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Golf: a game of life and death – reduced mortality in Swedish golf players

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The specific health benefits achieved from different forms and patterns of leisure-time physical activity are not established. We analyzed the mortality in a cohort of Swedish golf players. We used the Swedish Golf Federation's membership registry and the nationwide Mortality Registry. We calculated standardized mortality ratios (SMR) with stratification for age, sex, and socioeconomic status. The cohort included 300 818 golfers, and the total number of deaths was 1053. The overall SMR was 0.60 [95% confidence intervals (CIs): 0.57–0.64]. The mortality reduction was observed in men and women, in all age groups, and in all socioeconomic categories. Golfers with the lowest handicap (the most skilled players) had the lowest mortality; SMR = 0.53 (95% CI: 0.41–0.67) compared with 0.68 (95% CI: 0.61–0.75) for those with the highest handicap. While we cannot conclude with certainty that all the 40% decreased mortality rates are explained by the physical activity associated with playing golf, we conclude that most likely this is part of the explanation. To put the observed mortality reduction in context, it may be noted that a 40% reduction of mortality rates corresponds to an increase in life expectancy of about 5 years.

Leisure-time physical activity is associated with decreased risk of illness and premature death but the specific health benefits achieved from different forms and patterns of leisure-time physical activity are not established. People engage in a variety of different sports and exercises partly because they expect health benefits. Most studies on associations between leisure-time physical activity and health risks use information obtained from questionnaires or interviews to assess physical activity and data are often transferred into measures of energy expenditure. A different approach is to assess risks of disease or premature mortality among people involved in specific activities and to compare them with an appropriate reference population. This approach has the advantage of providing information about health benefits, or risks for that matter, related to specific types of leisure-time physical activity. It makes it possible to consider dimensions such as duration of sessions, variation in intensity, which muscle groups are involved, seasonal variations, etc. Studies on specific sports and types of exercise have been conducted on runners (Schnohr et al., 2000), long-distance skaters (van Saase et al., 1990), and long-distance skiers (Farahmand et al., 2003) as well as on elite-level athletes in a variety of disciplines (Sarna et al., 1993). Common endpoints have been total or cardiovascular mortality but studies have also looked at more benign outcomes such as injuries (McHardy et al., 2007) and musculo-skeletal disorders (Vingard et al., 1995).

Golf is a popular sport worldwide attracting an increasing number of practitioners. The Swedish Golf Federation (SGF) has more than 600 000 members, out of a population of 9 million people. Golf is a low-intensity leisure-time physical activity for which sessions, at least in Sweden where golf carts are not frequently used, last about 4 or 5 h and involve walking 5–6 km. While golf can be played around the year in many countries, the season in most parts of Sweden is limited to around 6–8 months depending on the geographical area. There are no age restrictions in playing golf and many elderly are highly active. The purpose of the present study was to analyze the mortality among Swedish golf players compared with the general population.

Material and methods

Almost all Swedish golf players are members of a golf club associated with the SGF because this membership is required for playing on nearly all golf courses in the country. The SGF maintains a computerized registry of all its members. This membership registry is kept for administrative reasons and is used to keep track of the financial status of members, to record golf handicap, and for booking of tee times. As a consequence, the registry is regularly updated with inclusion of new members and exclusion of past members, including deceased members. The removal of dead members from the roster obviously affects the possibilities for meaningful mortality follow-up. For the purpose of the present study it was possible to copy the membership registry as of January 20, 2006 and to use this as the basis for the follow-up. The membership registry uses the unique 10-digit personal registration number for identification of individuals. This number is ubiquitous in Swedish databases and was utilized for matching to other registries with information relevant to this study

In order to verify that all the individuals in the so-created database had correct personal registration numbers, were still alive, and were still residing in the country, the registry was matched to the Registry of the Total Population, which includes everyone who is registered as living in the country, uses the personal registration number to identify individuals, and is updated continuously with information about demographic changes including migration and death. This is an official registry maintained by the government and is considered to have complete coverage. For the purpose of the current study, a restriction was further made to those individuals who were born in 1920 or later and had their registration in the SGF registry before 2001.

