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Physical activity, use of alcohol and smoking in middle-aged and aging men. A longitudinal study among Finnish male former athletes and controls.

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ABSTRACT

Objective: It is not known whether decrease in physical activity (PA) is associated with binge drinking among former athletes. The purpose of this study was to investigate the reciprocal associations between PA and use of alcohol among former athletes and controls at four time points. Furthermore, we examined whether there were longitudinal latent profiles related to use of alcohol, smoking and PA during the follow-up.

Methods: Finnish male former elite athletes (n=1633) and matched controls (n=1099) questionnaire-reported their PA, alcohol consumption and smoking at four time points in 1985, 1995, 2001 and 2008.

Results: Former athletes were more physically active and smoked less than controls, but in all profiles smoking decreased during the follow-up. Former athletes consumed alcohol significantly more compared to controls in 1985, especially if their athletic career had ended suddenly by sports injury. At other time points, no differences were seen. Five latent profiles were found, and there were significant differences between former athletes and controls in the probabilities to belong to four of them. PA decreased in four of five profiles, while alcohol consumption decreased or increased in some profiles. But PA did not predict later alcohol consumption at any time point. Cross-lagged path model indicated that the mutual associations of alcohol use and PA were weak at most.

Conclusions: Although risk of excessive alcohol consumption may increase in individuals, whose athletic career has ended suddenly by sports injury, overall PA and alcohol affected each other's development only modestly among former athletes and controls during the 23-year follow-up.

Key words: ALCOHOL, COHORT STUDY, FORMER ATHLETE(S), PHYSICAL ACTIVITY, SMOKING.

INTRODUCTION

There is a widespread scientific and public health policy consensus that behavioral factors such as low physical activity (PA), cigarette smoking, and alcohol drinking are major contributors to morbidity and mortality.[1-3] PA exerts several positive health effects on adult chronic diseases, on psychological health and functionality.[4]

Cross-sectional and longitudinal studies have found that habitual physical inactivity, compared to continuous PA during late adolescence, predicts higher prevalence of smoking during young adulthood even after familial factors are accounted for.[5-6] Correspondingly, people who drink are much more likely to smoke,[7-8] and dependence on alcohol and tobacco is also correlated.[9]

Studies have found that current and former athletes smoke less than non-athletes.[10-14] Correspondingly, sports participation is identified in some studies as a protective factor against drinking in young individuals.[15] But athletic participation has been associated in other studies with excessive alcohol consumption,[16-18] alcohol-related problems[19] and alcohol dependence.[20] There is a paucity of scientific data on alcohol consumption among former athletes, because most studies are only focused on drinking habits among younger and current athletes.[15-20] Correspondingly, it is not known whether decrease in PA is associated with increased alcohol use and binge drinking among former athletes in later life. Furthermore, the longitudinal course of drinking among individuals with variable degrees of athletic participation is less studied.[16]

Studies have found that retirement can lead to increased binge drinking among older people, who may use alcohol to combat loneliness and counter boredom.[21-23] It has been detected that if an active sports career ends unexpectedly and an individual has a high athletic identity, adaptation to forced athletic retirement will be challenging [24] and it might lead to alcohol-related problems.[25]

The first aim of this study was to examine if there was difference in use of alcohol or smoking between Finnish former athletes from a well-studied cohort having different reasons for quitting active sports career. Correspondingly, it is not known whether changes in PA are associated with changes in the overall consumption and pattern of use of alcohol among former athletes. The second purpose of this study was to investigate the associations between PA and use of alcohol among former elite athletes and controls at four time points spanning 23 years from middle-age onwards after an active sports career. Furthermore, we examined whether the characteristics of longitudinal latent profiles related to use of alcohol, smoking and PA during the follow-up. So, this unique longitudinal study revealed novel data on the associations between PA and other health-related behaviors in middle-aged and aging men.

METHODS

Participants

An original cohort of former elite athletes (n=2657) was formed by identifying men who had represented Finland between 1920 and 1965 at least once at the Olympic Games, European or World championships, or international contests between two or three countries.[14,26] A control cohort (n=1712) was selected from Finnish men who at the age of 20 years had been identified healthy in the medical inspection for enlisting in ordinary military service (class A1, which means fully fit for ordinary military service). The control cohort was formed by matching the same age groups and area of residence with the former elite athletes.[14,26] After first finding the athlete in the register, the selection of each control subject was done. The control subject was chosen nearest the A1 conscript listed to the athlete. This procedure was carried out in the years 1978-1979, when 85.3 % of the athletes had been identified.[26]

Participants who had died before the follow-up started in January 1, 1985 were excluded from this study. Thus, the final study population was 2732 men (1633 former athletes, 1099 controls) shown in Table 1 and

Figure 1. The athletes were divided into three groups according to the type of training needed to achieve optimal results:[27] endurance (n=287), mixed (n=769) and power sports (n=577).

