Cycling (N=4833)	Jogging (N=504)	Soccer (N=184)	Badminton (N=388)	Tennis (N=167)	Other activities (N=755)
Ranking of activities by participation frequency									
Ranked first	Cycling	Cycling	Cycling	Calisthenics	Cycling	Cycling	Cycling	Cycling	Cycling
Participation, %	(76.7)	(80.4)	(68.8)	(21.8)	(88.3)	(83.2)	(83.5)	(87.4)	(76.0)
Ranked second	Calisthenics	Calisthenics	Swimming	Swimming	Calisthenics	Jogging	Jogging	Badminton	Calisthenics
Participation, %	(25.2)	(35.9)	(21.9)	(15.6)	(27.6)	(28.8)	(20.4)	(29.3)	(23.7)
Ranked third	Swimming	Jogging	Other activities	Other activities	Swimming	Other activities	Calisthenics	Jogging	Jogging
Participation, %	(24.8)	(13.4)	(11.7)	(11.9)	(24.8)	(21.7)	(15.5)	(28.1)	(16.3)
Ranked fourth	Jogging	Other activities	Jogging	Jogging	Other activities	Badminton	Swimming	Other activities	Swimming
Participation, %	(22.3)	(12.1)	(9.1)	(9.2)	(24.4)	(17.9)	(15.2)	(21.0)	(15.0)
Ranked fifth	Other activities	Badminton	Badminton	Badminton	Badminton	Swimming	Other activities	Calisthenics	Badminton
Participation, %	(20.9)	(6.3)	(3.9)	(6.7)	(15.7)	(11.4)	(14.9)	(20.4)	(7.7)
Ranked sixth	Badminton	Health club	Health club	Health club	Soccer	Tennis	Tennis	Swimming	Health club
Participation, %	(8.7)	activities (5.4)	activities (3.4)	activities (3.3)	(10.5)	(9.8)	(12.6)	(18.6)	activities (5.7)
Ranked seventh	Tennis	Tennis	Tennis	Soccer	Tennis	Calisthenics	Soccer	Soccer	Soccer
Participation, %	(7.3)	(3.3)	(2.2)	(3.2)	(9.3)	(8.2)	(8.5)	(10.8)	(5.3)
Ranked eighth	Soccer	Soccer	Soccer	Tennis	Health club	Health club	Health club	Health club	Tennis
Participation, %	(4.9)	(2.2)	(1.0)	(3.0)	activities (9.1)	activities (5.4)	activities (4.6)	activities (9.0)	(4.6)
Ranking of activities according to duration									
Ranked first	Cycling	Cycling	Cycling	Cycling	Cycling	Cycling	Cycling	Cycling	Cycling
% of total duration	(55.1)	(71.0)	(66.4)	(83.9)	(59.2)	(54.7)	(61.8)	(54.9)	(56.3)
Ranked second	Health club	Swimming	Calisthenics	Calisthenics	Jogging	Soccer	Badminton	Tennis	Other activities
% of total duration	activities (24.1)	(11.8)	(22.5)	(4.4)	(17.3)	(24.0)	(19.3)	(18.6)	(29.5)
Ranked third	Calisthenics	Calisthenics	Other activities	Other activities	Other activities	Other activities	Other activities	Other activities	Calisthenics
% of total duration	(5.9)	(7.0)	(3.9)	(4.1)	(7.0)	(7.0)	(5.4)	(7.5)	(5.1)
Ranked fourth	Jogging	Other activities	Swimming	Jogging	Calisthenics	Jogging	Jogging	Badminton	Jogging
% of total duration	(4.6)	(3.8)	(2.8)	(1.9)	(5.2)	(5.8)	(3.6)	(4.7)	(3.0)
Ranked fifth	Other activities	Jogging	Jogging	Swimming	Badminton	Badminton	Calisthenics	Jogging	Health club
% of total duration	(4.0)	(2.8)	(2.0)	(1.8)	(2.7)	(3.1)	(3.2)	(4.5)	activities (1.6)
Ranked sixth	Swimming	Health club	Health club	Badminton	Soccer	Health club	Soccer	Calisthenics	Swimming
% of total duration	(2.9)	activities (1.4)	activities (0.9)	(1.3)	(2.5)	activities (1.8)	(2.1)	(4.0)	(1.6)
Ranked seventh	Badminton	Badminton	Badminton	Health club	Swimming	Calisthenics	Swimming	Soccer	Badminton
% of total duration	(1.6)	(1.0)	(0.7)	activities (1.0)	(2.4)	(1.3)	(2.0)	(2.2)	(1.1)
Ranked eighth	Tennis	Soccer	Tennis	Soccer	Health club	Tennis	Tennis	Swimming	Soccer
% of total duration	(1.0)	(0.6)	(0.4)	(0.8)	activities (2.2)	(1.3)	(1.7)	(2.1)	(1.0)
Ranked ninth	Soccer	Tennis	Soccer	Tennis	Tennis	Swimming	Health club	Health club	Tennis
% of total duration	(0.9)	(0.6)	(0.3)	(0.6)	(1.5)	(1.0)	activities (1.0)	activities (1.5)	(0.7)