Information about sex and age is imbedded in the personal registration number and therefore included in the membership registry. In addition, the membership registry contains a set of administrative data for each individual. Of particular interest to this study was information about number of years since a player was first recorded in the membership registry. This was considered to be a proxy for number of years as a golf player. Furthermore, each golf player is assigned an individual golf handicap, that reflects the level on which he or she plays and that is used in golf competitions. The handicap is continuously updated based on recent performances. The membership registry keeps a record of each member's lowest ever handicap, which was used for the analysis in the current study. While there is no evidence that there is a direct correlation between handicap and number of golf rounds or level of physical activity on the golf course, it is likely that low golf handicappers have to play more frequently than high handicappers in order to obtain their low handicap and in order to maintain it.

It cannot be excluded that golf players differ socioeconomically from the general population. In order to evaluate this and to adjust for socioeconomic status (SES) if necessary, the membership registry was matched to the Swedish Census of 1990 and information about education and occupation was transferred from the census to the membership registry. The golf players were classified into four SES categories after type of job: blue-collar, lower–middle white-collar, high white-collar, entrepreneurs, and unclassifiable or missing. Those subjects who did not have an SES on their own, for example those who were not gainfully employed, were assigned the household SES. Unemployed and students were placed in the last category.

Information about deaths in the cohort of golf players was obtained through record linkage to the Mortality Registry using the personal registration number, which was also used as an identifier in the Mortality Registry. The Mortality Registry includes information about all deaths among Swedish residents and is essentially complete. At the time of the record linkage the Mortality Registry was updated through April 25, 2007. Mortality follow-up was performed during the 15-month period from January 20, 2006 through April 25, 2007. However, information about cause of death was not available at that time, implying that only data on total mortality could be presented.

The Mortality Registry provides death rates for the general population by age and sex. It does not, however, provide death rates by level of SES. Reference death rates were therefore obtained from the Swedish Work and Mortality Data Base (WMD) created by the Center for Health Equity Studies (CHESS), which includes death rates by SES based on the 1990 census, which includes everyone who was residing in Sweden on November 1, 1990. The WMD data are restricted to the age group 40–79. The mortality rates in the CHESS registry refer to the year 2002. We estimate that the mortality rates have decreased by 5–10% during the period from 2002 to 2007 resulting in a corresponding overestimation of the expected numbers of deaths that form the basis for the SMR calculations.

Standardized mortality ratios (SMR) were calculated by comparing the observed number of deaths in the golf cohort with the corresponding expected number calculated from the reference death rates and the number of person years among the golf players with stratification by age and sex. Ninety-five percent confidence intervals (CIs) were calculated around the SMR values (Ahlbom, 1990).

The study was approved by the regional ethical review board in Stockholm (Regionala etikprövningsnämnden Protokoll 2006/4:9).

Results

The total number of persons who were included in the SGF membership register as of January 20, 2006 was 666 750. Out of these, 621 730 had complete personal registration numbers, were born 1920 or later, and were residing in Sweden. Of these, 570 620 were identified in the 1990 Census. After restriction to those with first membership registration before 2001, the 300 818 were left in the cohort to be followed up for mortality: 203 778 males and 97 040 females. Table 1 displays the distribution by age, sex, and SES. It shows that the SES distribution among the golf players is somewhat shifted toward the higher SES categories.

The total number of deaths among the 300 818 persons in the golf cohort during the follow-up period was 1234. Of these, 912 had occurred among men and 322 among women. In the age group 40–79, i.e., the ages covered by the WMD, the total number of deaths was 1053. The overall SMR value, with adjustment for age and sex, was 0.41 (95% CI: 0.39–0.44) based on the Mortality Registry comparison and 0.49 (95% CI: 0.46–0.53) based on the WMD comparison. That is, the observed mortality was slightly less than half of the expected.