Participants were not involved in setting the research question, the outcome measures or study design. Before taking part in the study all the participants gave informed consent by returning the questionnaires, which were accompanied by a cover letter explaining the purpose of the study. This study was conducted according to good clinical and scientific practice and the Declaration of Helsinki. Ethical approval for questionnaire data collection was given by The ethics committee of the Hospital District of Helsinki and Uusimaa, and the Ministry of Social Affairs and Health in Finland.

The 1985, 1995, 2001 and 2008 questionnaire studies

Questionnaires eliciting information on reasons for ending sports career, socio-demographic factors, and health-related lifestyle habits, were sent to the surviving cohort members in the years 1985, 1995 and 2001 (Figure 1). In 2008, an invitation to participate in a clinical study was sent to all former athletes and controls who were still alive and had answered at least one of the previous questionnaires. The clinical study included a physical examination, laboratory tests and questionnaires.[28] Former elite athletes (n=1255, 82% response rate in 1985) and controls (n=764, 76% response rate in 1985), who answered the physical activity-, alcohol- or smoking-related questions in any questionnaires, were included in the statistical analysis. Because the analyses were made by using the full information maximum likelihood method, there was no need to use imputation. The missing values are supposes to be missing at random (MAR).

Questionnaire-based covariates

The volume of physical activity (MET-hours/week, MET, metabolic equivalent) in questionnaires was computed from the responses to three structured questions on intensity, duration and frequency of activity using a previously validated method.[29]

Alcohol consumption based on quantity-frequency measures of beverage use, asked separately for beer, wine and spirits, was converted into grams of pure alcohol per month as previously reported[14,30] in each survey. In the 1985 questionnaire study alcohol consumption was assessed by heavy drinking occasions (HDO). HDO is defined as drinking 5 or more alcoholic drinks (>60 grams of pure alcohol) on a single occasion on at least 1 day in the past 30 days.[31] Responses formed two categories: no HDO and at least one HDO.[14] The smoking status of the participants was classified into three categories from responses to a detailed smoking history: never, former, current (including occasional) smokers (for more details see Table S1, Supplemental Digital Content 1). Furthermore, cigarettes per day (CPD) for former and current smokers was calculated based on all questionnaires. Use of coffee (cups per day) was based on responses from 1985, 1995 and 2008 questionnaires.

Marital status of the participants was classified into 6 categories in the questionnaire study of 1985: unmarried, married, remarried, cohabitated, divorced, widowed. The working status of the participants was classified into 4 categories in the questionnaire study 1985: employed (salaried or self-employed), retired for old age, retired on a disability pension and unemployed. The participants were classified into five social class groups: executives and professionals, lower white collar workers, skilled (blue) collar workers, unskilled workers and farmers [32] according to the occupation in which they had practiced the longest (for the distributions see Table S2, Supplemental Digital Content 2). This classification also reflects the occupational loading and socioeconomic status of the participants. The social group distribution of athletes differed from that of controls ($p<0.001$, χ^2 -test). Occupational data were collected partly from the Central

Population Registry of Finland and partly from the 1985 questionnaire, asking for the occupation in which they had been active the longest.

Reasons for ending the athletic sports career was categorized into six groups based on questions in the 1985 questionnaire: enthusiasm had ended, sports injury, work or studies, age, disease and other reasons.

Statistical analysis

The descriptive data are presented as the mean and standard deviation (SD) or 95% confidence intervals (CI) if distributed normally; otherwise the descriptive data are shown as the median and range. The differences in the distributions of the categorical variables were examined using cross-tabulations with the Chi-square (χ^2) -test.[14]

The questionnaire data was analyzed using non-parametric Kruskall-Wallis-test and using the Dunn-Bonferroni approach for post hoc testing in pairwise comparisons for more than two groups ($p<0.05$), because some of the variables were not normally distributed and variances were not equal. The Mann-Whitney-U-test was used to compare differences between sports groups and controls ($p<0.05$). Homogeneity of variances were assessed using Levene`s test and normality using Kolmogorov-Smirnov`s test ($p<0.05$).[14]

A bivariate cross-lagged path model was used to investigate the direction and magnitude of the associations between PA and alcohol consumption at four time points. The full cross-lagged path model and its specifications are shown in Supplemental Digital Content 4 (Figure S4). A bivariate cross-lagged path model was not used to examine associations between PA and smoking, because neither CPD nor categorical smoking status variable were not appropriate to this model.