and doubles tennis do not typically require strenuous exertion, but do entail a great deal of social interaction. Regular participation in highly interactive sports provides not only exercise but also a social support group that plays together. Belonging to a group that meets regularly promotes a sense of support, trust, and commonality, which has been shown to contribute to a sense of well-being and improved long-term health.[39-41] In addition, benefits of PA and exercise to reduce psychological distress may explain many of the benefits noted regarding cardiovascular disease and mortality.[7,40,42] The smallest improvement in life expectancy was noted in people who predominantly did health club activities. The reason for this could be that their working heart rate was lower than for the other sports, but the reason could also be due to the tendency for people to exercise alone on stationary machines with weights in the health clubs, thereby missing out on the social interaction mandated by racquet sports and soccer, for example.

A scientifically rigorous and widely cited meta-analysis on the topic found that social support had a stronger effect on long-term survival than any other factor, including being a nonsmoker, staying lean, or having normal blood pressure.[43] In that study, having good interpersonal connections conferred twice as much protection against early mortality compared with being physically active. Studies also show that increasing the number of in-person friendships increases one's sense of well-being.[44] If social support and interpersonal relationships exert stronger effects on life expectancy than does exercise, then the highly social but less physically demanding sports such as doubles tennis, badminton, and golf conceivably could be more strongly associated with longevity than more solitary but arduous activities such as running, cycling, stationary exercise machines, and swimming.

Alternatively, the divergent improvements in life expectancy might be accounted for by the differing forms of PA required by the various sports. The sports that were linked to the best life expectancy gains typically require interval bursts of exercise using large muscle groups and full body movements, whereas the sports typically performed in a continuous manner showed less impressive life expectancy gains. This is supported by intervention studies for augmenting CRF, in which activities such as soccer showed better improvements than did a regimen of continuous running.[45] Furthermore, a growing body of evidence indicates that short repeated intervals of higher intensity exercise appear to be superior to continuous moderate intensity PA for improving health outcomes.[46] Cycling as a competitive sport qualifies as high intensity but generally is performed at only low-to-moderate intensity when used for commuting to work. Roughly 40% of the Copenhageners commute to work via bicycle.[47]

Previously, we analyzed the CCHS cohort focusing on 1098 healthy joggers followed for 12 years, and found a U-shaped association between pace, quantity, and frequency of jogging and all-cause mortality. In that previous analysis, the lowest mortality was found in light joggers (HR, 0.22; 95% CI, 0.10-0.47); they had a slow or average pace (<2.5 h/wk and ≤3 times per week) followed by moderate joggers (HR, 0.66; 95% CI, 0.32-1.38; slow or average pace, >3 times per week or ≥2.5 h/wk with a frequency of ≤3 times per week; or fast pace, <2.5 h/wk or 2.5-4 h/wk with a frequency of ≤3 times per week), whereas strenuous joggers had a mortality rate not statistically different from that of the sedentary (HR, 1.97; 95% CI, 0.48-8.14; fast pace, >4 hours of jogging per week or 2.5-4 h/wk with a frequency of >3 times per week). The strenuous group was, however, quite small.[26] Other reports on running have likewise emphasized the benefits of relatively low doses of strenuous PA.[1-19,21-31,42] It should be emphasized that even slow jogging (6 metabolic equivalents) corresponds to vigorous exercise and that strenuous running corresponds to very heavy vigorous exercise (≥12 metabolic equivalents). In the present analyses, the joggers' average life gain was only 3.2 years compared with tennis players' life gain of 9.7 years, raising the possibility that moderate exercise may be better for improving life expectancy than more strenuous exercise.[48]

