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It is just a game: lack of association between watching football matches and the risk of acute cardiovascular events.

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Abstract

Background: The role of trigger factors in acute cardiovascular events has been much studied in the last few years. A recent study analysed changes in the rates of cardiac emergencies in Bavaria (Germany) during the last Football World Cup. The authors reported a 2.7-fold increase in the incidence of cardiac emergencies in the 12 hours before and after football matches involving the German team, and sparked the debate on the necessity of the introduction of ad-hoc cardiovascular preventive measures.

Methods: We studied 25159 hospital admissions for acute myocardial infarction (AMI) among the Italian population during three international football competitions: World Cup 2002, European Championship 2004 and World Cup 2006. Poisson regression was used to estimate the relative risk of hospital admission for AMI on the days when football matches involving the Italian team were disputed, compared with the other days of the three competitions. Furthermore, we reviewed the available published studies regarding the association between football matches and the risk of cardiovascular events.

Results: We did not find an increase in the rates of admission for AMI on the days of football matches involving Italy in either the single competitions or in the three competitions combined (relative risk: 1.01, 95% confidence interval 0.98-1.05). We identified ten studies published on this topic. With the exception of the recently published German study and two small Swiss studies, all relative risk estimates were between 0.7 and 1.3.

Conclusions: The cardiovascular effects of watching football matches are likely to be, if anything, very small.

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Introduction

The role of trigger factors in acute cardiovascular events has been much studied in the last few years. Studies have investigated the effects of triggers acting on both the individual level, such as episodes of anger, heavy physical exertion, sexual activity and drug consumption (1), and on a large number of people during a limited time span, from earthquakes and armed conflicts to political and sporting events (2-4). Watching sporting events could contribute to cardiovascular risk by increases in sympathetic nervous system stimulation and circulating catecholamines induced by the emotional involvements in the game, associated with other behaviours such as smoking, binge drinking and overeating (4).

A recent study by Wilbert-Lampen and collaborators (5) analysed changes in the rates of cardiac emergencies in Bavaria (Germany) during the last football world cup, held in Germany in 2006. The population incidence of cardiac emergencies increased by 2.7-fold during the 12 hours before and after matches involving the German team (5). The authors claimed that this finding has relevant public health implications, which sparked a debate on the necessity of the introduction of ad-hoc preventive measures (5-7).

We have investigated the association between football matches involving the Italian team in the last three international competitions and the rates of hospital admissions for acute myocardial infarction (AMI) among the Italian population (60 million inhabitants). Since the Italian team participated in the final phase of all of the last competitions, our study is based on a very large number of events and takes advantage of several repeated episodes of exposure. Furthermore, we evaluated the results of our study and that of Wilbert-Lampen and collaborators in the context of published studies on the association between football matches and the risk of cardiovascular events.

Methods

We studied daily hospital admissions for AMI in Italy during three international football competitions: the 2002 FIFA World Cup (held in South Korea and Japan between May 31 and June

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3 30), the European Championship 2004 (held in Portugal between June 12 and July 4) and the 2006
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5 FIFA World Cup (held in Germany between June 9 and July 9). Records of hospital admissions
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7 with a primary diagnosis of acute myocardial infarction (ICD-9 code 410) were obtained from the
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9 National Hospital Discharge Database in the form of individual anonymous records, which included
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11 age, date of admission and gender. The National Hospital Discharge Database, created in 1994,
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13 collects information on all hospitalisations recorded in Italy. The data collection has gradually
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15 improved in quality and completeness during the first five years and is currently regarded as highly
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17 complete (8).
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22 The exposure period included the days on which the Italian team played, whereas the control
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24 period included all other days of the three competitions. We used Poisson regression to estimate the
25
26 relative risk of hospital admission for AMI comparing the exposure days to the control days, for
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28 each single competition and for the three competitions combined.
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32 All models were adjusted for day of the week. The pooled effect estimate was obtained
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34 fitting a model including tournament as a random-effect. As the comparison was made between
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36 exposed and control days within the same competition, possible confounding by long term trends
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38 and seasonal variations in incidence of AMI were inherently taken into account. As the the control
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40 period consisted of days before and after the matches, we considered unlikely that temperature and
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42 air pollution could change between control days and exposed days at such an extent to introduce
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44 bias. We checked this assumption collecting data on temperature and concentration of nitrogen
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46 dioxide for one northern Italian city (Milan), one city in central Italy (Rome) and one in southern
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48 Italy (Palermo). As reported in table 1, average temperature and concentration of nitrogen dioxide
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50 during days when the Italian team played were very similar to figures recorded during control days.
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3 We also carried out secondary analyses that were limited to men aged less than 65 years on
4 the assumption that football matches are viewed mostly by younger male individuals. Moreover we
5 also carried out analyses stratifying matches by time of the day when they were broadcasted in
6 Italy. Finally, we conducted an analysis including only matches disputed in the final stage (knock-
7 out stage) of each competition (one match in 2002, no match in 2004, four matches in 2006) in the
8 assumption that these matches were watched by a larger proportion of the population and could be
9 associated with a larger emotional involvement of the viewers.
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20 To identify previously published studies on the association between football matches and
21 cardiovascular events, we searched PUBMED in December 2008 using combinations of the
22 following MeSH terms: Football; Soccer; Acute Coronary Syndrome; Angina; Arrhythmias,
23 Cardiac; Coronary Disease; Myocardial Infarction; Stroke; Cardiovascular Diseases; Heart Arrest;
24 Death, Sudden. Furthermore, we scrutinised all cited references from the retrieved articles. When
25 studies reported both single-match and pooled estimates, we considered the summary estimate in
26 our review. In addition, if only gender-specific estimates were reported, we calculated a pooled
27 estimate for men and women combined.
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41 Results