Latent profile analysis (LPA) was used to find simultaneous developmental profiles in PA, alcohol and smoking behaviors measured at 1985, 1995, 2001 and 2008. Profiles in the latent classes were specified to differ in the mean values of PA and alcohol consumption whereas smoking behavior was specified as categorical (three categories) allowing the proportion of three categories differ between profiles. Variances of the two continuous variables were allowed to differ between latent profiles. The estimation method was full information maximum likelihood with robust standard errors estimates (MPLUS).

Missing values were supposed to be missing at random (MAR). Total sample size was 2275 in which covariance coverage in year 1985 was between 0.85 - 0.86, in year 1995 0.56 - 0.67, in year 2001 0.48 - 0.52 and in year 2008 0.23 - 0.29. For details of the analysis method and use of covariates, see Supplemental Digital Contents 5 and 6.

P-values <0.05 were considered statistically significant. Statistical analyses were performed using SPSS statistical software (versions 24.0 and 26.0 for Windows; SPSS Inc., Chicago, IL), and Mplus statistical software package (version 8.2 for Windows; Mplus Corp, California).

RESULTS

The former athletes (n=1276) were 56.8 (SD 11.0) years old on average in 1985, compared to 55.0 (SD 10.3) years among controls (n=777 respondents). Former athletes self-reported reasons for quitting athletic career in the 1985 questionnaire: 22.6 % (n=231) enthusiasm had ended, 20.2 % (n=207) sports injury, 9.9 % (n=101) work or studies, 32.1 % (n=328) age, 1.8 % (n=18) disease and 13.5 % (n=138) other reasons. In 2008 the mean age of the former athletes (n=747) was 73.8 (SD 7.0) years and controls 72.8 (SD 6.3) years (N=436) (for more details, see Table 1).

Survey descriptives in 1985, 1995, 2001 and 2008

Former athletes were more physically active than controls at the four time points, also mean of MET-hours/week was significantly higher among former athletes (30.3 MET-hours/week in 1985 and 31.4 MET-hours/week in 2008) than controls (14.9 MET-hours/week in 1985 and 20.5 MET-hours/week in 2008) during the 23-year follow-up ($p<0.0001$) (For more details see Table S1, Supplemental Digital Content 1).

In 1985 former athletes consumed more alcohol (425 g/month) compared to controls (398 g/month) ($p<0.05$), but the proportion having HDOs did not differ between former athletes and controls ($p=0.60$) (For more details see Table S1, Supplemental Digital Content 1). The use of alcohol was higher among former athletes if their athletic sports career had ended suddenly by sports injury (524 g/month) or enthusiasm had ended (536 g/month) compared to age (478 g/month) or disease (406 g/month) ($p<0.05$). Correspondingly, the proportion having HDOs differed between reasons for athletic career ending ($p<0.001$): HDOs were more common among former athletes if their athletic sports career had ended suddenly by sports injury (35.8 %) or enthusiasm had ended (43.5 %) compared to age (12.0 %) or disease (28.4 %).

Reasons for quitting active sports career among former athletes were not associated with smoking status ($p=0.21$). Controls smoked more than former athletes at all surveys ($p<0.0001$). In 1985 31 % of controls and 21% of former athletes were current smokers, while 9 % of controls and 5 % of former athletes were current smokers in 2008 (For more details see Table S1, Supplemental Digital Content 1). Finally, current and ex-smokers consumed more alcohol than non-smokers in 1985 ($p<0.05$).

