

Does sport have a protective effect against suicide?

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SUMMARY. **Aim** – The association between sporting activities, or lack thereof, and suicidal behaviour has not yet been clarified. The objective of this study was to determine, if sports participation has an impact on risk for completed suicide. **Methods** – Axis I and Axis II disorders, sociodemographic factors, and current and former sports activities, including various sports disciplines, were assessed by a semi-structured interview by psychological autopsy method in 163 suicides and by personal interview in 396 living population-based control persons. **Results** – Current sports activities (OR = 0.24, 95%CI, 0.15 to 0.39; OR = 0.27, 95%CI, 0.16 to 0.45) and sports activities at some point in life (OR = 0.33, 95%CI, 0.18 to 0.62; OR = 0.40, 95%CI, 0.23 to 0.68, after adjustment for axis I and II disorders or educational level, each) were associated with decreased suicide risk. **Conclusions** – Current sports activities and sports activities at some point in life may reduce suicide risk.

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INTRODUCTION

There are many risk factors for suicide (Cavanagh *et al.*, 2003) and risk factors do not differ much across cultures (Cheng *et al.*, 2000; Phillips *et al.*, 2002). However, it is also vitally important to direct suicide research toward identifying protective factors.

Few studies have so far assessed the relationship between suicide and physical activity, and far less studies have assessed the association between suicide and participation in sports activities, which are a particular kind of physical activity. Paffenbarger *et al.* (1994) did not observe an association between different physical activity habits and completed suicide in a 23 to 27 year follow-

up of Harvard alumni, even though a (non-significant) trend was observed. Furthermore, a case-control study showed that young suicide attempters were far less likely to be involved in physical activity than control persons (Simon *et al.*, 2004). A possible clue to an association between reduced suicidal behaviour and sports participation has been found in some (Brown & Blanton, 2002; Brosnahan *et al.*, 2004; Sabo *et al.*, 2005; Chioqueta & Stiles, 2007; Brown *et al.*, 2007; Taliaferro *et al.*, 2008), but not all cross-sectional studies (Nattiv & Puffer, 1991; Choquet *et al.*, 1993); furthermore, results were ambiguous with respect to gender (Unger, 1997; Pate *et al.*, 2000). A positive effect of physical activity on mental health has repeatedly been demonstrated in many studies (Lawlor & Hopker, 2001; Brosse *et al.*, 2002; Dunn *et al.*, 2005; Manger & Motta, 2005; Knubben *et al.*, 2007). Endurance sports, in particular marathon running, can improve signs of depression (Knubben *et al.*, 2007).

However, the effect of taking part in sports at some time in life, especially in endurance sports, on the risk of completed suicide has not been investigated in a population-based controlled psychological autopsy study. The objective of this study was to determine if sports activi-

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ties, and in particular endurance sports, have an impact on the risk of completed suicide. We hypothesized that sports activity at some time during life and the performance of endurance sports lower suicide risk.

METHOD

Study population

All 263 suicides (mean age 50.9 [SD 19.6] years; 66.2% males) who died in the Frankfurt/Main area (864,253 inhabitants on December 31, 1999) in 1999 and 2000 were included in the study. All suicides were classified as certain suicides (ICD-10 X 60 – X 84) by the Center of Forensic Medicine, which examines all deaths by unnatural or uncertain causes in this region. Twenty suicides did not have any 1st or 2nd degree relatives or other close persons; the relatives of 22 suicide victims could not be interviewed in German and/or were living outside of Germany. In 58 cases, relatives or friends of the deceased declined participation in the study. The relatives of the resulting 163 suicides (mean age 49.8 [SD 19.3] years; 64.4% males; men: 48.4 [SD 19.4] years; women: 52.1 [SD 19.1] years) were interviewed using the psychological autopsy method with a semi-structured interview 8.5 [SD 6.8] months after the suicide. The study sample is described in detail elsewhere (e.g. Schneider *et al.*, 2009).