There is only one other study that analyzed the associations of various types of exercise with all-cause mortality.[33,34] That study population comprised 80,306 men and women from the United Kingdom. The participants were randomly drawn from several samples taken from The Health Survey for England and the Scottish Health Survey. In that study, because the mortality rates of the different types of sports were drawn from several samples, the comparisons between sports are less reliable, and the observed mortality differences between the sports could in fact just reflect differences in mortality of the different populations sampled. However, they did have estimates available for duration, frequency, and intensity of the different sports. As in our study, the UK study showed that the most robust reduction in all-cause mortality was noted for participation in racquet sports (HR, 0.53; 95% CI, 0.40-0.69); considerable reductions in all-cause mortality were also noted for swimming (HR, 0.72; 95% CI, 0.65-0.80) and aerobics (HR, 0.73; 95% CI, 0.63-0.85). In contrast to our study, the UK study reported unimportant associations with mortality for soccer (HR, 0.82; 95% CI, 0.61-1.11) and running (HR, 0.87; 95% CI, 0.68-1.11).[33,34]

Other studies show that golf is another sport that is associated with robust health benefits.[49] One very large observational study found that playing golf on a regular basis improved life expectancy by about 5 years.[50]

Strengths of the present study included the prospective design, the large size of a random sample of both men and women representative of the population of Copenhagen, the detailed information about potential confounding variables, and the 100% follow-up.

Limitations of the study must also be considered. The ideal would have been that the participants in different sports only participated in a single sport. Unfortunately, this was not the case, because all major sports were associated with other kinds of sports although generally to a much lesser degree. We suggest that the 8 different sports analyzed, each representing around 20% or more of the total duration, represent a distinct characteristic that can be used to compare the different sports. Regarding health club activities, we were not able to separate the time spent on aerobic exercise or anaerobic exercise because these activities include treadmill, elliptical, stair-climber, stationary bikes, weightlifting, and so forth.

Although several authors have found that observational studies and randomized controlled studies usually produce similar results, our study was observational and not a randomized trial, and therefore, we cannot be sure that the associations observed in our study represent a causal relationship.[51] Baseline differences among the participants of the various sports and residual confounding could also partly explain the wide range of gains in life expectancy.[33] For example, previous epidemiological studies consistently show that education is strongly positively associated with life expectancy.[52] We have tried to address this issue by comparing the mortality risk across the 8 sports for individuals with a university degree, and tennis players still had the lowest risk of mortality.

CONCLUSION

All forms of LTPA studied were associated with improved life expectancy; however, a wide range in benefit was seen among the various sports. Because this is an observational study, it remains uncertain whether this relationship is causal or merely an association. Interestingly, sports with more social interaction appeared to be associated with the greatest longevity; therefore, the impact of social interaction during LTPA appears to warrant additional study.

Abbreviations and Acronyms: **CCHS** = Copenhagen City Heart Study; **CHD** = coronary heart disease; **CRF** = cardiorespiratory fitness; **HR** = hazard ratio; **LTPA** = leisure-time physical activity; **PA** = physical activity

Affiliations (Continued from the first page of this article.): Orleans, LA (C.J.L.); and Department of Respiratory Medicine, Section of Social Medicine, Institute of Public Health (P.L.) and Medical Department O, Herlev-Gentofte Hospital, University of Copenhagen (P.L.), Copenhagen, Denmark.

Grant Support: The study was supported by the Danish Heart Foundation.

Potential Competing Interests: The authors report no competing interests.

Correspondence: Address to Peter Schnohr, The Copenhagen City Heart Study, Bispebjerg-Frederiksberg Hospital, Nordre Fasanvej 57, DK-2000 Copenhagen, Denmark (peter@schnohr.dk).

REFERENCES

1. Morris JN, Heady JA, Raffle PA, Roberts CG, Parks JW. Coronary heart-disease and physical activity of work. *Lancet*. 1953; 265(6795):1053-1057.