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43 In total, 25 159 hospital admissions for acute myocardial infarction (AMI) occurred in the
44 Italian population during the three football competitions. Out of these, 4,395 events occurred on 1
45 of the 14 days of matches involving the Italian team (Table 2). During the 2002 FIFA World Cup,
46 matches involving Italy were viewed in Italy between 9am and 11am. In the European
47 Championship 2004, they started between 4pm and 7pm. Finally, in the 2006 FIFA World Cup
48 matches involving Italy started between 4pm and 9pm. The days of the football matches were not
49 associated with an increase in admissions for AMI in the three competitions combined (pooled
50 relative risk [RR] 1.01, 95% confidence interval 0.98-1.05) or in each single competition. The
51 incidence did not increase (RR=1.03, 95% CI: 0.90-1.17) when Italy and France played a dramatic
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3 penalty shootout in the final match of the World Cup 2006 (data not reported in tables). Restriction
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5 of the analyses to men aged less than 65 years (pooled RR= 1.03, 95% CI: 0.97-1.09) did not
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7 substantially affect the results. Further secondary analyses were carried out stratifying matches by
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9 time of the day when they were broadcasted in Italy. No effect was observed in any of three groups
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11 – matches of World cup 2002 (viewed in Italy in the morning), matches disputed in the afternoon
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13 (RR 0.97; 95 %CI: 0.92-1.03), matches disputed in the evening (RR 1.02; 95% CI 0.96-1.08).
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17 Finally, when we included in the analysis only matches disputed in the final stage of each
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19 competition, no increase in the rates of admissions for AMI was observed (RR: 0.99, 95% CI 0.94-
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32 Our review identified ten published articles on the association between football matches and
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34 cardiovascular events (Table 3). There were important methodological heterogeneities among these
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36 studies that hampered a quantitative summary measure of effect. Regarding the definition of the
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38 outcome, five studies analysed mortality rates for AMI (9, 10) or AMI and stroke combined (4, 11,
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40 12), two studies evaluated hospital admissions with a discharge diagnosis of either AMI or stroke
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42 (13, 14), two studies investigated the occurrence of out-of-hospital cardiac arrests and sudden
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44 cardiac death (15, 16) and one study investigated hospital admissions with a preclinical diagnosis of
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46 acute cardiovascular events (AMI, unstable angina, symptomatic cardiac arrhythmia, cardiac arrest
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48 leading to cardiopulmonary resuscitation or therapeutic discharge of an implantable cardioverter-
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50 defibrillator) (5). Regarding the definition of the exposure period, three studies evaluated the effect
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52 of a single football match (4, 9, 10), while the studies by Bauman and colleagues (14), Carroll and
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54 colleagues (13), Brunekreef and colleagues (11) and Wilbert-Lampen and colleagues (5) were based
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56 on two, four, five and seven matches, respectively.
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The English study by Kirkup and Merrick (12) evaluated all competitive matches played over five years by four local football teams to investigate if the result of the matches (local team lost at home vs. other results) was associated with cardiovascular mortality. Finally, in the two studies by Katz and colleagues (15, 16), the entire duration of the studied competitions was considered as the exposure period, regardless of whether a match involving the national team was played or not.

