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 pubic 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

Introduction

The health status of professional soccer players has been of great concern in recent years,1 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.2

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 prevalence, of ALS in 7325 male professional soccer players who were active between 1970 and 2001,3 the other on proportional mortality rates in 24 000 active Italian soccer players from 1960 to 1996.4 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 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

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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
death 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
team they belonged to and confirmed by telephone by the team
administrators, in three other cases it was communicated by
the office of the register of the residents of the most recent city
of residence, while in six cases it was confirmed by both
Internet websites and at least two archived national newspa-
sers. In one case, the accident involved two soccer players,
who both died simultaneously. The death certificate of the
companion who died in the accident was available, and
confirmed the cause of death. The causes of death of the
remaining four players without an available death certificate
were suicide (n = 1), cancer (1 mesothelioma, 1 non-Hodgkin
lymphoma) and post-surgery complications (n = 1). The two
cases of cancer and of post-surgery complications were
confirmed by the office of the register of the residents of the
most recent city of residence and by a family member, while
the case of suicide was confirmed by Internet websites and two
archived national newspapers. The date of death was obtained
from the office of the register of the residents of the most
recent city of residence for all 17 players.

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.Air.PDF.

We also referred to the Cancer Institute website
to complete the data collection (http://www.istitutotumori.
mi.it/menu/instituto/diparclinici/epidemiologia/frametumori.
asp?name=stat.pdf). Mortality rates for ALS were obtained
from two publications5,6 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 distribution9 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-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, (mortality rate: 61.84 × 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 role was unknown in two players.

<table>
<thead>
<tr>
<th>Table 1 Description of the study population</th>
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<tbody>
<tr>
<td>Position played in the professional team</td>
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<tr>
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<tr>
<td>Forward</td>
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<tr>
<td>Midfielder</td>
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<tr>
<td>Defender</td>
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<td>Goalkeeper</td>
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<td>Multi role</td>
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The role was unknown in two players.

<table>
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<tr>
<th>Table 2 Observed deaths by age at death and calendar period</th>
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<tr>
<td>Age at enrolment (years)</td>
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<td>--------------------------</td>
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<tr>
<td>18.4 ± 2.0</td>
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<tr>
<td>38.0 ± 10.4</td>
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<tr>
<td>5.6 ± 0.7</td>
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DCS: Diseases of the circulatory system; CA: Cancer; ID: Immune deficiency; ALS: Amyotrophic Lateral Sclerosis; SLE: Systemic Lupus Erythematosus.

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<th>Table 3 Mortality rates (per 100 000), and Standardized Incidence Ratios by cause of death</th>
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<tr>
<td>Cause of death</td>
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<td>-----------------</td>
</tr>
<tr>
<td>Overall</td>
</tr>
<tr>
<td>Cause of death</td>
</tr>
<tr>
<td>Car Accident</td>
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<tr>
<td>Diseases of the circulatory system</td>
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<tr>
<td>Cancer</td>
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<tr>
<td>Suicide</td>
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<tr>
<td>Amyotrophic lateral sclerosis</td>
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<td>Immune deficiency</td>
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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 and 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 to the Gulf in comparison with those not deployed. We have no information on behavioural risk factors in our population; therefore no connection can be made at this point between personality traits or substance abuse and the increased risk of motor vehicle accidents observed in this study.

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.

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.
References

17 Vanacore N. Premorbid weight, body mass, and varsity athletics in ALS. *Neurology* 2003;61:1024.

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