Table 2 gives the number of deaths and SMR values with 95% CIs by age, sex, and SES with reference death rates taken from the WMD. This table also gives SES-adjusted SMR values, which are 0.60 (95% CI: 0.56–0.64) for males and 0.62 (95% CI: 0.55–0.70) for females. Thus, the unadjusted SMR value of 0.41 was somewhat confounded by SES. Reduced SMR values were observed in both

Table 1. Characteristics of study subjects

	Men		Women		All	
	$n = 203\,778$	%	$n = 97\,040$	%	$n = 300\,818$	%
Age						
20–39	62 984	30.9	19 746	20.3	82 730	27.5
40–49	39 115	19.2	14 758	15.2	53 873	17.9
50–59	42 714	21.0	26 718	27.5	69 432	23.1
60–69	41 764	20.5	27 087	27.9	68 851	22.9
70–79	14 681	7.2	7620	7.9	22 301	7.4
≥ 80	2520	1.2	1111	1.1	3631	1.2
Socioeconomic status						
Blue-collar (33/31)*	41 649	20.4	13 421	13.8	55 070	18.3
Lower–middle white-collar (23/32)	73 874	36.3	50 507	52.0	124 381	41.3
High white-collar (13/7)	58 432	28.7	20 605	21.2	79 037	26.3
Entrepreneurs (8/4)	14 468	7.1	5326	5.5	19 794	6.6
Unclassifiable or missing (22/26)	15 355	7.5	7181	7.4	22 536	7.5
Education						
Low (< 9 years)	35 317	17.3	17 379	17.9	52 696	17.5
Medium (9–12 years)	67 797	33.3	30 995	31.9	98 792	32.8
High (> 12 years)	58 013	28.5	34 588	35.6	92 601	30.8
Handicap						
> 30	30 018	14.7	51 988	53.6	82 006	27.3
21–30	46 800	23.0	28 767	29.6	75 567	25.1
11–20	83 509	41.0	13 483	13.9	96 992	32.2
≤ 10	43 451	21.3	2802	2.9	46 253	15.4
First record in membership registry						
1930–1985	20 639	10.1	9809	10.1	30 448	10.1
1986–1990	37 957	18.6	18 776	19.3	56 733	18.9
1991–1995	53 942	26.5	26 201	27.0	80 143	26.6
1996–2000	91 240	44.8	42 254	43.5	133 494	44.4

*Percentage of SES (men/women) in CHESS population according to census of 1990.
CHESS, Center for Health Equity Studies; SES, socioeconomic status.

Table 2. Number of deaths and standardized mortality ratio (SMR) and 95% confidence interval (CI) by age, sex, and SES

	Men			Women			All		
	Observed	SMR	95% CI	Observed	SMR	95% CI	Observed	SMR	95% CI
Age									
40–49	29	0.41	(0.27–0.58)	10	0.53	(0.26–0.98)	39	0.43	(0.31–0.59)
50–59	118	0.56	(0.47–0.67)	64	0.67	(0.52–0.86)	182	0.60	(0.51–0.69)
60–69	306	0.59	(0.53–0.66)	130	0.63	(0.53–0.75)	436	0.60	(0.55–0.66)
70–79	311	0.64	(0.57–0.72)	85	0.59	(0.47–0.73)	396	0.63	(0.57–0.70)
Socioeconomic status									
Blue-collar	103	0.48	(0.39–0.58)	31	0.51	(0.34–0.72)	134	0.49	(0.41–0.58)
Lower–middle white-collar	270	0.58	(0.52–0.66)	158	0.63	(0.54–0.74)	428	0.60	(0.55–0.66)
High white-collar	255	0.73	(0.65–0.83)	55	0.74	(0.56–0.96)	310	0.73	(0.65–0.82)
Entrepreneurs	79	0.68	(0.54–0.85)	18	0.73	(0.44–1.16)	97	0.69	(0.56–0.84)
Unclassifiable or missing	57	0.41	(0.31–0.53)	27	0.50	(0.33–0.73)	84	0.44	(0.35–0.54)
All adjusted for age	764	0.49	(0.45–0.52)	289	0.51	(0.46–0.58)	1053	0.49	(0.46–0.53)
All adjusted for age and SES	764	0.60	(0.56–0.64)	289	0.62	(0.55–0.70)	1053	0.60	(0.57–0.64)