(Table 3 here)

Figure 1 shows the results of the different studies plotted against their precision. In the absence of publication bias, the effect estimates are expected to be distributed in a triangular (“funnel”) pattern, with less precise studies (on the right side of the graph) randomly dispersed around the mean. The two small studies by Katz and colleagues (15, 16) had the same study design and were carried out on the same population during two different competitions. For these reasons they have been pooled together. With the exception of the study by Wilbert-Lampen and colleagues (5) (RR for both genders: 2.66) and the two small studies by Katz et colleagues (15, 16) (pooled RR for both genders: 1.8), all RR estimates were between 0.70 (10) and 1.3 (4). The effect estimate found by Wilbert-Lampen and colleagues is a clear outlier, as there is no overlap between its confidence interval and most of the confidence intervals reported by the other authors.

(Figure 1 here)

Discussion

Football is the most popular sport in Italy. The final match of the World Cup 2006, when Italy beat France, was watched by more than 24 million television viewers (approximately 40% of the population), corresponding to a share of 84% ([http://it.wikipedia.org/wiki/Audience_\(media\)](http://it.wikipedia.org/wiki/Audience_(media))). Nevertheless, we found no evidence of increased rates of hospital admissions for acute myocardial infarction (AMI) associated with football matches played by the Italian national team in three international competitions held between 2002 and 2006. Our estimates are based on large numbers of events and football matches distributed over a period of five years. The control period consisted of the days before and after the matches. For these reasons it is unlikely that our results are due to the effects of unmeasured potential confounders such as temperature and pollution.

Although a fraction of patients with AMI die before they reach hospital, it is unlikely that the proportion of deaths outside hospital increased selectively during days when the Italian team played biasing our observed incidence rates downwards.

Our findings are consistent with most of previous studies (4, 9-14) that report a weak, if any, increase in cardiovascular events during the days of football matches. A remarkable exception is the recently published study by Wilbert-Lampen and colleagues, which reported a 2.7-fold increase in hospital admissions for cardiac emergencies on the days of matches involving the German team (5). The main difference in study design between the German study and the other studies is that the former used prospectively collected information, whereas the latter studies were based on routinely collected administrative data that lack information on the exact time of the onset of the symptoms. Moreover, while Wilbert-Lampen and colleagues (5) analysed an interval of 24 hours beginning at noon, the other studies used a daily interval beginning at midnight. The latter approach could introduce a certain degree of misclassification as some of the matches were watched by European viewers at dinner time; hence, some of the cardiovascular events in excess could have been admitted to the hospital after midnight and thus been counted on a control day. However, we consider unlikely that this could explain the differences in the results. First, watching a football

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3 match is considered to be a trigger for cardiovascular events, implying that its effects are likely to
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5 act during a short time period, typically 1-2 hours (1, 5, 17). Therefore, the proportion of cases
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7 admitted to the hospital the day after the matches would probably be small even when matches were
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9 disputed at evening. Second, we did not find an increased incidence of AMI in either the World Cup
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11 2002, in which all matches were played in Korea and Japan and therefore watched by Italians
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13 during the morning, nor in single matches disputed during afternoon in the World Cup 2006 and the
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15 European Championship 2004
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20 One should also consider the magnitude of the estimated relative risks, which were averaged
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22 over a 24-hour period in all studies, including that of Wilbert-Lampen and colleagues (5), while
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24 triggers typically increase cardiovascular risk over a short time period. Assuming that the risk is
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26 increased within the first 2 hours from the start of a match, the RR of 2.66 over a 24-hour period
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28 found by the German study would correspond to an acute relative risk of 21 (i.e., a RR of 2.66 is the
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30 24-hour average between a RR of 1.00 during 22 hours and a RR of 21 during 2 hours). However,
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32 only a proportion of the population actually watches the matches (and is thus exposed). Assuming a
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34 proportion of viewers of 50% (higher than that reported in Italy during the final match of the World
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36 Cup 2006 ([http://it.wikipedia.org/wiki/Audience_\(media\)](http://it.wikipedia.org/wiki/Audience_(media)))), the corresponding acute RR among
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38 viewers would be of 41 (set to 1.0 the acute RR for non-viewers). This estimate is considerably
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40 larger than that of any other cardiovascular trigger studied in case-crossover studies (1). Indeed,
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42 with the exception of cocaine consumption which entails an acute RR of 24 (18), sexual activity, an
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44 episode of anger, strenuous physical exercise, smoking marijuana, drinking coffee and having a
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46 heavy meal are all associated with acute RRs ranging between 2 and 7 (1). Even assuming a
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48 conservative scenario, in which the effect of watching a football match lasts for 8 hours, the
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50 corresponding acute RR would still be 10. The inconsistency between the effect estimates reported
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52 by Wilbert-Lampen and the magnitude of the effects expected on the basis of previous evidence on
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54 other recognised cardiovascular triggers further suggests that the results by Wilbert-Lampen et al.
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56 should be regarded cautiously.
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3 The publication of the German study stimulated intense media coverage and debate (6, 7,
4 19-21), but neither in the scientific literature nor in the media was it mentioned that its relative risk
5 estimate was much higher than those previously reported. This resulted in public concern over the
6 possible harmful effects of watching sports events and in proposals to introduce ad-hoc preventive
7 measures, including changes in the pharmacological treatments for individuals with pre-existing
8 coronary artery disease (5-7). Our study and review contribute to the debate and suggest that the
9 population cardiovascular effects of watching a football match are likely to be, if anything, very
10 small. This is reassuring in terms of public health.
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Key messages

