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Original research

Lifetime physical activity and cancer incidence—A cohort study of male former elite athletes in Finland

Jorma Sormunen[a,*], Heli M. Bäckmand[b,c], Seppo Sarna[b], Urho M. Kujala[d], Jaakko Kaprio[b,e,f], Tadeusz Dyba[g], Eero Pukkala[a,g]

[a] University of Tampere, School of Health Sciences, Finland
[b] University of Helsinki, Department of Public Health, Finland
[c] City of Vantaa, Health and Social Welfare Department, Finland
[d] University of Jyväskylä, Department of Health Sciences, Finland
[e] University of Helsinki, Institute for Molecular Medicine FIMM, Finland
[f] National Institute for Health and Welfare (THL), Finland
[g] Finnish Cancer Registry, Institute for Statistical and Epidemiological Cancer Research, Finland

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ABSTRACT

Objectives: Physical activity has been shown to decrease the risk of certain cancers. Objective of this study was to assess the effect of physical activity on cancer incidence in former male athletes in older age.
Design: A cohort of 2448 elite male athletes and 1712 referents was followed-up for cancer incidence during 1986–2010 through the Finnish Cancer Registry.
Methods: Standardised incidence ratios were calculated with the general male population as the reference. Self-reported questionnaire-based data on covariates were used in Cox regression analyses comparing the risk of cancer in athletes and referents.
Results: The overall cancer incidence was lower in athletes than in the general population, standardised incidence ratio 0.89 (95% confidence interval 0.81–0.97). It was lowest among middle-distance runners (standardised incidence ratio 0.51, 95% confidence interval 0.22–1.01), long-distance runners (standardised incidence ratio 0.57, 95% confidence interval 0.35–0.88) and jumpers (standardised incidence ratio 0.60, 95% confidence interval 0.37–0.92). The standardised incidence ratio of lung cancer among athletes was 0.40 (95% confidence interval 0.27–0.55) and that of kidney cancer 0.23 (95% confidence interval 0.06–0.57). The hazard ratio for lung cancer between athletes and referents increased from the unadjusted ratio of 0.29 (95% confidence interval: 0.18–0.48) to 0.61 (95% confidence interval: 0.30–1.26) after adjustment for smoking status and pack-years of smoking.
Conclusions: Former male elite athletes evidently have less cancer than men on the average. The lesser risk can be attributed to lifestyle factors, notably less frequent smoking among the athletes.
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1. Introduction

In addition to the well-recognized role of smoking, alcohol consumption and unhealthy diet in the aetiology of many cancers, increasing evidence implicates physical inactivity as a risk factor for some cancers. In 2002 the International Agency for Research on Cancer (IARC) estimated that excess body weight and physical inactivity could account for one quarter to one third of cancers of colon, kidney and oesophagus.[1] Since especially leisure-time physical activity is usually associated with a generally healthier lifestyle,[2,3] the independent role of physical activity in the aetiology of cancer may be difficult to demonstrate.

Several studies have reported links between physical activity and reduced risk of certain cancers, especially breast[4,5] and colon cancer.[6–8] There is conflicting evidence from the studies on prostate, lung and kidney cancer among physically active men. Some studies have suggested that the risks of these cancers are lower among the more physically active[9,10] but not all studies agree with this finding.[11,12]

Cancer incidence of Finnish world-class athletes in 1967–1995 was reported to be one-fifth lower than that of the general Finnish male population.[13] This was mainly explained by smaller incidence

Abbreviations: BMI, body mass index; CI, confidence interval; HR, hazard ratio; IARC, International Agency for Research on Cancer; LTPA, leisure-time physical activity; MET, standard metabolic equivalent; PIC, personal identity code; SES, socio-economic status; SIR, standardised incidence ratio.

* Corresponding author.
E-mail address: Jorma.Sormunen@fimnet.fi (J. Sormunen).

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of smoking-related cancers in the athletes, but individual-level risk factor data prior to 1985 were not available. The value of studying elite athletes is that there is a documented period of intensive physical activity needed to achieve elite status and this information is available historically obviating the need to study young adults prospectively into the period of high risk for cancer decades later. However, elite athletes differ also for other cancer risk factors, which need to be accounted for in a rigorous analysis of the relationship of elite athlete status with future cancer. We now report the cancer incidence of these individuals for a period of 21 years from 1986 to 2010, with due consideration of cancer-related life-style factors collected in 1985.

The aim of this study was to evaluate the effects of an athlete status and their lifestyle covariates in incidence of different cancers.

2. Methods

The study cohort consisted of Finnish male athletes, who had represented Finland between the years 1920 and 1965 at least once in international or inter-country competitions (for details, see Sarna et al.[14]). The following sports were selected: track and field athletics, cross-country skiing, soccer, ice hockey, basketball, boxing, wrestling, weight lifting, and shooting. Sport disciplines were chosen based on the numbers of Finnish Olympic games participants. In addition it was made sure that endurance, speed, power and team sports disciplines were included in the cohort. One referent for each athlete was selected from the archives of the registry of men liable for military service, matched for year of birth and area of residence. The referent had to have been classified as completely healthy ("A1 category") at the compulsory medical examination for induction into military service at age of 20 years (referents were born between years 1898 and 1948). No eligible referent was traced for 15% of athletes because ice hockey, basketball, weight lifting, and shooting were retrospectively included in the study after selection of the referents.