Age (adjusted for age and SES).
SES, socioeconomic status (adjusted for age).

genders and across all age groups. When the SMR values were compared between SES groups, it appeared that the strongest mortality reduction was seen in the blue-collar category, SMR = 0.49 (95% CI: 0.41–0.58), and in the unclassifiable/missing category, SMR = 0.44 (95% CI: 0.35–0.54). The lowest mortality reduction was noted among high white-collar, SMR = 0.73 (95% CI: 0.65–0.82).

In Table 3, the results by lowest ever golf handicap and by number of years since first record in the SGF registry are presented. These SMR values were adjusted for age and SES. It is clear from the table that the SMR values decreased substantially with decreasing golf handicap (increasing level of play) similarly for males and females. The table also shows that, at least for males, the mortality reduction was

Table 3. Number of deaths and standardized mortality ratio (SMR) and 95% confidence interval (CI) by handicap and time since first record in membership registry

	Men			Women			All		
	Observed	SMR	(95% CI)	Observed	SMR	(95% CI)	Observed	SMR	(95% CI)
Handicap									
>30	169	0.72	(0.61–0.83)	164	0.64	(0.55–0.75)	333	0.68	(0.61–0.75)
21–30	262	0.65	(0.57–0.73)	90	0.60	(0.49–0.74)	352	0.64	(0.57–0.71)
11–20	270	0.52	(0.46–0.59)	32	0.59	(0.40–0.83)	302	0.53	(0.47–0.59)
≤ 10	63	0.52	(0.40–0.67)	3	0.72	(0.15–2.12)	66	0.53	(0.41–0.67)
First record in membership registry									
1930–1985	174	0.81	(0.69–0.94)	44	0.56	(0.41–0.64)	218	0.74	(0.64–0.84)
1986–1990	190	0.62	(0.54–0.72)	65	0.60	(0.46–0.76)	255	0.62	(0.54–0.70)
1991–1995	201	0.58	(0.51–0.67)	80	0.63	(0.59–0.79)	281	0.60	(0.53–0.67)
1996–2000	199	0.48	(0.42–0.55)	100	0.67	(0.54–0.81)	299	0.53	(0.47–0.59)

All SMRs adjusted for eight age categories (40–44, 45–49, …. 75–79) and SES (five categories).
SES, socioeconomic status.

the strongest for those with the shortest duration of membership, although all had to have at least 5 years in order to be included in the follow-up.

Discussion

The results of these analyses show that Swedish golf players have mortality rates that are about 60% of those in the general population after adjustment for socioeconomic status. This is true for both sexes and in all age groups. Stratification for SES shows that the reduced mortality is present in all socioeconomic categories but that the reduction was stronger in the blue-collar category and among unclassifiable or missing and smaller among white-collar categories. The mortality was the lowest in those with the lowest golf handicap, i.e., among the most skilled golfers.