2. Kannel WB. Habitual level of physical activity and risk of coronary heart disease: the Framingham Study. *Can Med Assoc J*. 1967;96(12):811-812.
3. Paffenbarger RS Jr, Hyde RT, Wing AL, Hsieh CC. Physical activity, all-cause mortality, and longevity of college alumni. *N Engl J Med*. 1986;314(10):605-613.
4. Powell KE, Thompson PD, Caspersen CJ, Kendrick JS. Physical activity and the incidence of coronary heart disease. *Ann Rev Pub Health*. 1987;8:253-287.
5. Pekkanen J, Marti B, Nissinen A, Tuomilehto J, Punsar S, Karvonen MJ. Reduction of premature mortality by high physical activity: a 20-year follow-up of middle-aged Finnish men. *Lancet*. 1987;1(8548):1473-1477.
6. Leon AS, Connett J, Jacobs DR Jr, Rauramaa R. Leisure-time physical activity levels and risk of coronary heart disease and death. The Multiple Risk Factor Intervention Trial. *JAMA*. 1987;258(17):2388-2395.
7. Morris JN, Clayton DG, Everitt MG, Semmence AM, Burgess EH. Exercise in leisure time: coronary attack and death rates. *Br Heart J*. 1990;63(6):325-334.
8. Blair SN, Kohl HW III, Barlow CE, Paffenbarger RS Jr, Gibbons LW, Macera CA. Changes in physical fitness and all-cause mortality: a prospective study of healthy and unhealthy men. *JAMA*. 1995;273(14):1093-1098.
9. Wannamethee SG, Shaper AG, Walker M. Changes in physical activity, mortality, and incidence of coronary heart disease in older men. *Lancet*. 1998;351(9116):1603-1608.
10. Bijnen FC, Feskens EJ, Caspersen CJ, Nagelkerke N, Mosterd WL, Kromhout D. Baseline and previous physical activity in relation to mortality in elderly men: the Zutphen Elderly Study. *Am J Epidemiol*. 1999;150(12): 1289-1296.
11. Leitzmann MF, Park Y, Blair A, et al. Physical activity recommendations and decreased risk of mortality. *Arch Intern Med*. 2007; 167(22):2453-2460.
12. Hamer M, Chida Y. Walking and primary prevention: a meta-analysis of prospective cohort studies. *Br J Sports Med*. 2008; 42(4):238-243.
13. Dumurgier J, Elbaz A, Ducimetiere P, Tavernier B, Alperovitch A, Tzourio C. Slow walking speed and cardioascular death in well functioning older adults: prospective cohort stud. *BMJ*. 2009;339:b4460.
14. Byberg L, Melhus H, Gedoborg R, et al. Total mortality after changes in leisure time physical activity in 50 year old men: 35 year follow-up of population based cohort. *Br J Sports Med*. 2009;43(7):482.
15. Wen CP, Wai JP, Tsai MK, et al. Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. *Lancet*. 2011;378(9798): 1244-1253.
16. Li J, Loerbroks A, Angerer P. Physical activity and risk of cardiovascular disease: what does the new epidemiological evidence show? *Curr Opin Cardiol*. 2013;28(5):575-583.
17. Armstrong ME, Green J, Reeves GK, Beral V, Cairns BJ; Million Women Study Collaborators. Frequent physical activity may not reduce vascular disease risk as much as moderate activity: large prospective study of women in the United Kingdom. *Circulation*. 2015;131(8): 721-729.
18. Arem J, Moore SC, Patel A, et al. Leisure time physical activity and mortality: a detailed pooled analysis of the dose-response relationship. *JAMA Intern Med*. 2015;175(6): 959-967.
19. Katzmarzyk PT, Lee IM, Martin CK, Blair SN. Epidemiology of physical activity and exercise training in the United States. *Prog Cardiovasc Dis*. 2017;60(1):3-10.
20. Schnohr P, O'Keefe JH, Lange P, Jensen GB, Marott JL. Impact of persistence and non-persitence in leisure time physical activity on coronary heart disease and all-cause mortality: the Copenhagen City Heat Study. *Eur J Prev Cardiol*. 2017;24(15): 1615-1623.
21. Schnohr P, Scharling H, Jensen JS. Intensity versus duration of walking, impact on mortality: the Copenhagen City Heart Study. *Eur J Cardiovasc Prev Rehabil*. 2007;14(1):72-78.
22. Schnohr P, Marott JL, Jensen JS, Jensen GB. Intensity versus duration of cycling, impact on all-cause and coronary heart disease mortality: the Copenhagen City Heart Study. *Eur J Prev Cardiol*. 2012;19(1):73-80.
23. Schnohr P, Parner J, Lange P. Mortality in joggers: population based study of 4658 men. *BMJ*. 2000;321(7261):602-603.
24. Schnohr P. Physical activity in leisure time: impact on mortality. Risks and benefits. *Dan Med Bull*. 2009;56(1):40-71.
25. Schnohr P, Marott JL, Lange P, Jensen GB. Longevity in male and female joggers: the Copenhagen City Heart Study. *Am J Epidemiol*. 2013;177(7):683-689.
26. Schnohr P, O'Keefe JH, Marott JL, Lange P, Jensen GB. Dose of jogging and long-term-mortality. The Copenhagen City Heart Study. *J Am Coll Cardiol*. 2015;65(5):411-419.
27. Lee DC, Pate RR, Lavie CJ, Sui X, Church TS, Blair SN. Leisure-time running reduces all-cause and cardiovascular mortality risk. *J Am Coll Cardiol*. 2014;64(5):472-481.
28. Lee DC, Lavie CJ, Sui X, Blair SN. Running and mortality: is more actually worse? *Mayo Clin Proc*. 2016;91(4):534-536.
29. Lee DC, Brellenthin AG, Thompson PD, Sui X, Lee IM, Lavie CJ. Running as a key lifestyle medicine for longevity. *Prog Cardiovasc Dis*. 2017;60(1):45-55.
30. Lavie CJ, Lee DC, Sui X, et al. Effects of running on chronic diseases and cardiovascular and all-cause mortality. *Mayo Clin Proc*. 2015;90(11):1541-1552.
31. Lavie CJ, Arena R, Swift DL, et al. Exercise and the cardiovascular system: clinical science and cardiovascular outcomes. *Circ Res*. 2015;117(2):207-219.
32. Maslov P, Schulman A, Lavie CJ, Narula J. Personalized exercise dose prescription. *Eur Heart J*. 2018;39(25):2346-2355.
33. Oja P, Kelly P, Pedisic Z, et al. Associations of specific types of sports and exercise with all-cause and cardiovascular-disease mortality: a cohort study of 80,306 British adults. *Br J Sports Med*. 2017;51(10):812-817.
34. Stamatakis E, Kelly P, Titze S, et al. The associations between participation in certain sports and lower mortality are not explained by affluence and other socioeconomic factors. *Br J Sports Med*. 2017;51(21):1514-1515.
35. Schnohr P, Jensen GB, Lange P, Scharling H, Appleyard M. The Copenhagen City Heart Study - Østerbroundersøgelsen. Tables with data from the third examination 1991-1994. *Euro Heart J*. 2001;3(Suppl H):H1-H83.
36. Rose GA, Blackburn H. Cardiovascular survey methods. *Monogr Ser World Health Organ*. 1968;56:1-188.
37. Lin DY, Wei LJ, Ying Z. Checking the Cox model with cumulative sums of martingale-based residuals. *Biometrika*. 1993; 80(3):557-572.
38. Makuch RW. Adjusted survival curve estimation using covariates. *J Chronic Dis*. 1982;35(6):437-443.
39. Jetten J, Haslam C, Haslam SA. *The Social Cure: Identity, Health and Well-Being*. Hove and New York: Psychology Press/Taylor & Francis Group; 2011:408.
40. Lavie CJ, Menezes AR, DeSchutter A, Milani RV, Blumenthal JA. Impact of cardiac rehabilitation and exercise training on psychological risk factors and subsequent prognosis in patients with cardiovascular disease. *Can J Cardiol*. 2016;32(10, Suppl 2): S365-S373.
41. Rackow P, Scholz U, Hornung R. Received social support and exercising: an intervention study to test the enabling hypothesis. *Br J Health Psychol*. 2015;20(4):763-776.
42. Schnohr P, Kristensen TS, Prescott E, Scharling H. Stress and life dissatisfaction are inversely associated with jogging and other types of physical activity in leisure time–The Copenhagen City Heart Study. *Scand J Med Sci Sports*. 2005;15(2): 107-112.