A bivariate cross-lagged path model

The specific bivariate cross-lagged model fitted well to the data (Model fit: Chi^2 (d.f.=9)=10.29, p=.328, RMSEA=0.007, CFI=0.999, TLI=0.997 and SRMR=0.018 (see Figure S4)). R-squares (R^2) and standardized regression coefficients for stability of PA and use of alcohol between consecutive time points are given in Supplemental Table for all participants, former athletes and controls (see Table S3, Supplemental Digital Content 3). R^2- values for use of alcohol in 1995, 2001 and 2008: 0.74, 0.82 and 1.00. R^2- values for PA in 1995, 2001 and 2008: 0.66, 0.84 and 0.73 (PA 2008) (for more details, see Table S3 and Figure S4). Among all participants there was only one statistically significant cross-lagged regression coefficient -0.10 (beta) from use of alcohol in 1995 to PA in 2001 (p<0.001). Correspondingly, the correlation of -0.14 between use of alcohol and PA was statistically significant only in 1985 (p<0.001) (see Figure S4, Supplemental Digital Content 4). There was no interaction between athletic status and the use of alcohol ($\chi^2(12) = 14.55, p = 0.267$).

Latent profile analysis (LPA)

According to the Adjusted Lo-Mendell-Rubin likelihood ratio test (AdjLMR) tests the five latent profile solution fitted to the data best. At least five latent profiles were supported by the BIC (see Table S5, Supplemental Digital Content 5). Even if the BIC value decreased to the six latent profile solution the mean profiles for two latent classes were very similar. So, we decided upon the five latent profile solution. In the Figure 2 the mean values of PA and use of alcohol (standardized using whole data) and estimated proportions of smoking status showed that the longitudinal profiles were very stable across measurements. Confidence intervals for key estimates are presented in Supplementary Tables S6b (standardized) and S6c (distributions).

Profile 1 (total 14.0 % (n=317)) included participants who were physically inactive, used more alcohol than average and did not smoke. Profile 2 (21.7 % (n=494)) included participants who were physically inactive, used average amounts of alcohol, but smoked more than average. Profile 3 (30.8 % (n=700)) included participants who were physically inactive, used less alcohol and were average smokers. Profile 4 (15.4 % (n=351)) included participants who were highly physically active, used less alcohol and smoked less than average. Profile 5 (18.1 % (n=413)) included participants who were highly physically active, used alcohol and smoked more than average (Figure 2).

During follow-up, PA decreased in profile 1, while the use of alcohol both increased and decreased, and smoking decreased ($p<0.05$). In profile 2 PA and the use of alcohol increased, but smoking decreased over time ($p<0.05$). In profile 3 PA, the use of alcohol and smoking decreased ($p<0.05$). In profile 4 PA decreased, the use of alcohol increased and smoking decreased over time ($p<0.05$). In profile 5 there was very little change in PA and the use of alcohol between surveys, but smoking decreased ($p<0.05$) (for more details, see Figure 2 and Supplemental Digital Contents 6 and 7, tables S6b-c and description).

Profile 4 differed from other profiles in PA at every timepoint ($p<0.05$), but profiles 1 and 3 did not differ from each other. There was a significant difference in the use of alcohol between all profiles at every timepoint ($p<0.05$), except profiles 1 and 2 did not differ from each other at baseline (1985) (Figure 2). Furthermore, there were statistically significant differences in the proportion of current smokers between profiles at all timepoints, but profiles 3 and 4 as well as profiles 2 and 5 did not differ from each other (for more details, see Figure 2 and Supplemental Digital Contents 6 and 7, tables S6b-c and description).

Average Latent Class Posterior Probabilities (AvePP) showed a clear distinction of latent profiles, which were 0.90, 0.87, 0.83, 0.90 and 0.94 for latent profiles 1-5. Probability of former athletes (62.0 % (n=1410)) belong to profile 1 was 0.17, profile 2 was 0.15, profile 3 was 0.28, profile 4 was 0.21 and profile 5 was 0.19, whereas probability of controls (38.0% (n=864)) belong to profile 1 was 0.09, profile 2 was 0.33,

profile 3 was 0.35, profile 4 was 0.06 and profile 5 was 0.17 (Figure 3). There was statistically significant difference between former athletes and controls in probability belong to profiles 1-4: profile 1 ($p=0.002$), profile 2 ($p<0.001$), profile 3 ($p=0.002$), profile 4 ($p<0.001$), but not profile 5 ($p=0.31$). Neither mean values of PA and use of alcohol nor proportion of smoking did not differ statistically significantly between former athletes and controls in any profile.

Profile distributions of covariates are presented in tables and figures in supplemental digital contents 6 and 8.

DISCUSSION

Main findings

Former athletes were more physically active and smoked less than controls at all four time points. In contrast, former athletes consumed significantly more alcohol compared to controls only in the 1985 questionnaire study, but not later. Among all participants there was only one statistically significant cross-lagged regression coefficient from use of alcohol in 1995 to PA in 2001, and correspondingly the correlation between use of alcohol and PA was statistically significant only in 1985. The use of alcohol was higher among former athletes especially if their athletic sports career had ended suddenly by sports injury or enthusiasm had ended compared to age or ill-health as reasons for career termination.