The benefits of leisure-time physical activities in terms of reduced risks of cardiovascular disease are well established through a number of epidemiological cohort studies (Paffenbarger et al., 1986; Powell et al., 1987; Blair et al., 1989; Berlin & Colditz, 1990). The positive effects of regular exercise are mediated through favorable effects on several cardiovascular risk factors such as obesity, blood pressure, lipoprotein metabolism, and glucose–insulin homeostasis (Torjesen et al., 1997; Fagard & Cornelissen, 2007). Leisure-time physical activity in the form of golf contains components of potential importance for preventive effects like walking with engagement of large muscle groups and most likely also positive psychological effects from the play. A controlled trial of the health benefits of regular walking on a golf course including 55 healthy Finnish golf players, 48–64 years of age, and 55 age- and sedentary-matched controls clearly showed that playing golf regularly increased aerobic performance and trunc muscle performance. Likewise, favorable effects were noted for body composition with reductions in weight, waist circumference, and abdominal skin fold thickness. In addition, training benefits were seen for lipoprotein variables with an increase of the HDL/cholesterol ratio particularly due to an increase of HDL (Parkkari et al., 2000). It is, thus, likely that regular walking on a golf course could beneficially affect cardiovascular risk factors. Such mechanisms might have been in operation explaining the reduced total mortality, which was observed in the present study.

While the inducement behind this study was to investigate the potential health benefits from the type of physical activity that is associated with golf, we cannot with certainty ascribe the reduced mortality that we observed to the fact that the cohort members play golf. However, we believe that we have been rather successful in addressing the possibility of confounding due to biased socioeconomic selection into the game. This assertion is based on the observation that the SMR value is indeed changed from 0.49 to 0.60 when SES is adjusted for and that all SES categories display a reduced mortality. Yet, the possibility of some residual SES confounding cannot be ruled out (Fewell et al., 2007). There are some other mechanisms that could lead to a reduced mortality in the cohort that would not be a direct consequence of the physical activity associated with playing golf. The effect of these resembles the healthy worker effect that may occur when an occupational cohort is compared with the general population. It is possible that playing golf is associated with a life style that results in reduced mortality, such as a healthy diet and low smoking prevalence, and that this explains the low mortality rates among golfers rather than the exercise experienced through the golf game. The current database includes no information about golf players' life style and this issue cannot be addressed in the present study. We believe, however, that the SES adjustment addresses this to some extent. Another hypothesis would be that some genetic factor increases the likelihood that a person takes on the game of golf and that the same genetic factor affects longevity. This is perhaps not likely, but it cannot be addressed in the current study (Carlsson et al., 2007). It is also conceivable that golf players stop playing if they experience early signs of disease that make it difficult or impossible to continue the game. If so, the golf players with declining health would be selected out and, thus, leave healthier individuals in the cohort. However, the likelihood of this is reduced because we require 5 years of golf club membership for inclusion in the cohort. Similarly, starting to play golf requires a certain level of fitness while the general population also includes those who do not fulfill this requirement. As a consequence, the baseline mortality would differ between golfers and the general population. In the present study all SMR values are conditional on SES level, which is based on occupational category. As a consequence the mortality reference levels are based on subjects who are at least fit enough to be included in the work force. In addition, the comparison across golf handicap is in effect an internal comparison within the golf cohort.

Owing to the way the membership registration is conducted, we have only been able to include about half of the country's golf players in the analysis, but we cannot think of any way that this could create a bias. Because of the setup of the database, the follow-up for mortality was only 15 months. But again, we cannot see any other consequence of this than on the actual number of deaths in the cohort, which is reasonable anyway because of the size of the cohort and because the analyses are restricted to total mortality.

Perspectives

Several previous epidemiological studies have shown that leisure-time physical activity is associated with decreased risk of illness and premature death particularly due to cardiovascular disease. However, the specific health benefits achieved from different forms and patterns of leisure-time physical activity are not established. We analyzed the mortality in a cohort of Swedish golf players compared with the general population adjusted for SES.

We noted that the mortality is the lowest among the most skilled players, i.e., among those with the lowest handicap, which suggests that the level of intensity of the game plays a role. This in turn indicates that the reduced mortality, at least partly, is indeed due to the playing of golf rather than to bias. The observation that the mortality reduction is weaker in men with a long duration of golf club membership would be consistent with the game being played less intensely among veteran golfers and with a positive health effect that tapers off if the physical activity is reduced or discontinued. That the apparent protective effect from playing golf was larger in lower socioeconomic groups was unexpected, but similar findings have been reported for smoking showing that non-smoking was more beneficial in lower socioeconomic groups (Hallqvist, 1998).