43. Helliwell JF, Huang H. Comparing the happiness effects of real and on-line friends. *PLoS One*. 2013;8(9):e72754.
44. Bok D. *The Politics of Happiness: What Government Can Learn From the New Research on Well-Being*. Princeton: Princeton University Press; 2010:272.
45. Knoepfil-Lenzin C, Sennhauser C, Toigo M, et al. Effects of a 12-week intervention period with football and running for habitually active men with mild hypertension. *Scand J Med Sci Sports*. 2010;20(Suppl 1):72-79.
46. Karlsen T, Aamot IL, Haykowsky M, Rognmo Ø. High intensity interval training for maximizing health outcomes. *Prog Cardiovasc Dis*. 2017;60(1):67-77.
47. Larsen J. The making of a pro-cycling city: social practices and bicycle mobilities. *Environ Planning A*. 2017;49(4):876-892.
48. O'Keefe JH, Patil HR, Lavie CJ, Magalski A, Vogel RA, McCullough PA. Potential adverse cardiovascular effects from excessive endurance exercise. *Mayo Clin Proc*. 2012;87(6): 587-595.
49. Murray AD, Daines L, Archibald D, et al. The relationships between golf and health: a scoping review. *Br J Sports Med*. 2017; 51(1):12-19.
50. Farahmand B, Broman G, de Faire U, Vagero D, Ahlbom A. Golf: a game of life and death–reduced mortality in Swedish golf players. *Scand J Med Sci Sports*. 2009;19(3):419-424.
51. Benson K, Hartz AJ. A comparison of observational studies and randomized, controlled trials. *N Engl J Med*. 2000;342(25): 1878-1886.
52. Laditka JN, Laditka SB. Associations of educational attainment with disability and life expectancy by race and gender in the United States: a longitudinal analysis of the panel study of income dynamics. *J Aging Health*. 2016;28(8): 1403-1425.