We found five latent profiles, and there was a statistically significant difference between former athletes and controls in probabilities of belonging to profiles 1-4, but not profile 5. Within profiles, PA, use of alcohol, and the proportion of smokers did not differ between former athletes and controls in any profile. This indicates that the latent class profiles captured distinct longitudinal lifestyle characteristics of ageing

middle-aged men. Former elite athletes differ from healthy controls in the probability of belonging to a specific profile. Former athletes belonged more likely than controls to profile in which individuals were more physically active, used less alcohol and smoked less. Changes in profile means were seen: generally PA and smoking decreased but alcohol consumption could also increase during the follow-up.

Strengths and limitations of our study

This long-term follow-up study revealed new information on the associations between PA and health-related behavior in middle-aged and aging men. The large study population and long follow-up time were strengths of this study. Self-reported data on health-related behaviors include known limitations, but our questions on PA,[29] smoking[33] and the use of alcohol[34] have been previously validated. Because these former athletes competed at top-level before 1965, we cannot predict whether these results can be generalized to today's elite athletes or athletes who had competed in lower level, to non-athletes or to women. Additionally, the controls were fit enough for military participation which considerably limits the generalisability of this study findings to general population, but it increases the comparability between former athletes and controls. Furthermore, it is generally known that today's elite athletes have more progressive training methods, better equipment, techniques, specializations and more specific coaches with better knowledge of such as biomechanics, nutrition and psychological factors compared with elite athletes in the past.

Comparisons with other studies

Binge drinking and alcohol-related harms are generally known among current athletes.[16-18] But there is a paucity of evidence on the longitudinal course of drinking among current[16] and former athletes and how vigorous PA is associated with alcohol consumption and smoking among former athletes several decades after their peak sporting performance.

Current athletes smoke less than non-athletes as we have shown in previous studies on this cohort[10,13-14] but also by other investigators.[11-12] Furthermore, our findings were partly consistent with other studies that have shown that active athletes consume more alcohol than non-athletes.[16-18] Former athletes consumed more alcohol than controls in the 1985 questionnaire study, but there were no differences later.

Of note is that use of alcohol was higher among those former athletes especially if their athletic career had ended suddenly by sports injury. The role of unplanned change in PA with later increase in alcohol use is consistent with our previous observation that alcohol consumption was greater if participation in leisure-time sports was discontinued after athletic career.[14] Other studies have also observed that if an active sports career ends unexpectedly and an individual has a high athletic identity, adaptation to athletic retirement will be challenging [24] and it might lead to alcohol-related problems.[25] According to Chambers (2002) alcohol-related problems were associated with disability and adaption to life after athletic career among former ice-hockey players.[25] Some studies suggest that sports-induced pressure, peer- or teammate-induced influence, and competitive nature of athletes, might be related to heavy use of alcohol among young athletes.[16,35] Additionally, most alcohol-related risk factors, such as familial and sociodemographic factors, among the general population may also be applicable to current and former athletes.[16] It has been indicated that different factors can predispose to alcohol-related problems in different ages.[36] Studies have found that retirement can lead to increased binge drinking among older people, who may use alcohol to combat loneliness and counter boredom.[21-23]

Finally, we found that PA did not predict later alcohol consumption at any time point. However, findings of the latent profile analysis reflected the overall decrease in PA with age which is consistent with other studies.[37-39] Correspondingly, smoking decreased in all profiles during the follow-up, reflecting the strong decrease of smoking among Finnish men in the same time. However, the use of alcohol both increased and

311 decreased during the follow-up, reflecting the overall increased consumption of alcohol in Finland in the
312 1980s, 1990s and early 2000s.
313
314 **Future directions**
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316 There is less studies focused on assessing the effect of interventions implemented in sports settings on
317 alcohol consumption.[40] Additionally, further studies will be needed to examine the associations between PA,
318 alcohol consumption and smoking among today's athletes, non-athletes or women. A deeper understanding
319 of the relationships between PA, the use of alcohol and smoking is necessary to determine the true
320 consequences of alcohol and tobacco on health and well-being among current and former athletes.
321
322 **CONCLUSIONS**
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324 Former athletes have distinct profiles from non-athletes with respect to PA, alcohol and smoking. However,
325 PA did not predict later alcohol consumption at any time point. Although alcohol consumption may increase
326 in individuals, whose athletic career has ended suddenly by sports injury, overall PA and alcohol affected
327 each other's development only modestly over a 23 year follow-up.
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Contributors

SS, JK and UMK collected the data. TKK and AT analyzed the data. TKK drafted the manuscript. All authors contributed to study design, and the revision of the manuscript, and accepted the final version. The authors apologize for not being able to cite all the noteworthy work in this area because of constraints on space.

