All causes mortality in male professional soccer players

Emanuela Taioli

**Background:** Despite the great public concern for the health status of professional soccer players, no formal study on mortality from all causes in soccer players has been performed so far. A study on mortality rates of professional soccer players in Italy between 1975 and 2003 was conducted.

**Methods:** A total of 5389 players, age 14–35 years at enrollment were identified from public sources, and actively followed up for vital status from birth up to 31 December 2003, for 204 125 subject-years of follow-up. Overall and cause-specific mortality rates were calculated; expected number of deaths was calculated by applying the calendar period and age cause-specific mortality rates for men to the cohort of soccer players. The ratios between the observed and expected deaths gave the Standardized Mortality Ratios. **Results:** Deaths from diseases of the circulatory system, cancer and immune deficiency were significantly lower than expected. The SMR for car accidents was 2.23 (95% CI 1.46–3.27). There were four deaths for Amyotrophic Lateral Sclerosis (ALS), and 0.2 expected, giving a SMR of 18.18 (95% CI 5.00–46.55). **Conclusion:** The public health impact of these findings has to be balanced against the significant observed lower mortality for cancer and cardiovascular disease. However, the early age at death, and the youthful composition of the cohort pose questions on the relative weight of ALS mortality in this population in the coming years.

**Keywords:** cohort study, epidemiology, SMR

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**Introduction**

The health status of professional soccer players has been of great concern in recent years, because of the anecdotal reports of a large number of cases of Amyotrophic Lateral Sclerosis (ALS), a highly lethal degenerative disease of the motor neuron with very poor prognosis, inconsistently associated with vigorous physical activity, major injuries, the possible use of drugs to improve performance, and the exposure to pesticides sprayed on the playing fields.

Despite anecdotal information on increased ALS and cancer in athletes, no formal study on all causes of mortality in soccer players has been performed so far, in order to obtain a complete picture of the health status of this population. Two studies appeared recently, one addressing the possible increased morbidity, defined in the paper as mortality plus increased prevalence, of ALS in 7325 male professional soccer players who were active between 1970 and 2001, and another on proportional mortality rates in 24 000 active Italian soccer players from 1960 to 1996. Despite the fact that both studies suggested a significant increased risk in ALS, neither of these two studies was designed to address the question of whether professional soccer players experienced a higher mortality rate for some specific disease during their lifetime, since neither study included the complete follow-up of the whole cohort. The first study was focused on ALS only, the second study could only calculate proportional mortality rates, which is a relative measure of risk.

Under direct funding by the Italian Minister of Health, a study on mortality rates from all causes of professional soccer player was conducted, by reconstructing the cohort of players who were enrolled in the Italian professional A and B leagues starting in 1975, and by actively following them up for vital status up to 31 December 2003.

**Materials and methods**

A study of soccer players who were enrolled in the Italian A and B professional leagues for at least one season, between the years 1975 through 2003 was conducted. A total of 5389 players, age 14–35 years at enrolment, were identified through a complete collection of public information on Italian soccer teams published and furnished by the Italian branch of the Panini Company (www.almanaccopanini.it). The following information was extracted and computerized: first and last name, date and place of birth, position played, date and age of the first appearance in an Italian or foreign Championship, total official games played, last year played in A or B league, height and weight as recorded by the Panini Company at the time of first appearance as professional player. The protocol of the study and its ethical aspects were approved by the Research Committee of the Directorate for Research of the Italian Ministry of Health, which reviewed and approved the complete procedure for ascertainment and follow-up of the cohort.

**Ascertainment of vital status**

All the players were actively followed up for vital status from birth up to 31 December 2003, for a total of 204 125 subject-years of follow-up. The ascertainment of vital status of all players was conducted by one person, who applied the following strategies. First, the National Retirement System for Sport and Actors (ENPALS, www.enpals.it), a private pension fund that enlists athletes, actors and television workers was contacted, and asked to furnish a list of players who were still active in the system because they were either receiving or paying monthly pension premium, and were therefore alive. This gave information on the vital status of 1727 players. For the remaining players, we obtained permission by the Italian National Revenue System to search their database. Through a personal, protected password which gave access to the yearly tax payments, we were able to identify through the first and last name, date and place of birth the Vital Status of all the remaining players.
last name, and date and place of birth, 708 additional players who were paying taxes as of 31 December 2003, and therefore were considered alive at that date. For all the remaining players \((n = 2954)\) a formal written request was mailed to the most recent city of residence reported in the electronic database of the Italian National Revenue System, asking for the vital status of the person. Every city in Italy maintains by law an updated electronic register of residents. We were able to obtain the vital status of a further 1743 players through this source. For the remaining 1211 players we searched Internet websites dedicated to soccer and to newspapers, and considered alive players for whom we were able to document an activity (such as giving a lecture, presenting a television program, etc) as of or after 31 December 2003 in at least two different unrelated websites. This search confirmed that 1031 of the missing players were alive at the time of end of follow-up.