In addition, out of the 685 population-based controls contacted, 396 persons (mean age 51.6 [SD 17.0] years; 55.8% males), who were comparable to the suicides regarding residential area, age, and gender, were personally interviewed. The controls were chosen by 'random digit dialing'. The suicides' relatives and the control persons were contacted by mail introducing them to the research project. All potential informants and control persons were told that the participation was voluntary. Control persons were also asked to give their permission for repetition of the interview, for interviews by two interviewers, and for asking a close relative or friend to give an interview about the control person himself or herself. All relatives and friends of the included suicides as well as the control persons were interviewed between 1999 and 2000.

INSTRUMENTS AND DIAGNOSTIC PROCEDURE

A semi-structured interview, a modified and translated version of the interview applied in the National Suicide Prevention Project in Finland including differentiated questions about current and lifetime sports activities (Henriksson *et al.*, 1993), and the Structured Clinical Interview for DSM-IV Axis I and II disorders (lifetime;

SCID-I, SCID-II, German version) were carried out with control persons and with informants about the suicide cases. As recommended, SCID-II was employed after SCID-I. Dementia and other cognitive disorders were diagnosed using the DSM-IV algorithm. For assessment of sports activities, people were asked which sports they have taken part in and in which periods of their lives. Among all mentioned sports disciplines during lifetime, the subgroup "endurance sports" was created. This category includes running, cycling (road and mountain biking), swimming, walking, inline-skating, cross-country skiing, hiking, rowing and mountaineering.

The assessment of interrater reliability, test-retest reliability, and agreement between personal and informant's interview for DSM-IV axis I and axis II diagnoses, sports, and socio-demographic features were measured using kappa statistics and Kendall's tau, and were found to be good for interrater reliability and test-retest reliability. Comparison of personal and relative's interview generated kappa coefficients above 0.79 for most axis I and above 0.65 for most personality disorder diagnoses (Schneider *et al.*, 2004); kappa coefficients were only moderate for sports activities (0.47 for sports participation at some point during life, 0.50 for current sports activities), however good to excellent for most kinds of sports.

The study protocol was approved by the ethics committee of the Medical Faculty of the University of Frankfurt/Main and carried out in accordance with the ethical standards laid down in the Declaration of Helsinki. Written informed consent was obtained by all interviewees after the aims of the study and all procedures had been fully explained.

Statistical analyses

The statistical analyses were performed with SPSS version 15.0. Binary logistic regression analysis was used to estimate the odds ratios (OR) and their 95% confidence intervals (95% CI) for the association between suicide and sports. The logistic regression analysis was adjusted for age group and gender and in further models also for axis I and axis II disorders, level of education (at least twelve years vs. twelve years or less), living together with one's partner, and current employment, respectively. Odds ratios and confidence intervals were not calculated for variables with less than five subjects in suicides or in controls in one of the subgroups.

RESULTS

Both, current sports activities (controls: 64.8%, suicides: 31.5%; OR = 0.24, 95%CI, 0.15 to 0.39; after adjustment for axis I and axis II disorders: OR = 0.27,