Informations patient

NOM :

Prénom :

Âge :

Sexe :

Taille :

Service :

Pathologie :

Date :

Bilan : Entrée / Sortie

Poids :

Tests effectués et score :

- ☐ Tinetti : ……/28
- ☐ Timed Up and Go : ……mn ……s
- ☐ Sit to Stand : …… répétitions
- ☐ Test de marche (6mn) : ……m
- ☐ MOS SF-12 : ……
- ☐ QLQ-C30 : ……
- ☐ Piper Fatigue Scale : ……

Rapport du patient à l'activité physique :

- Avant la pathologie :
- Depuis la pathologie :
- Objectif en rééducation :
- Objectif retour à domicile :

Évaluateur :

Timed Up and Go

Matériel : chaise, plot, chronomètre.

Le patient démarre assis sur une chaise, dos appuyé contre le dossier. Il doit se lever, marcher sur une distance de 3 mètres, faire demi-tour autour d'un plot, marcher jusqu'à la chaise et s'asseoir à nouveau, dos appuyé contre le dossier. Il marche à sa vitesse habituelle, avec son aide à la marche habituelle.

Le chronomètre est lancé lorsque le patient décolle son dos du dossier pour se lever, et est arrêté lorsque qu'il est assis, dos appuyé contre le dossier.

Durée :

Interprétation

Durée moyenne de réalisation de ce test (sans aide à la marche), témoignant d'un bon équilibre dynamique, en fonction de l'âge :

- 60-69 ans : 8 secondes (entre 7s et 9s)
- 70-79 ans : 9 secondes (entre 8s et 10s)
- 80-99 ans : 11 secondes (entre 10s et 13s)

Remarques :

Sit to Stand

Matériel : chaise, chronomètre.

Le patient est assis sur une chaise sans accoudoir adossée à un mur.
Il a les bras croisés sur la poitrine et ne s'appuie pas sur le dossier de la chaise.

Au signal de l'évaluateur, le patient doit se lever et s'asseoir le plus de fois possible pendant 30 secondes. Le chronomètre sera lancé au signal de l'évaluateur et on comptera le nombre d'extensions complètes réalisées. Le sujet ne doit à aucun moment s'aider des bras.

Nombre de relevé de chaises :

Interprétation
Score moyen en fonction chez les hommes en fonction de l'âge :

Âge	60-64	65-69	70-74	75-79	80-84	85-89	90-94
Score moyen	14-19	12-18	12-17	11-17	10-15	8-14	7-12

Score moyen en fonction chez les femmes en fonction de l'âge :

Âge	60-64	65-69	70-74	75-79	80-84	85-89	90-94
Score moyen	12-17	11-16	10-15	10-15	9-14	8-13	4-11

Remarques :

Test de Marche de 6mn

Matériel : 2 cônes, 1 chaise, matériel de secours d'urgence, matériel de surveillance des constantes cardio-vasculaires. Parcours de minimum 30m, plat, rectiligne, balisé régulièrement, avec un cône à chaque extrémité pour le demi-tour.

Le but du test est de parcourir la plus grande distance possible en faisant des allers-retours sur le parcours pendant 6mn. Le patient peut ralentir et même s'arrêter, mais il est préférable de continuer à marcher, même lentement.

Distance parcourue :

Vitesse moyenne :

	FC	BORG (souffle)	BORG (membres inférieurs)
Départ			
Fin			
Après 1mn de repos			

Interprétation

Formule de Troosters :
Distance théorique = 218 + (5.14 x taille en cm) - (5.32 x âge) - (1.80 x poids en kg) + (51.31 x sexe)
Sexe : Homme = 1 ; Femme = 0

Distance théorique :

% Distance théorique = (distance parcourue x 100) / distance théorique

% Distance théorique :

Une distance parcourue inférieure à 82% de la distance théorique obtenue avec l'équation ci-dessus témoigne d'un déficit.