As a result of these searching strategies, 5146 players were confirmed to be alive, while 63 were confirmed to have died during the follow-up. For an additional 116 players \((2.2\%)\), the follow-up was incomplete, dating between 11 years and 6 months before the established end of follow-up for this study. For 64 players \((1.1\%)\), the last day of follow up coincided with the last year of presence in a professional soccer team, since none of the search strategies produced any further follow-up information. In this last case, we used as the last date of follow-up the most recent date in which they played in the Italian Championship, as reported by the Panini Company information. A total of 180 soccer players had an incomplete follow-up (average length of follow-up, 15 years), 18 \((10\%)\) were born between 1939 and 1949, 52 \((29\%)\) during the years 1950–59, 60 \((33\%)\) during 1960–69, 38 \((21\%)\) during 1970–79 and 12 \((7\%)\) during 1980–84. Seventy players \((39\%)\) were foreign born. Players who were born in Italy did not result dead at their most recent city of residence.

### Search for causes of death

Sixty three players were confirmed dead by the electronic register of residents, which also furnished a date and a place of death. We formally requested a death certificate from each Regional Public Office that geographically covered the indicated place of death. These offices routinely collect and computerize the causes of death of the resident population. A standard request letter was mailed, wherein each subject was identified with last and first name, date and place of birth, date and place of death. A total of 46 copies of the original death certificates were obtained using this system. For the remaining 17 players, 13 had died in car accidents; in three cases, the date and cause of death was reported by the official website of the Italian Championship, as reported by the Panini Company information. A total of 180 soccer players had an incomplete follow-up (average length of follow-up, 15 years), 18 \((10\%)\) were born between 1939 and 1949, 52 \((29\%)\) during the years 1950–59, 60 \((33\%)\) during 1960–69, 38 \((21\%)\) during 1970–79 and 12 \((7\%)\) during 1980–84. Seventy players \((39\%)\) were foreign born. Players who were born in Italy did not result dead at their most recent city of residence.

### Statistical analysis

#### Mortality rates

Overall mortality rate, and mortality rates according to cause of death were calculated as the ratios between the number of deaths and the total number of subject-years of follow-up. For this purpose, subject-years of follow-up were calculated from the date at the first appearance in an Italian or foreign Championship (as indicated by Panini Company) until 31 December 2003, or the date of death or the date of the last follow-up, for a total of 101 878 subject-years of follow-up.

#### Methods for deriving the expected number of deaths and for calculation of Standardized Mortality Ratios (SMRs)

The expected number of deaths for each cause was calculated by applying the cause-specific mortality rates for men, stratified by calendar period and where possible by age, to the cohort of soccer players. Expected rates were calculated for men aged 15–69 years, in order to represent the age range observed in the cohort of soccer players.

For cancer, age and time-specific mortality rates were derived from the Italian coordination of cancer registries (www.registri-tumori.it/incidenza/main.htm) rather than national mortality data because the latter does not contain data on cancer-specific sites. Data from 1998 to 2002 were reported in: http://www.registri-tumori.it/incidenza1998–2002/main.htm, while historical data were reported in http://www.registri-tumori.it/pubblicazione/Trend_Airt.PDF.

We also referred to the Cancer Institute website to complete the data collection (http://www.istituttonommi.mi. it/mensatributo/diparclinici/epidemiologia/framesregisteri. asp?name=stat.pdf). Mortality rates for ALS were obtained from two publications \(^5\) relative to the calendar periods 1975–89 and 1979–2001 in US. A publication on ALS mortality from Italy during the period 1990–2003 did not include age- and gender-specific mortality rates.\(^7\)

The expected number of deaths for car accidents and suicides were calculated, respectively, from the mortality rates provided by the Italian Car Association (http://www.aci.it/wps/ portal, rates are not stratified by age) and by a study on suicides in Italy.\(^8\)

The age- and calendar period-stratified mortality rates for the diseases of the circulatory system and for AIDS were obtained from the Italian National Institute of Health website (http://www.iss.it/site/mortalita).

The SMRs according to each cause of death were calculated as the ratios between the number of observed and the number of expected deaths. The exact confidence intervals for SMRs were obtained using the Poisson distribution\(^9\) using the STATA software.

The independent contribution on survival of body mass index, age at starting professional activity, years of professional activity and number of participations in official games was assessed performing a survival analysis using Cox’s survival methods (PHREG procedure of the SAS statistical package; SAS Institute, Inc., Cary, NC, USA). The end point event was death for all causes, and then cause-specific death. Players were censored at 31 December 2003, or at the end of follow-up.