95%CI, 0.15 to 0.49; after adjustment for educational level: OR = 0.27, 95%CI, 0.16 to 0.45; after adjustment for current employment: OR = 0.24, 95%CI, 0.15 to 0.40; after adjustment for 'partnership': OR = 0.24, 95%CI, 0.14 to 0.40) and sports activities at some time during life (controls: 81.9%, suicides: 54.6%; OR = 0.24, 95%CI, = 0.14 to 0.40; after adjustment for axis I and axis II disorders: OR = 0.33, 95%CI, 0.18 to 0.62; after adjustment for level of education: OR = 0.40, 95%CI, 0.23 to 0.68; after adjustment for current employment: OR = 0.23, 95%CI, 0.15 to 0.39; after adjustment for 'partnership': OR = 0.23, 95%CI, 0.14 to 0.40) were associated with decreased suicide risk. Endurance sports at some time during life was associated with reduced suicide risk (controls: 44.3%, suicides: 23.1%; OR = 0.20; 95%CI, 0.11 to 0.36; after adjustment for axis I and axis II disorders: OR = 0.28, 95%CI, 0.14 to 0.59; after adjustment for educational level: OR = 0.23, 95%CI, 0.12 to 0.41; after adjustment for current employment: OR = 0.19, 95%CI, 0.10 to 0.35; after adjustment for 'partnership': OR = 0.20, 95%CI, 0.11 to 0.37); sports other than endurance sports were also associated with a decreased suicide risk (controls: 37.3%, suicides: 30.6%: OR = 0.28, 95%CI, = 0.16 to 0.49; after adjustment for axis I and axis II disorders: OR = 0.36, 95%CI, 0.18 to 0.72; after adjustment for level of education: OR = 0.33, 95%CI, 0.18 to 0.60; after adjustment for current employment: OR = 0.28, 95%CI, 0.15 to 0.50; after adjustment for 'partnership': OR = 0.27, 95%CI, 0.15 to 0.48). Adjustment for axis I and axis II disorders and all or only one of the above mentioned socio-demographic variables showed nearly identical odds ratios to those already presented.

DISCUSSION

In this study, we found that both, current sports participation and sports participation at some point during life are associated with highly decreased suicide risks. The performance of endurance sports shows a slightly greater beneficial effect than participation in non-endurance sports disciplines. Adjustment for axis I disorders and personality disorders and adjustment for the level of education, for being currently unemployed, or for partnership do not substantially alter the protective effect of sports participation on completed suicide.

Our results are supported by the findings of Paffenbarger *et al.* (1994), who observed a (non-significant) trend between different physical activity habits and completed suicide in a 23 to 27 year follow-up of Harvard alumni, despite the differences in design and methodology. Our results are also supported by Simon *et al.* (2004), who reported that suicide attempters were far less likely

to be involved in physical activity than controls.

Although we observed a protective effect of sports activities against suicide, a direct association between sports participation and reduced suicide risk is not obvious, particularly as elite athletes might have increased risk for suicide (Baum, 2005). However, this protective effect of sports participation is unlikely to be the result of the effects on or by axis I and personality disorders. One possible explanation for the suicide protective effect could be that physical activity improves general well-being, possibly even for longer periods of time. The relationship between the improvement of mental health and physical activity is explained by various mechanisms: Physical activity increases the synaptic transmission of monoamines (Ransford, 1982; Morgan, 1985), which supposedly functions in the same manner as antidepressive drugs (Dunn & Dishman, 1991; Nicoloff & Schwenk, 1995). Furthermore, physical activity increases the release of endorphins, basically beta-endorphins (Ransford, 1982; Morgan, 1985; Dunn & Dishman 1991; Nicoloff & Schwenk, 1995; Carrasco *et al.*, 2007). In particular during and after endurance sports, the levels of beta-endorphins, cortisol, catecholamines, cytokines, and ACTH increase significantly (Rahkila *et al.*, 1987; 1988; Wilmore & Costill, 1994; Heitkamp *et al.*, 1996). All these factors have been described to have effects on mood or to be involved in the physiopathology of affective disorders (Wilmore & Costill, 1994). Furthermore, new evidence suggests that regular physical activity may increase neurogenesis in the hippocampus (Ernst *et al.*, 2006). In addition, our results are supported by the following three findings:

- a) Individuals without psychiatric symptoms who regularly exercise experience better moods than those who do not (Dua & Hargreaves, 1992; Slaven & Lee, 1997);
- b) Regular physical activity may protect against the development of depression (Camacho *et al.*, 1991; Paffenbarger *et al.*, 1994; Kritz-Silverstein *et al.*, 2001);
- c) Physical inactivity might be a risk factor for depression (Farmer *et al.*, 1988).