A recent study carried out in Bavaria (Germany) during the last Football World Cup reported a 2.7-fold increase in the incidence of cardiac emergencies in the 12 hours before and after football matches involving the German team.

We investigated this issue in the entire Italian population. We found no evidence of increased rates of hospital admissions for acute myocardial infarction associated with football matches played by the Italian national team in three international competitions held between 2002 and 2006.

We also reviewed the ten published studies on the association between football matches and the risk of cardiovascular events. With the exception of the German study and two small Swiss studies, all relative risk estimates are spread around the null value, ranging between 0.7 and 1.3.

Our study and review suggest that the population cardiovascular effects of watching a football match are likely to be, if anything, very small.

Table 1. Descriptive statistics of temperature and concentrations of nitrogen dioxide in different Italian cities during three international football competitions (2002 FIFA World Cup, the European Championship 2004, and 2006 FIFA World Cup). Mean values and standard deviations (SD) are stratified by days when the Italian team played and days when the Italian team did not play.

	Temperature (C°)		Nitrogen Dioxide ($\mu\text{g}/\text{m}^3$)	
	When Italy played	When Italy did not play	When Italy played	When Italy did not play
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Milan (Northern Italy)	24.8 (3.1) ^a	25.1 (2.9) ^a	47.8 (13.6)#	39.8 (11.8)#
Rome (Central Italy)	23.9 (3.0) ^a	24.6 (3.4) ^a	57.3 (14.8) ^a	57.8 (15.5) ^a
Palermo (Southern Italy)	25.5 (3.6) ^a	26.1 (3.3) ^a	50.3 (14.1)#	48.2 (12.2)#

^a: figures are based on measurements obtained during all the three competitions.

#: figures are based on measurements obtained during 2002 FIFA World Cup and the European Championship 2004.

Table 2. Hospital admissions for acute myocardial infarction (ICD9:410) in the Italian population during three international football competitions. The relative risk of acute myocardial infarction on match days involving the Italian team is compared with the other days of the competitions.

	Days of the competitions			
	When Italy played		When Italy did not play	
	N. Events (N. Days)	RR ^a (95% CI) ^a	N. Events (N. Days)	RR ^a
World Cup 2006	2236 (7)	1.00 (0.95-1.05)	7377 (24)	1 (ref)
EURO 2004	929 (3)	0.98 (0.91-1.06)	5800 (20)	1 (ref)
World Cup 2002	1230 (4)	1.05 (0.99-1.12)	7587 (27)	1 (ref)
Overall	4395 (14)	1.01 (0.98-1.05)	20764 (71)	1 (ref)

^a RR, relative risk adjusted for day of the week; CI, confidence interval

Table 3. A summary of the published studies on the association between football matches and cardiovascular events. Relative risks refer to the numbers of cardiovascular events on days in which major football matches were played compared with events during control periods.

