Longevity of Soccer Players -

An Investigation of all German Internationals from 1908-2006

Running title: Longevity of German International Soccer Players

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Abstract

Leisure-time physical activity is associated with better health and a reduced risk of all-cause mortality. It is unclear if this association is also present with a high level of physical activity as it is found in professional athletes. In a population based retrospective cohort study we compared the survival experience of all soccer players participating for Germany in international matches between 1908 and 2006 to that of the general population. To summarize survival experience, we calculated cumulative relative survival ratios from a life table. We included data of 812 international players, of which 428 (=52.7%) died during follow-up. In all of 13 life table intervals, the number of observed deaths was larger than those expected from the general population, resulting in a relative survival ratio below one. The resulting cumulative relative survival ratio was statistically significantly different from 1 in all but the last interval. We conclude that soccer players participating in international matches for Germany have shorter longevity than the general population. This finding is in line with the current knowledge of life expectancy in major athletes, especially those from team sports.

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Introduction

It is commonly accepted that leisure-time physical activity is associated with better health and a reduced risk of cardiovascular and all-cause mortality. This association was observed in numerous studies, most of which already reflected in reviews[1-4], and guidelines on the recommended amount of physical activity have been issued[5].

However, the situation is less clear with a high level of physical activity as it is commonly found in professional athletes. A review of all studies up to 1956 found that "physically demanding programmes of competition had no significant effect on longevity"[6]. Similar results were later reported for rugby players from New Zealand[7], professional baseball players from the US[8], and Danish male athletic champions[9]. Thus, Chandrashekhar/Anand concluded in 1991, that "there are now considerable data rejecting the hypothesis that major athletes have survival benefits."[10]. However, reduced mortality was observed in Polish athletes who participated in the Olympic Games[11], and in Finnish world class male athletes[12;13]. Consistent with these findings also Finnish long-distance skiers[14] and Dutch ice skaters[15] have a lower standardized mortality ratio (SMR) as compared to the general population. However, the SMR was higher for the more successful competitors as compared to less successful competitors, suggesting a gradient for reducing life expectancy with an increase in sports intensity. Considering different disciplines there seems to be a real advantage for athletes in endurance sports[12-14] or in tracks and fields[6;16], whereas this advantage was smaller or not existing in team sports[6-8] and in power sports[12]. However, a recent review still bemoans "a paucity of existing studies on mortality and longevity of elite athletes" and calls for further studies to examine elite athletes from a wide variety of sports[17]. And although soccer is the most popular sport worldwide, there is a lack of studies on the mortality or longevity of soccer players. Therefore, the objective of this study is to analyze survival and its determinants in German

professional soccer players who participated in an international match as compared to the general population.

Methods

To compare the observed survival in our cohort of internationals to the expected survival of the general population, we used the relative survival method[18]. In relative survival, each member of the cohort is matched to a virtual control from the general population where the matching is for age, sex and calendar-time. Observed survival in the study cohort is then compared to the expected survival in the virtual controls by calculating a ratio of observed and expected survival, the so called relative survival ratio (RSR). Relative survival aims to separate mortality due to the exposure of interest (here, having participated in an international soccer match) from mortality due to other underlying causes (exposures), thus giving an estimate for the mortality attributable to the exposure of interest.

Information on all German internationals from 1908 to 2006 was achieved from the annual almanac of the most popular German soccer magazine[19] and complemented by the respective German Wikipedia page[20]. We included all internationals who ever played an international match for the German soccer federation (Deutscher Fußball-Bund, DFB). We recorded date of birth, date of death, date of first and last international match, and number of international matches. The date of the last international match was defined as the entry time into the cohort. The outcome of interest was time to death or censoring. An international being alive at 2006-12-31 was considered censored. Published age-, sex-, and calendar-time-specific mortality rates were achieved from the National Statistical Office (Statistisches Bundesamt)[21;22]. We intra- and extrapolated missing values in the mortality tables (e.g., above the age of 90, or in time periods where mortality rates are published only in each third year) by natural splines. Expected survival was calculated by the Ederer II[23] method.

Observed, expected, and relative survival is presented in a life-table. To achieve this, follow-up time was divided in 13 intervals of variable length to ensure that each interval had at least 30 observed events. Confidence intervals for the relative survival ratio were calculated by using the complementary log-log transformation[24] to guarantee complete intervals lying within [0,1]. To assess dose response relationship for exposure to participation in international matches we evaluated the effect of “age of first international match”, “number of international matches”, and “years as international” by computing an Estève[25] regression model. Parameters from this model can be interpreted (after exponentiation) as relative excess risks for the respective covariate.

Information on the date of death was incomplete in several cases. In cases where only the year of death or the month and the year of death were given, we randomly selected a date of death in the respective interval. We performed a sensitivity analysis for this imputation strategy where missing dates were set to the middle of the respective interval. Results from this sensitivity analysis were essentially equal to the analysis with randomly selected dates. Cases where date of death was missing completely were deleted as these contribute no information to longevity.

Results

Data on 847 internationals were retrieved initially. In 21 cases only the year of death and in 17 cases only the month and the year of death was given. In 35 cases, the date of death was missing completely. These 35 internationals were deleted, so the final analysis included 812 internationals. Table 1 gives characteristics of the cohort. Median follow-up, that is the time until death or censoring, was 35.0 years, and total follow-up amounted to 25,972.8 person-years. Internationals had their first match at a median age of 23.7 and their last at a median age of 26.6. Median number of matches was 4, and median time as an international was 1.5 years. 428 of the 812 (=52.7%) internationals died in the follow-up time.