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Competing interest

None.

Ethical approval

This study was conducted according to good clinical and scientific practice and the Declaration of Helsinki. The authors declare that the results of this study are presented clearly, honestly, and without fabrication, falsification or inappropriate data manipulation. Approval for questionnaire data collection was given by The ethics committee of the Hospital District of Helsinki and Uusimaa, and the Ministry of Social Affairs and Health in Finland. All the participants gave informed consent by returning the questionnaires, which were accompanied by a cover letter explaining the purpose of the study.

Data sharing

The former athletes are well known persons in Finnish society; hence the data cannot be openly shared. Researchers are encouraged to contact the authors and we will make every effort to accommodate additional analyses.

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Table 1. Number of participants alive in 1985, 1995, 2001 and 2008.

Sports groups	Participants alive in 1985		Questionnaire responders in 1985		Participants alive in 1995		Questionnaire responders in 1995		Participants alive in 2001		Questionnaire responders In 2001		Participants alive in 2008		Questionnaire responders in 2008	
	(N)	Mean age (SD)	(N)	Mean age (SD)	(N)	Mean age (SD)	(N)	Mean age (SD)	(N)	Mean age (SD)	(N)	Mean age (SD)	(N)	Mean age (SD)	(N)	Mean age (SD)
1. Endurance	287*	61.0 (11.4)	226	60.6 (11.1)	219	68.0 (9.4)	170	67.9 (9.1)	177	72.0 (8.2)	132	71.6 (8.4)	134	76.9 (7.0)	121	77.1 (6.7)
2. Mixed sports	769†	55.2 (11.1)	607	54.9 (10.8)	633	62.4 (9.1)	467	62.6 (9.0)	561	67.3 (8.3)	415	67.1 (8.0)	449	72.5 (7.1)	396	72.6 (6.9)
3. Power sports	577‡	58.3 (11.4)	443	57.5 (10.7)	413	64.1 (8.8)	300	64.2 (8.3)	341	68.6 (7.8)	234	68.5 (7.7)	257	73.8 (6.8)	230	74.1 (6.8)
All athletes	1633	57.3 (11.5)	1276	56.8 (11.0)	1265	63.9 (9.3)	937	64.1 (9.0)	1079	68.5 (8.3)	785	68.3 (8.1)	840	73.6 (7.2)	747	73.8 (7.0)
Controls	1099	55.6 (10.6)	777	55.0 (10.3)	832	62.5 (8.7)	576	62.2 (8.1)	683	67.1 (7.6)	416	66.9 (7.0)	529	72.6 (6.5)	436	72.8 (6.3)
Total	**2732**	**56.4 (11.1)**	**2053**	**56.1 (10.8)**	**2097**	**63.4 (9.1)**	**1513**	**63.3 (8.7)**	**1762**	**67.9 (8.0)**	**1201**	**67.9 (7.8)**	**1369**	**73.2 (6.9)**	**1183**	**73.4 (6.8)**

Data are numbers in 1985.
*Long distance running 128, middle distance running 66, cross-country skiing 93.
†Soccer 199, ice hockey 144, basketball 80, high jump 39, pole vault 43, long jump 26, triple jump 30, hurdling 74, short distance running 99, decathlon 35.
‡Weightlifting 91, boxing 177, wrestling 182, shotput 29, discus 29, javelin 41, hammer 28.