Study	Competition	Comparison	Outcome	N	Relative risk (95% Confidence interval)
Witte 2000 (4)	E.C (1996)	Events during the day of the last match played by the national team vs. events during preceding and following five days	Mortality for AMI and stroke in the Netherlands	M:41 W:38	M: 1.51 (1.08-2.09) W: 1.11(0.8-1.56)
Toubiana 2001 (9)	E.C. (1996)	Events during the day of the last match played by the national team vs. events during preceding and following five days	Mortality for AMI in France	M:61 W:83	M: 0.74 (0.58-1.02) W: 0.96(0.80-1.21)
Brunekreef 2002 (11)	E.C (1988 and 1992) W.C.(1990 and 1994)	Events during the days of five matches played by the national team in the four tournaments vs. events during other days between 1986 and 1994	Mortality for AMI and stroke in Netherlands	NA	M+W: 1.00 (0.90-1.11)*
Carroll 2002 (13)	W.C (1998)	Events within two days after a match of the national team vs. events during the other days of the tournament	Hospital admissions for AMI in England	M+W: 270 NA NA	Penalty: 1.25 (1.08-1.44) ** Win: 0.99 (0.89-1.11) ** Loss: 0.91 (0.78-1.07) **
			Hospital admissions for stroke in England	NA NA NA	Penalty: 1.00 (0.82-1.23) ** Win: 0.87 (0.74-1.03) ** Loss: 0.97 (0.79-1.19) **
Berthier 2003 (10)	W.C. (1998)	Events during the day of the final match of the national team vs. events during the preceding and following five days	Mortality for AMI in France	M:23 W:18	M: 0.71 (0.55-0.98) W: 0.65 (0.45-1.16)
Kirkup 2003 (12)	E.F.T. (1994-1999)	Events on days when the local team lost at home vs. events on days with any other result.	Mortality for AMI and stroke in some UK health authorities	M: 220 W: 202	M: 1.28 (1.11-1.47)§ W: 1.07 (0.93-1.24)§
Katz 2005 (15)	W.C. (1998)	Events during days of the tournament vs. events during the preceding 33 days and following 33 days	Incidence of out-of-hospital cardiac arrests in selected provinces of Switzerland	M+W: 45 M: 37 W: 8	M+W: 2.00 (1.32-3.02) M: 2.31 (1.40-3.83) W: 1.23 (0.44-3.20)
Katz 2006 (16)	W.C. (2002)	Events during days of the tournament vs. events during the same period in 2001	Incidence of sudden cardiac death in selected provinces of Switzerland	M+W: 38 M: 26 W: 12	M+W: 1.63 (1.09-2.44) M: 1.77 (1.09-2.86) W: 1.33 (0.63-2.82)
Bauman 2006 (14)	A.F.L (2005) W.C.Q.(2005)	Events within 2 days after a the AFL final match and after the regional World Cup qualifying match vs. events during the preceding 14 days and following 11 days	Hospital admissions for AMI in New South Wales (Australia)	(A.F.L.) M+W: 79 (W.C.Q.) M+W: 71	(A.F.L.) M+W: 1.21 (0.90-1.63)§ (W.C.Q.) M+W: 0.81 (0.63-1.05)§
			Hospital admissions for stroke in New South Wales (Australia)	(A.F.L.) M+W: 38 (W.C.Q.) M+W: 49	(A.F.L.) M+W: 1.12 (0.81-1.56)§ (W.C.Q.) M+W: 1.36 (0.97-1.91)§
Wilbert-Lampen 2008 (5)	W.C. (2006)	Events during days of matches played by the national team vs. events during control days in the years 2003, 2005 and 2006°	Hospital admissions for acute cardiovascular events in Bavaria (Germany)	M:216 W: 86 M+W: 302	M: 3.26 (2.78-3.84)# W: 1.82 (1.44-2.31)# M+W: 2.66 (2.33-3.04)#
Present study	E.C (2004) W.C.(2002 and 2006)	Events during the day of matches played by the national team vs. events during the other days of the tournaments	Hospital admissions for AMI in Italy	M+W: 4395	M+W: 1.01 (0.98-1.05)§§

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3 * RR adjusted for year, month, day of the week, temperature, air pollution, influenza epidemics

4 ** RR adjusted for gender, year, month, day of the week, temperature.