### Results

Table 1 describes the general characteristics of the studied population. There were very few differences among the players with a complete or a partial follow-up, aside from the fact that the latter had a shorter career and played significantly less
games in the Italian championship, as expected \( (P\text{-value} < 0.001) \). The stature of players who died during the follow up was significantly different than that of players who were alive at the end of their career; players who died were less likely to have been a goalkeeper during their career, although this last difference was not significant. During the follow-up, 63 deaths were recorded, \( (\text{mortality rate: } 61.84 \times 100\,000) \). The average age at death was 36.3 ± 10.3 years.

The distribution of deaths according to calendar period, age and type of death are reported in table 2. As expected, the number of deaths increased over the calendar period, due to the aging of the population. Most of the events were concentrated in two age groups: 20–24 and 35–39 years of age.

The cause-specific mortality rates (table 3) indicates that deaths form diseases of the circulatory system, cancer and immune deficiency were significantly lower than expected.

The most common reported cancer was colon, followed by leukaemia and lymphoma. No substantial differences in the SMR were observed across calendar years; no significant excess risk of cancer as a whole, or of any type of cancer was observed in this population. Only mortality for mesothelioma was 3-fold higher than expected, although the data were not

### Table 1 Description of the study population

<table>
<thead>
<tr>
<th>Position played in the professional team</th>
<th>Players who were alive at the end of follow up (%)</th>
<th>Players with partial follow-up (%)</th>
<th>Players who died during the follow-up (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward</td>
<td>1084 (21.1)</td>
<td>47 (26.1)</td>
<td>13 (20.6)</td>
</tr>
<tr>
<td>Midfielder</td>
<td>1985 (38.6)</td>
<td>78 (43.3)</td>
<td>29 (46.0)</td>
</tr>
<tr>
<td>Defender</td>
<td>1434 (27.9)</td>
<td>36 (20.0)</td>
<td>18 (28.6)</td>
</tr>
<tr>
<td>Goalkeeper</td>
<td>604 (11.7)</td>
<td>18 (10.0)</td>
<td>3 (4.8)</td>
</tr>
<tr>
<td>Multi role</td>
<td>5146</td>
<td>1 (0.06)</td>
<td>0</td>
</tr>
</tbody>
</table>

### Table 2 Observed deaths by age at death and calendar period

<table>
<thead>
<tr>
<th>Age class at death</th>
<th>Calendar period</th>
</tr>
</thead>
<tbody>
<tr>
<td>15–19</td>
<td>0</td>
</tr>
<tr>
<td>20–24</td>
<td>2</td>
</tr>
<tr>
<td>25–29</td>
<td>1</td>
</tr>
<tr>
<td>30–34</td>
<td>1</td>
</tr>
<tr>
<td>35–39</td>
<td>1</td>
</tr>
<tr>
<td>40–44</td>
<td>0</td>
</tr>
<tr>
<td>45–49</td>
<td>0</td>
</tr>
<tr>
<td>50+</td>
<td>5</td>
</tr>
</tbody>
</table>

### Table 3 Mortality rates (per 100 000), and Standardized Incidence Ratios by cause of death

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Observed (%</th>
<th>Mortality rate × 100 000</th>
<th>Age at death (years) mean ± SD</th>
<th>Expected Cases</th>
<th>SMR(^a)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>63</td>
<td>61.84</td>
<td>36.3 ± 10.3</td>
<td>93.31</td>
<td>0.68</td>
<td>0.52–0.86</td>
</tr>
<tr>
<td>Car Accident</td>
<td>26 (41%)</td>
<td>25.52</td>
<td>29.4 ± 8.4</td>
<td>11.65</td>
<td>2.23(^c)</td>
<td>1.46–3.27</td>
</tr>
<tr>
<td>Diseases of the circulatory system</td>
<td>11 (17%)</td>
<td>10.80</td>
<td>42.7 ± 10.3</td>
<td>27.11</td>
<td>0.41</td>
<td>0.20–0.73</td>
</tr>
<tr>
<td>Cancer</td>
<td>11 (17%)</td>
<td>11.59</td>
<td>43.8 ± 10.6</td>
<td>35.90</td>
<td>0.31</td>
<td>0.15–0.55</td>
</tr>
<tr>
<td>Suicide</td>
<td>8 (12%)</td>
<td>7.85</td>
<td>38.7 ± 2.9</td>
<td>9.92</td>
<td>0.81</td>
<td>0.35–1.59</td>
</tr>
<tr>
<td>Amyotrophic lateral sclerosis</td>
<td>4 (6%)</td>
<td>3.93</td>
<td>40.6 ± 1.8</td>
<td>0.22</td>
<td>18.18</td>
<td>5.00–46.55</td>
</tr>
<tr>
<td>Immune deficiency</td>
<td>2 (3%)</td>
<td>1.96</td>
<td>34.8 ± 4.7</td>
<td>8.51</td>
<td>0.24</td>
<td>0.03–0.85</td>
</tr>
</tbody>
</table>

\(^a\): SMR, by age and calendar period.
\(^b\): both cases are AIDS.
\(^c\): Standardized by calendar period.
\(^d\): Two players died of SLE (age at death 42 years), and post surgery complications (age at death 27 years).
significant, and the absolute numbers very small (only 1 case observed). No cases of lung cancer deaths were observed, while roughly 10 were expected.