The original study cohort consisted of 2448 athletes and 1712 referents. In 1985 a questionnaire on physical activity and health was mailed to the survivors of the cohort and their referents. The response proportion was 85% for the athletes and 81% for the referents. We had no reason to expect recall bias between the two groups. Out of the responders 1324 athletes and 754 of referents had no missing values on the main covariates. All persons with non-missing values of variables included in the models were included in the Cox regression analyses.

Everyone residing in Finland since 1967 has been assigned a unique personal identity code (PIC), which is used in all main registers. PICs for every cohort member together with possible dates of emigration or death were obtained from the Population Register Centre of Finland. Follow-up for cancer through the files of the population-based countrywide Finnish Cancer Registry was done using the PIC as a key.

In this article we report the cancer incidence of the survivors of the cohort on the 1st of January 1986 from 1st of January 1986 to death or 31st of December 2010.

The ethics committee of the University of Helsinki approved the study, and all subjects have provided informed consent.

Assessment of leisure-time physical activity (LTPA) was based on three structured questions on participation in recreational physical activity. The activity-MET index was used as a measure of physical activity level in 1985 and expressed as the score of MET-hours per week. It was further classified into five groups by four quintiles (lowest quintile value 3 and highest 45 MET-hours per week) (Table 1). For Cox regression analyses the three middle fifths (II–IV) were combined. Athletes exercised more MET-hours weekly than their referents (Table 1).

Table 1
Distribution of the background characteristics of the study subjects on December 31, 1985.

Characteristic	Athletes	Referents
Age	N = 1609	N = 1046
Years: median (min–max)	55.2 (35.6–93.8)	53.3 (38.0–87.5)
≤50 years	31.1%	36.3%
50–64 years	45.9%	45.5%
65–79 years	20.3%	16.5%
≥80 years	2.7%	1.6%
Leisure time physical activity (LTPA)	N = 1257	N = 731
MET[a], MET * h/week: median (min–max)	18 (0–228)	6 (0–228)
Lowest fifth (<3 MET * h/week)	13.6%	32.6%
Intermediate (fifth II, III & IV (3–45 MET * h/week)	65.9%	60.5%
Highest fifth V (>45 MET * h/week)	20.5%	7.0%
Alcohol consumption	N = 1238	N = 723
Abstainers (<1 drinks/week)	11.7%	15.5%
Occasional users (1–3 drinks/week)	45.4%	46.7%
Moderate users (3–14 drinks/week)	29.7%	25.4%
Heavy users (≥14 drinks/week)	13.2%	12.3%
Cigarette smoking status	N = 1247	N = 725
Never smokers	48.9%	28.0%
Occasional smokers	4.7%	2.5%
Ex-smokers	30.6%	40.7%
Current smokers	15.9%	28.8%
Pack-years for current smokers: median, during smoking period (min–max)	15 (0.4–87)	23 (0.4–72)
Body mass index (BMI)	N = 1264	N = 735
kg/m^2: median (min–max)	25.6 (16.2–43.3)	26.1 (15.8–58.1)
Normal weight (BMI ≤ 24.99)	41.8%	36.5%
Overweight (BMI 25.00–29.99)	46.4%	50.9%
Obese (BMI ≥ 30.00)	11.9%	12.7%
Socio-economic status	N = 1579	N = 962
Executives	26.4%	10.3%
Clerical workers	40.5%	23.4%
Skilled workers	26.5%	41.6%
Unskilled workers	2.1%	7.9%
Agricultural workers	4.3%	16.5%
Other	0.3%	0.3%

[a] The metabolic equivalent (MET) index was calculated by assigning a coefficient of the resting metabolic rate to each activity and by calculating the product of intensity × duration × frequency.

Alcohol consumption was evaluated by quantity-frequency measures of beverages. Respondents were categorised as abstainers, light, moderate and heavy users of alcohol based on number of drinks per week.[15]

Smoking status was based on a detailed smoking history.[16] Respondents were classified into four categories: never, ex-, occasional or current (daily or almost daily) smokers. Current smokers were defined as persons, who had smoked more than 100 cigarettes in their lifetime and smoked daily or almost daily at the time of the 1985 questionnaire. For Cox regression analyses the groups occasional and current smokers were combined.

Duration of smoking was based on age of onset of smoking and age in 1985 (for current smokers), or age at cessation (for former smokers). In the calculation of pack-years of smoking for current smokers in 1985, the daily smoking was classified as follows: those who smoked 1–15 cigarettes daily were given value of 0.4 packs (8 cigarettes/day); for those who smoked more than 15, but less than 25 cigarettes/day were given a value of 1.0 pack; and for those who smoked >25 cigarettes/day were given a value of 1.5 packs. The numbers of pack-years was then packs smoked daily multiplied by the number of years of smoking.

Self-reported data on height (m) and weight (kg) were used to calculate the body mass index (BMI) as weight divided by height squared (kg/m^2).

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