Our study shares the general methodological limitations of controlled psychological autopsy studies. These methodological limitations have been described in detail in previous articles (e. g. Schneider *et al.*, 2009). With respect to the present topic, some particular limitations have to be addressed:

- a) Our response rates were relatively low. However, we have no indication of selection bias. Low response rates were also noted in several Western controlled psychological autopsy studies (Appleby *et al.*, 1999; Hawton *et al.*, 2002). Unfortunately, due to data pro-

tection regulations in Germany, we could not perform non-responder analyses in our sample for estimation of selection effects, which might bias the results. However, we have no hints for selection bias; prevalences of psychiatric disorders and frequency of current sports participation correspond to those of the general population of Germany (Mensink, 2003). But our data are not the latest and the prevalence of sport activities in the general population might have changed in the last years.

- b) Due to the small sample size, separate analyses for men and women could not have been carried out, although the influence of sports on suicidal behaviour may be different between men and women (Unger, 1997).
- c) A design that included a second control group of deceased who died from other causes than suicide would be helpful. In such a design, it could have been examined whether sport activities pose a different risk for suicide than for death due to other causes. Using a control group of living people might have overestimated sports activities as a preventive factor for suicide, as sport activities might also have an important preventive effect against premature death from other causes than suicide. Furthermore, it is difficult and also ethically questionable to assess living controls by best-estimate method as described by Hawton *et al.* (1998). Moreover, including suicide attempters as a further control group would provide an insight in risk reduction of other grades of suicidality than completed suicide.
- d) Furthermore, we have no clues to a potential misclassification of sports participation, although the scope of information bias could not be determined.
- e) Agreement between proxy and self-interview was high for psychiatric diagnoses (Schneider *et al.*, 2004) and at least moderate for the assessed sport disciplines (see above).
- f) In addition, current and former sports activities were only categorized into 'yes' and 'no'. However, protective effects on suicidality seem to be associated with a more detailed categorization of physical activity (e. g. Tao *et al.*, 2007) and sports activity is only a particular kind of physical activity. Unfortunately, more detailed questionnaires including lifetime sports participation, periods, frequency, duration, disciplines, and intensity of sports participation, and in particular non-sports physical activities were not applied. Therefore, it was not possible to distinguish between sports participation and other kinds of physical activities. Furthermore, classification into endurance and other than endurance sports was rough.
- g) Moreover, there are many factors which are associated with physical activity – which might also be associated with sports activities – and suicide like age, gender, education, and other socio-demographic factors

(Mensink, 2003). However, these factors were not included in the present analyses.

- h) Furthermore, the association between sports participation and/or other physical activities and suicide is very complex: Sports participation might be on the pathway between other factors and suicide or might influence the strength of the association between other factors and suicide. Besides, the association between sports participation and suicide might reflect the effects of non-observed factors which are associated with sports participation or are related to the development of suicidal behavior. All these methodological problems that impact research in the area of physical activity in general and mental health have already been well described (Morgan, 1997; Bauman *et al.*, 2002).

Despite all these limitations, our results demonstrate that current sports participation and sports participation at some point in life, both have a protective effect on completed suicide, even after taking into account whether or not an individual has a psychiatric disorder or low educational level. Simultaneously, the study indicates that having never participated in sports activities is associated with increased suicide risk. Even if the association between sports participation and suicide would rather reflect e. g. background factors than direct effects of sports, clinicians should interpret lack of sports participation during lifetime, which could be a proxy of lack of general well-being, as an indicator of increased risk of suicide. The present study indicates that future research is needed to identify the biological, psychological, and sociological mechanisms for the protective effect of sports activities on suicide. Besides, future research on the characteristics of sports and other physical activities that mostly contribute to this protective effect is required. Therefore, more detailed questionnaires on sports participation and physical activities, which should also be valid for psychological autopsy research, are needed. In addition, more research on the potential long-term stabilizing effect of sports on the individual is necessary.

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