A significantly higher than expected number of deaths for ALS and car accidents was observed. The SMR for car accidents was 2.23 (95% CI 1.46–3.27). There were four cases of death from ALS in the cohort, as opposed to an expected number of 0.2 cases, giving a SMR for ALS of 18.18 (95% CI 5.00–46.55), without significant variation across calendar year.

A survival analysis was performed on this cohort, to assess the independent effect of Body Mass Index, length of professional career in years, overall number of official games played, position played within the team, and calendar year of starting of professional activity. For overall mortality, length of professional career was protective against death, although not significantly. For cause-specific mortality, none of the mentioned covariates had a significant association with the event.

Discussion

This study on Italian male professional soccer players indicates that overall mortality and mortality rates from cancer and cardiovascular diseases in this population are significantly lower than expected in the general population of the same age. However, mortality rates for ALS and car accidents are significantly higher than expected, and for ALS the risk is 18 times than expected. This cohort has the unique advantage of being complete in terms of active follow-up and ascertainment of date and cause of death, with only 3.3% of the players with incomplete follow up.

Cancer and cardiovascular diseases, the main causes of death in men, are associated with health behaviours, mainly smoking habits, diet and physical activity. Subjects involved in professional sports engage in strenuous physical activity on a regular basis for several years, and are subjected to specific dietary regimens. In addition, healthy subjects are likely to be selected in order to be involved in professional sport activities, and undergo constant health monitoring during their professional career. These reasons may contribute to the low cardiovascular and cancer mortality rates observed in this study.

A higher than expected risk of car accidents has been observed in our population, although the available national statistics did not allow to calculate age-standardized rates; this limitation makes it difficult to draw any firm conclusion from the data. Motor vehicle accidents have been associated with personality traits with impulsive-aggressive behaviours, and with drugs and alcohol abuse in young males. A higher risk of alcohol-related fatal motor vehicle crashes was reported among veterans of the 1991 Gulf War who were deployed.

Mortality from ALS in this cohort is significantly higher than expected, and confirms the suggestions from previous work, although this is the first time that mortality rate, adjusted by age and calendar period, is reported. The present results indicate an almost 20-fold higher risk for ALS in professional soccer players, with an age at death that is younger than that reported in the general population. It has been suggested that death certificates for ALS should be reliable, however, a more complete ALS case finding in professions with greater awareness, together with an estimate 30% under-reporting in death certificates in the general population may produce an apparent 2-fold ALS excess in retrospective cohort/mortality studies. A more complete ascertainment of the cause of death in soccer players might be true for any other cause-specific mortality. If we assume a 30% increase in the expected number of deaths, still the excess risk of ALS in soccer players remains significant, while the protection versus cancer and cardiovascular disease would be even more striking.

A limitation of this result is the use of US data for calculation of the expected rates for our population, given the lack of age- and gender-specific mortality rates for Italy. However, published US and Italian mortality rates appear similar, with 1.84 × 100000 persons reported by Sejvar in US, and 1.69 × 100000 persons by Mandrioli in Italy.2 A higher than expected risk of car accidents has been observed in our population, although the available national statistics did not allow to calculate age-standardized rates; this limitation makes it difficult to draw any firm conclusion from the data. Motor vehicle accidents have been associated with personality traits with impulsive-aggressive behaviours, and with drugs and alcohol abuse in young males. A higher risk of alcohol-related fatal motor vehicle crashes was reported among veterans of the 1991 Gulf War who were deployed.

The public health impact of the observed significant increase in mortality for ALS in soccer players is likely to be counteracted by the significant lower mortality for the two leading causes of death in men, cancer and cardiovascular disease. However, the early age at death observed in this study, and the youthful composition of this cohort pose the question of what will be the relative weight of ALS mortality in this population in the coming years. Prospective cohort studies with incidence data and questionnaires collected on long life exposure to toxicants and detailed health behavior should be able to shed further light on this issue.

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Conflict of interest: None declared.

Key points

- All causes mortality rates in professional soccer players has never been calculated before.
- Mortality rates for ALS and car accidents are significantly higher than expected in professional soccer players.
- The public health impact of these findings has to be balanced against the significant lower mortality for more common diseases, such as cancer and cardiovascular disease.
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