5 § RR adjusted for month and day of the week

6 §§ RR adjusted for competition and day of the week

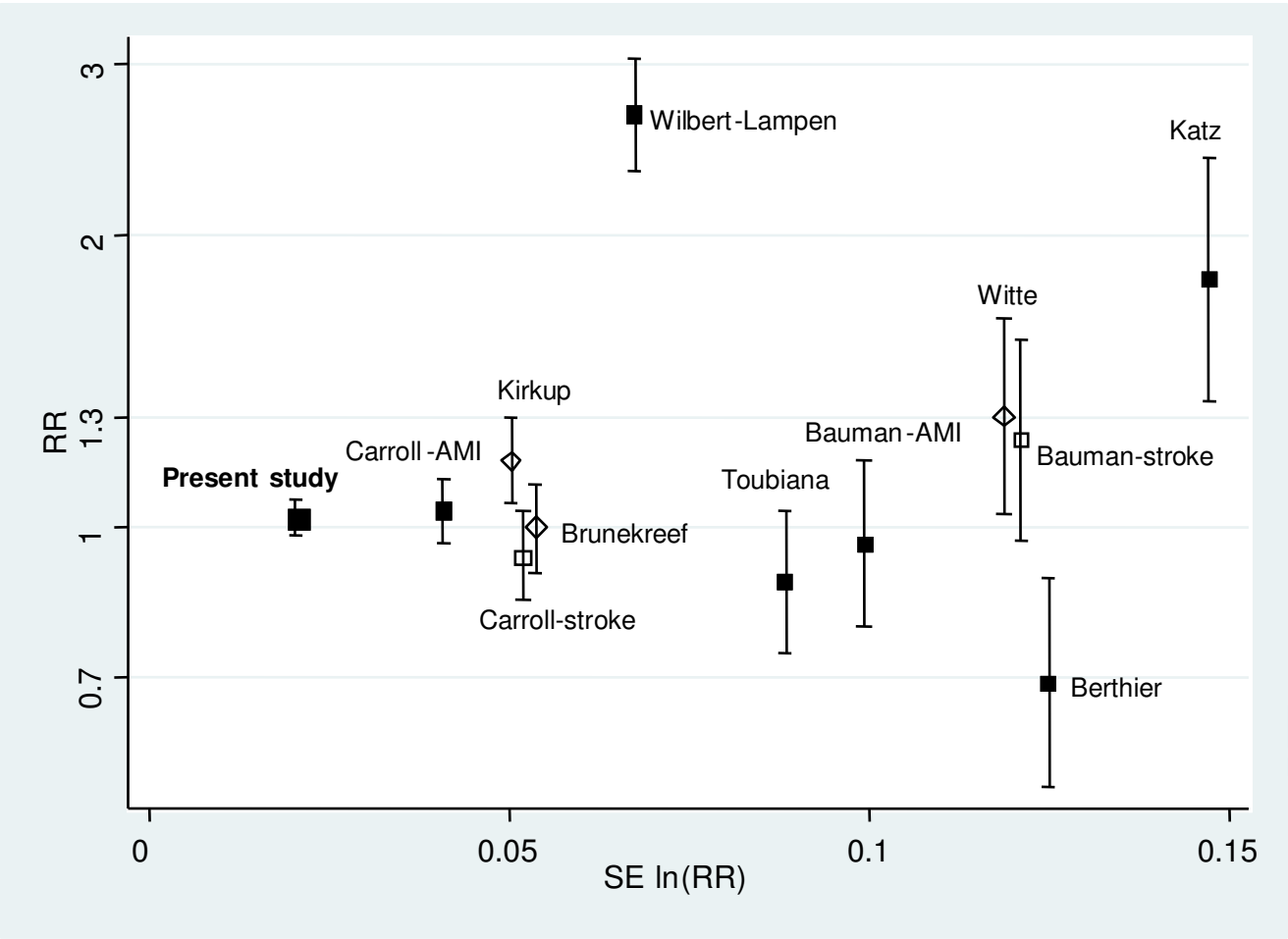
7 #: RR adjusted for year, day of the week, temperature, air pollution, barometric pressure

8 °: Control days were May 1 to June 8 and July 10 to July 31 in 2006; May 1 to July 31 in 2003 and 2005

9 List of abbreviations: N: number of events during the exposure period; AMI: Acute myocardial infarction E.C.: European Championship; W.C:
10 World Cup; E.F.T: English Football Tournament; A.F.L.: Australian Football League; W.C.Q: World Cup Qualifications; M: men; W: women;
11 M+W: both genders; Penalty: match lost by the team at a penalty shootout; Win: matches won by the team; Loss: match lost by the team not at
12 penalty shootout; NA: not available
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Figure 1. Funnel plot of the relative risks (RR) vs. their standard errors [SE Ln(RR): standard error of natural logarithm of the RR] for studies on football matches and the risk of cardiovascular events. Bars represent 95% confidence intervals.



Note: Full squares represent studies on coronary events, hollow squares studies on strokes and hollow diamonds studies on coronary events and strokes