Remarques :

Questionnaire de Qualité de Vie : MOS SF-12

1- Dans l'ensemble, pensez-vous que votre santé est :

☐ Excellente ☐ Très bonne ☐ Bonne ☐ Médiocre ☐ Mauvaise

2- En raison de votre état de santé actuel, êtes-vous limité pour :

a. Des efforts physiques modérés (déplacer une table, passer l'aspirateur…) ?

☐ Oui, très limité ☐ Oui, un peu limité ☐ Non, pas du tout limité

b. Monter plusieurs étages par l'escalier ?

☐ Oui, très limité ☐ Oui, un peu limité ☐ Non, pas du tout limité

3- Au cours du dernier mois, en raison de votre état physique :

a. Avez-vous accompli moins de choses que vous l'auriez souhaité ?

☐ Toujours ☐ La plupart du temps ☐ Souvent ☐ Parfois ☐ Jamais

b. Avez-vous été limité pour certaines choses ?

☐ Toujours ☐ La plupart du temps ☐ Souvent ☐ Parfois ☐ Jamais

4- Au cours du dernier mois, et en raison de votre état émotionnel (comme vous sentir triste, nerveux, déprimé) :

a. Avez-vous accompli moins de choses que vous l'auriez souhaité ?

☐ Toujours ☐ La plupart du temps ☐ Souvent ☐ Parfois ☐ Jamais

b. Avez-vous eu des difficultés à faire ce que vous aviez à faire avec autant de soin et d'attention que d'habitude ?

☐ Toujours ☐ La plupart du temps ☐ Souvent ☐ Parfois ☐ Jamais

5- Au cours du dernier mois, dans quelle mesure vos douleurs physiques vous ont-elles limité dans votre travail ou vos activités domestiques ?

☐ Pas du tout ☐ Un petit peu ☐ Moyennement ☐ Beaucoup ☐ Énormément

6- Les questions qui suivent portent sur comment vous vous êtes senti au cours du dernier mois. Pour chaque question, indiquez la réponse qui vous semble le plus approprié.

a. Y a-t-il eu des moments où vous vous êtes senti calme et détendu ?

☐ Toujours ☐ La plupart du temps ☐ Souvent ☐ Parfois ☐ Rarement ☐ Jamais

b. Y a-t-il eu des moments où vous vous êtes senti débordant d'énergie ?

☐ Toujours ☐ La plupart du temps ☐ Souvent ☐ Parfois ☐ Rarement ☐ Jamais

c. Y a-t-il eu des moments où vous vous êtes senti triste et abattu ?

☐ Toujours ☐ La plupart du temps ☐ Souvent ☐ Parfois ☐ Rarement ☐ Jamais

7- Au cours de ce dernier mois, y a-t-il eu des moments où votre état de santé physique ou émotionnel vous a gêné dans votre vie sociale et vos relations avec les autres, votre famille, vos amis, vos connaissances ?

☐ Toujours ☐ La plupart du temps ☐ Souvent ☐ Parfois ☐ Jamais

Échelle de fatigue de Piper

Les questions suivantes concernent la fatigue que vous éprouvez **en ce moment**. Répondez à toutes les questions du mieux que vous pouvez et notez le temps que vous avez mis à la fin du questionnaire. Nous vous en remercions.

1. Vous sentez-vous fatigué(e) en ce moment ?

☐ OUI
☐ NON

Si OUI, depuis combien de temps vous sentez-vous fatigué(e) ? Cochez et chiffrez une seule réponse.

☐ ………………… jours
☐ ………………… semaines
☐ ………………… mois
☐ Autre (précisez) : ………………………

Pour les questions qui suivent, entourez, dans la ligne des chiffres, celui qui correspond le mieux à votre état de fatigue en ce moment.

2. À quelle point la fatigue que vous ressentez en ce moment est une souffrance pour vous ?

Pas du tout — **Énormément**
0 1 2 3 4 5 6 7 8 9 10

3. La fatigue que vous ressentez en ce moment affecte-t-elle votre capacité à travailler ou suivre une activité scolaire ?

Pas du tout — **Énormément**
0 1 2 3 4 5 6 7 8 9 10

4. La fatigue que vous ressentez en ce moment affecte-t-elle vos possibilités de sortir et/ou de passer du temps avec vos amis ?