While we cannot conclude with certainty that all the 40% decreased mortality rates that we observe in the golf cohort are explained by the physical activity associated with playing golf, we conclude that most likely this is part of the explanation. To put the observed mortality reduction in context, it may be noted that a 40% reduction of mortality rates corresponds to an increase in life expectancy of about 5 years.

Key words: golf, leisure physical activity, mortality, cohort study, epidemiology.

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Conflicts of interest:

None.

References

Ahlbom A. Introducation to modern epidemiology, 2nd edn, Epidemiology Resources Inc., printed in the United States of America, 1990.

Berlin JA, Colditz GA. A meta-analysis of physical activity in the prevention of coronary heart disease. Am J Epidemiol 1990: 132: 612–628.

Blair SN, Kohl HW III, Paffenbarger RS Jr, Clark DG, Cooper KH, Gibbons LW. Physical fitness and all-cause mortality. A prospective study of healthy men and women. JAMA 1989: 262: 2395–2401.

Carlsson S, Andersson T, Lichtenstein P, Michaelsson K, Ahlbom A. Physical activity and mortality: is the association explained by genetic selection? Am J Epidemiol 2007: 166: 255–259.

Fagard RH, Cornelissen VA. Effect of exercise on blood pressure control in hypertensive patients. Eur J Cardiovasc Prev Rehabil 2007: 14: 12–17.

Farahmand BY, Ahlbom A, Ekblom O, Ekblom B, Hallmarker U, Aronson D, Brobert GP. Mortality amongst participants in Vasaloppet: a classical long-distance ski race in Sweden. J Intern Med 2003: 253: 276–283.

Fewell Z, Davey Smith G, Sterne JA. The impact of residual and unmeasured confounding in epidemiologic studies: a simulation study. Am J Epidemiol 2007: 166: 646–655.

Hallqvist J. Socioeconomic differences in myocardial infarction risk. Stockholm, Sweden: Karolinksa Institutet, 1998.
McHardy A, Pollard H, Luo K. One-year follow-up study on golf injuries in Australian amateur golfers. Am J Sports Med 2007: 35: 1354–1360.
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: 605–613.
Parkkari J, Natri A, Kannus P, Manttari A, Laukkanen R, Haapasalo H, Nenonen A, Pasanen M, Oja P, Vuori I. A controlled trial of the health benefits of regular walking on a golf course. Am J Med 2000: 109: 102–108.
Powell KE, Thompson PD, Caspersen CJ, Kendrick JS. Physical activity and the incidence of coronary heart disease. Annu Rev Public Health 1987: 8: 253–287.
Sarna S, Sahi T, Koskenvuo M, Kaprio J. Increased life expectancy of world class male athletes. Med Sci Sports Exerc 1993: 25: 237–244.
Schnohr P, Parner J, Lange P. Mortality in joggers: population based study of 4,658 men. BMJ 2000: 321: 602–603.
Torjesen PA, Birkeland KI, Anderssen SA, Hjermann I, Holme I, Urdal P. Lifestyle changes may reverse development of the insulin resistance syndrome. The Oslo diet and exercise study: a randomized trial. Diabetes Care 1997: 20: 26–31.
van Saase JL, Noteboom WM, Vandenbroucke JP. Longevity of men capable of prolonged vigorous physical exercise: a 32 year follow up of 2259 participants in the Dutch eleven cities ice skating tour. BMJ 1990: 301: 1409–1411.
Vingard E, Sandmark H, Alfredsson L. Musculoskeletal disorders in former athletes. A cohort study in 114 track and field champions. Acta Orthop Scand 1995: 66: 289–291.