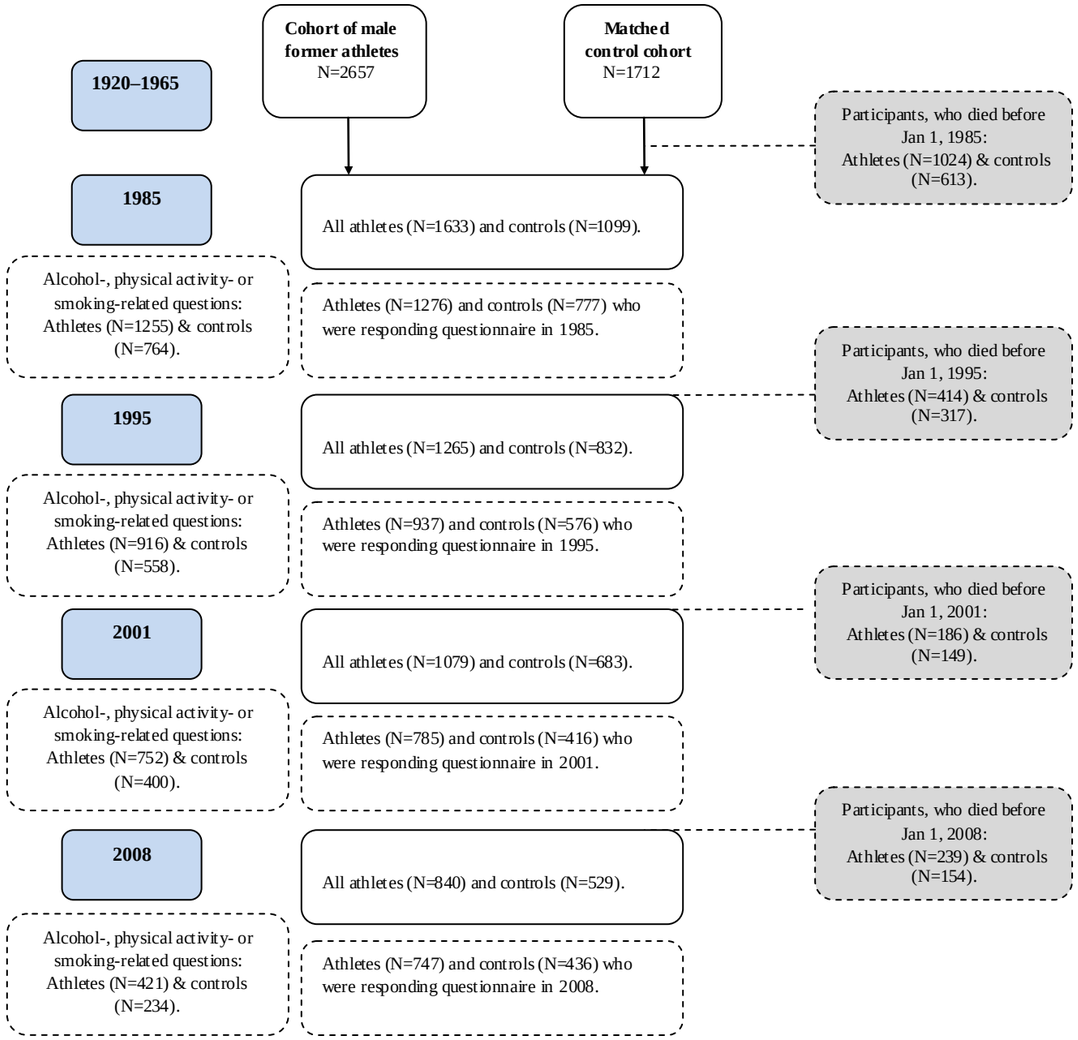


Figure 1. Study profile.