Table 2 gives the life table for the cohort, and figure 1 additionally shows cumulative observed and expected survival and the resulting cumulative relative survival ratio. In all 13 intervals, the number of observed deaths was larger in our cohort than those expected from the general population, resulting in a relative survival ratio below one. The resulting cumulative relative survival ratio was statistically significantly different from 1 in all but the last interval, where the number of cases became too small.

In Table 3 we report on the influence of the three exposure quantification models. Excess mortality is significantly diminished only for a higher age at the first international match. The earlier a soccer player becomes an international, the higher is his risk for dying earlier than expected. Each year increase in age at first international match reduced the excess risk of dying by 28.5% (= 1 - 0.715) as compared to the general population.

Discussion

The present study showed that soccer players participating in international matches for Germany have reduced longevity compared to the general population. This disadvantage was the larger, the earlier the international soccer player started his international career. This finding is in line with the current knowledge of life expectancy in major athletes, especially those from other team sports[6-8].

Tracey/Elcombe[26] hypothesize that three mechanisms could negatively impact lifelong health behaviour of professional athletes after finishing their career: The first mechanism is the atypical physical behaviour in professional sports. Major athletes in general accept regular pain, injury, use of performance enhancing substances and irregular weight changes during their career, and might have difficulties to abandon these behaviours afterwards. These behaviours could contribute to the reduced survival of soccer players. The second mechanism is the purely utilitarian attitude towards physical activity by athletes. During their career, they are used to externally dictated, highly intense training regimes, creating a training mentality with physical activity as a sole means to the end, irrespective of potential health benefits of physical activity. In the post-competitive phase there is no longer a need of training and former athletes are thus vulnerable for giving up physical activity completely. The third mechanism concerns the athletic identity of previous major sportsmen. After their career they lose physical fitness and strength on one hand, attention and interest from the public. These negative experiences are attributed to sports and might lead to stop physical activity. Finally (and not mentioned by Tracey/Elcombe), physical disability due to excessive training (such as joint arthrosis) could obviate later physical activity, leading to an accumulation of biological risk factors such as hypertension, obesity and hyperlipoproteinemia.

It is a clear limitation of our study that we cannot assess any of these hypotheses because we have no data on health behaviour of our internationals after their soccer careers. Moreover, by using the relative survival method we are implicitly assuming that our internationals are a representative sample from the general population. It might be the case that different patterns of life style factors and confounders in internationals might be responsible for the excess mortality, resulting in an a priori lower life expectancy, independent of their sports career. However, if would have been extremely difficult, especially before 1950, to recruit a control person for each international.

Practical implications

- After their career international soccer players should be motivated to maintain moderate physical activity.
- A sound medical monitoring of international soccer players is necessary also after their career.
- Health education and the communication of behavioural risk factors should start as early as possible for professional athletes.

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Table 1

Table 1: Description of all 812 internationals

Variables	Median	[Min, Q1, Q3, Max]
Age at first international match	23.7	[17.3, 21.7, 25.9, 34.5]
Age at entry in cohort (= last international match)	26.6	[18.1, 24.2, 29.6, 39.4]
Time in cohort (until death or censoring)	35.0	[0.1, 16.6, 47.2, 71.9]
Age at death or censoring	61.9	[21.1, 44.3, 73.7, 96.0]
Number of international matches	4	[1, 1, 14, 150]
Years as international	1.5	[0, 0, 4.7, 20.0]

Table 2

Table 2: Life table for the cohort of initially 812 internationals. Intervals in the table are given in years within cohort.

Left endpoint of interval (years)	Right endpoint of interval (years)	Number of internationals alive at start of the interval	Number of observed deaths in the interval	Number of censored observations	Expected deaths in the interval	Cumulative observed survival	Cumulative expected survival	Cumulative relative survival ratio [95%-CI]
0	7	812	30	74	12.7	0.961	0.984	0.977 [0.961, 0.989]
7	16	708	30	58	16.0	0.919	0.960	0.957 [0.934, 0.975]
16	25	620	30	67	21.6	0.872	0.925	0.942 [0.913, 0.967]
25	33	523	33	56	32.6	0.814	0.864	0.942 [0.904, 0.974]
33	37	434	30	24	28.3	0.756	0.806	0.938 [0.892, 0.978]
37	40	380	34	20	26.4	0.686	0.749	0.917 [0.863, 0.966]
40	44	326	37	29	37.6	0.605	0.658	0.919 [0.853, 0.980]
44	47	260	37	8	32.7	0.517	0.574	0.901 [0.823, 0.976]
47	50	215	32	23	31.6	0.436	0.485	0.899 [0.805, 0.991]
50	53	160	35	10	30.4	0.338	0.390	0.866 [0.750, 0.983]
53	55	115	32	2	19.0	0.243	0.325	0.747 [0.619, 0.882]
55	59	81	37	4	26.7	0.129	0.215	0.601 [0.449, 0.775]
59	75	40	31	9	30.5	0.016	0.030	0.544 [0.197, 1.225]

Table 3: Results from the Estève[25] regression model in terms of the relative excess risk with corresponding confidence intervals and p-values.

Variables	Relative excess risk	[95%-CI], p-value
Age at first international match	0.715	[0.594, 0.860], p=0.0004
Number of international matches	0.813	[0.634, 1.043], p=0.104
Years as international	0.986	[0.728, 1.337], p=0.929

Figure 1

Figure 1: Cumulative observed survival, cumulative expected survival and the resulting cumulative relative survival ratio for the cohort of initially 812 internationals. Dashed black lines give 95% confidence intervals for the cumulative relative survival ratio for each life table interval. Units on the Y-axis should be read as probabilities for cumulative observed and expected survival, and as a ratio for the cumulative relative survival ratio (RSR).