Pas du tout — **Énormément**
0 1 2 3 4 5 6 7 8 9 10

5. La fatigue que vous ressentez en ce moment perturbe-t-elle votre capacité à avoir une activité sexuelle ?

Pas du tout — **Énormément**
0 1 2 3 4 5 6 7 8 9 10

6. Dans l'ensemble votre fatigue affecte-t-elle votre capacité à profiter des choses auxquelles normalement vous prenez plaisir ?

Pas du tout — **Énormément**
0 1 2 3 4 5 6 7 8 9 10

7. Quelle est l'intensité ou la sévérité de la fatigue que vous ressentez **en ce moment ?**

Légère — **Forte**
0 1 2 3 4 5 6 7 8 9 10

8. La fatigue que vous ressentez **en ce moment** est-elle :

Plaisante — **Déplaisante**
0 1 2 3 4 5 6 7 8 9 10

9. La fatigue que vous ressentez **en ce moment** est-elle :

Agréable — **Désagréable**
0 1 2 3 4 5 6 7 8 9 10

10. La fatigue que vous ressentez **en ce moment** est-elle :

Protectrice | **Destructrice**

0 1 2 3 4 5 6 7 8 9 10

11. La fatigue que vous ressentez **en ce moment** est-elle :

Positive | **Négative**

0 1 2 3 4 5 6 7 8 9 10

12. La fatigue que vous ressentez **en ce moment** est-elle :

Normale | **Anormale**

0 1 2 3 4 5 6 7 8 9 10

13. Comment vous sentez-vous **en ce moment** ?

Fort(e) | **Faible**

0 1 2 3 4 5 6 7 8 9 10

14. Comment vous sentez-vous **en ce moment** ?

Bien réveillé(e) | **Endormi(e)**

0 1 2 3 4 5 6 7 8 9 10

15. Comment vous sentez-vous **en ce moment** ?

Dynamique | **Vide, sans entrain**

0 1 2 3 4 5 6 7 8 9 10

16. Comment vous sentez-vous **en ce moment** ?

Reposé(e) | **Fatigué(e)**

0 1 2 3 4 5 6 7 8 9 10

17. Comment vous sentez-vous **en ce moment** ?

Énergique | **Sans énergie**

0 1 2 3 4 5 6 7 8 9 10

18. Comment vous sentez-vous **en ce moment** ?

Patient(e) | **Impatient(e)**

0 1 2 3 4 5 6 7 8 9 10

19. Comment vous sentez-vous **en ce moment** ?

Détendu(e) | **Tendu(e)**

0 1 2 3 4 5 6 7 8 9 10

20. Comment vous sentez-vous **en ce moment** ?

Gai(e) | **Déprimé(e)**

0 1 2 3 4 5 6 7 8 9 10

21. Comment vous sentez-vous **en ce moment** ?

Capable de vous concentrer | **Incapable de vous concentrer**

0 1 2 3 4 5 6 7 8 9 10

22. Comment vous sentez-vous **en ce moment** ?

Capable de vous souvenir | **Incapable de vous souvenir**

0 1 2 3 4 5 6 7 8 9 10

23. Comment vous sentez-vous **en ce moment** ?

Capable de réfléchir | **Incapable de réfléchir**

0 1 2 3 4 5 6 7 8 9 10

CH BLIGNY - Echelle de fatigue de Piper

Dimension	Items	Items Entrée	Items Sortie	Dimensions Entrée	Dimensions Sortie
	Q2	8	6		
	Q3	4	5		
Comportementale/Sévérité	Q4	3	3		
	Q5	5	4		
	Q6	6	3		
	Q7	7	5	5,5	4,3
	Q8	9	6		
	Q9	6	4		
Affective	Q10	5	2		
	Q11	6	7		
	Q12	5	3	5,2	3,7
	Q13	2	2		
Sensorielle	Q14	8	6		
	Q15	9	5		
	Q16	2	2		
	Q17	5	4	4,3	3,2
	Q18	7	7		
	Q19	6	5		
	Q20	3	3		
Cognitive/Humeur	Q21	8	8		
	Q22	9	9		
	Q23	7	2	6,7	5,7

Dimension	Entrée	Sortie
Comporteme	5,5	4,3
Affective	5,2	3,7
Sensorielle	4,3	3,2
Cognitive/Hu	6,7	5,7

score global **5,4** **4,2**