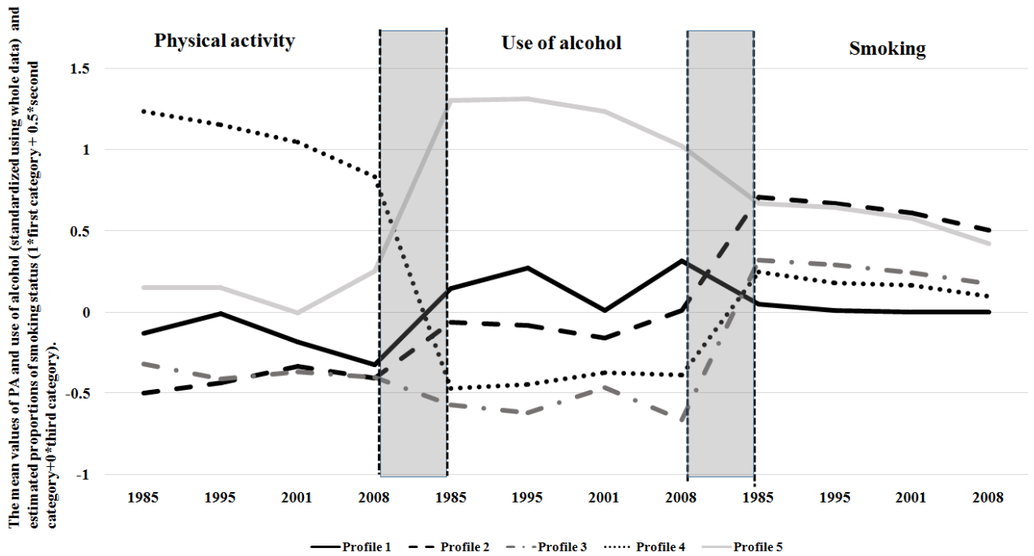
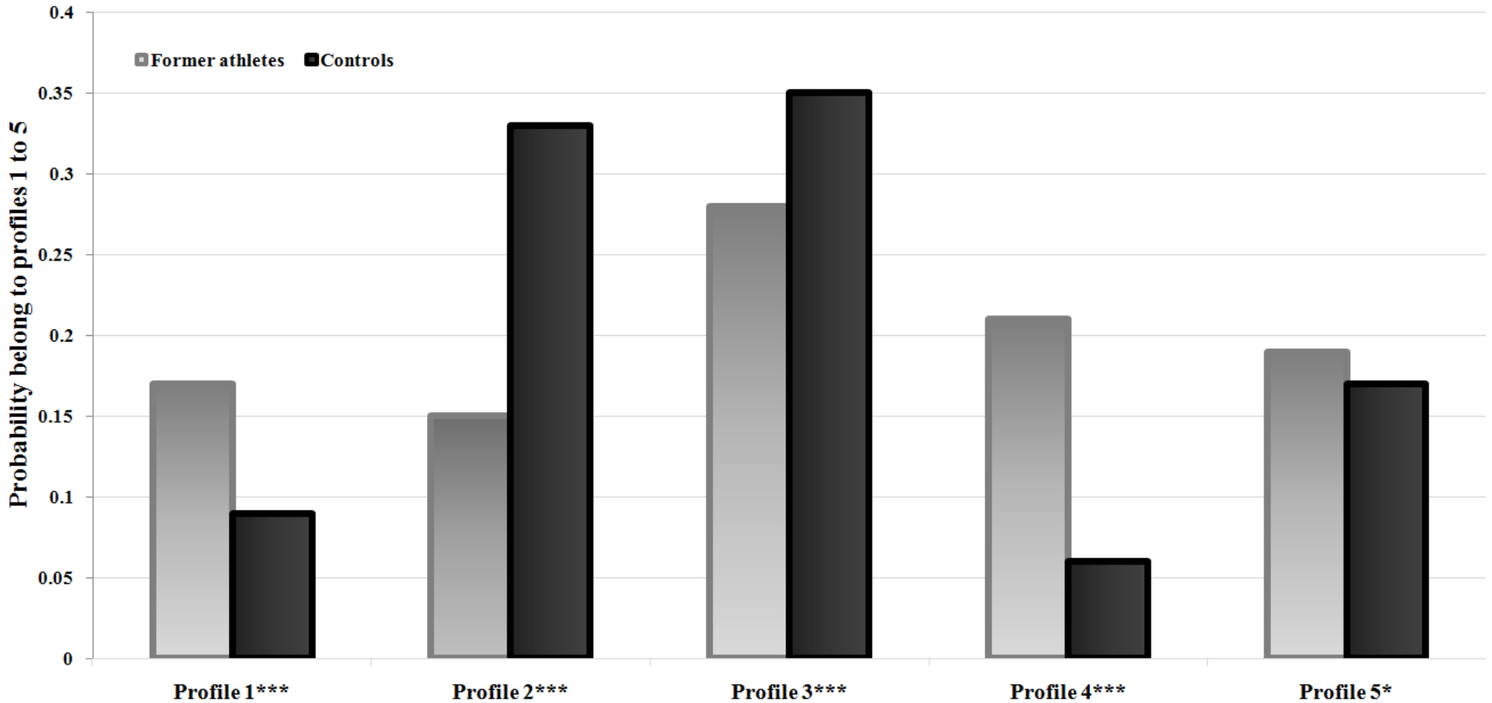


Figure 2.Characteristics of the 5 profiles from LPA among all participants.



*****p<0.005, *p=0.309 (P-values for the probability distributions across 5 latent classes separately for athletes and controls)**

Figure 3. Probability of former athletes and controls to belong to profiles 1 to 5.