



## Review article

## Physical activity and suicidal ideation: A systematic review and meta-analysis



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## ABSTRACT

**Background:** A potential approach to suicide prevention that has not been closely examined, but which holds promise in terms of widespread dissemination without major side-effects, is physical activity (PA). This systematic review and meta-analysis set out to: (a) explore associations between PA and suicidal ideation (SI) levels, and (b) investigate the effect of PA interventions on SI.

**Methods:** Major electronic databases were searched from inception up to 05/2017 to identify quantitative studies reporting an association between PA and SI. A quantitative correlates synthesis and random effects meta-analysis were conducted.

**Results:** Fourteen of 21 studies in adults (67%) ( $n = 130,737$ ), 7/14 (50%) in adolescents ( $n = 539,170$ ) and 2/3 (67%) in older adults ( $n = 50,745$ ) found a significant negative association between PA- and SI-levels. Pooled adjusted meta-analysis of 14 effect sizes over eight studies and 80,856 people found that those who were “active” versus those who were “inactive” were less likely to have SI (OR = 0.87, 95%CI = 0.76–0.98). Additionally, meeting PA guidelines conferred a significant protective effect against SI (OR = 0.91, 95%CI = 0.51–0.99,  $P = 0.03$ ;  $N$  studies = 3,  $n$  people = 122,395), while not meeting guidelines was associated with increased SI (OR = 1.16, 95%CI = 1.09–1.24,  $P < 0.001$ ;  $N = 4$ ,  $n = 78,860$ ). Data from the intervention studies ( $N = 3$ ,  $n = 121$ ) was mixed and limited.

**Limitations:** Our findings are based mainly on cross-sectional studies, while the majority of studies did not include a rigorous physical activity assessment.

**Conclusions:** The current study suggests that higher PA levels are associated with lower SI. However, the associations observed need to be confirmed in prospective observational studies and controlled trials.

## 1. Introduction

Suicide, defined as deaths caused by intentional, self-inflicted poisoning or injury, represents a global public health problem (WHO,

1993). It is the 13th leading cause of years of life lost worldwide (Wang et al., 2013). Globally, there are an estimated 11.4 suicides per 100,000 people, resulting in 804,000 suicide deaths worldwide (Turecki and Brent, 2016). Non-fatal suicidal behaviors occur at significantly higher

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frequencies than suicides (Turecki and Brent, 2016). International comparisons based on the WHO World Mental Health Survey (2001–2007) data ( $n = 108,705$ ) indicate that the average twelve-month prevalence estimates are 2.0% and 2.1% for suicidal ideation (SI), and 0.3% and 0.4% for suicide attempts in developed and developing countries, respectively (Borges et al., 2010). In developing and developed countries, those who report SI within the previous 12 months have a 15.1% and 20.2% higher 12-month prevalence of suicide, respectively (Borges et al., 2010). Those who attempt suicide have a 12-month suicide risk and repeated suicide attempt risk of about 1.6% and 16.3%, respectively, with a 5-year risk of suicide of 3.9% (Carroll et al., 2014).

As there is a clear relationship between SI and attempted and completed suicide (Turecki and Brent, 2016), identifying risk factors and treatments for people experiencing SI is essential in order to reduce suicide attempts and deaths. In high-income countries, middle-aged and elderly men have the highest risk and highest SI levels, with notably increased levels among those with sleep disturbances, somatic conditions (for example, epilepsy), painful comorbidities, depression, post-traumatic stress disorder and anxiety (Conwell et al., 2011; Krysinska and Lester, 2010; Nevalainen et al., 2016; Stubbs, 2016; Stubbs et al., 2016b). Adolescent suicide rates are increasing, and suicide is the second leading cause of death in those between 15 and 29 years (Turecki and Brent, 2016). The peak incidence of SI occurs during adolescence and young adulthood, with the lifetime prevalence of SI 12–33% (Brezo et al., 2007; Nock et al., 2013). Gender is also a clear risk factor with higher rates of SI among women (Nock et al., 2008).

Psychosocial interventions including dialectic and cognitive behavior therapy for those with SI have demonstrated reductions in suicide attempts (Turecki and Brent, 2016). Although these targeted psychotherapeutic interventions are vital and effective in saving the lives of many people each year, they are not widely available. Additionally, evidence for their effectiveness is predominantly derived from those at very high risk for suicide. There is also some evidence that pharmacotherapy and in particular lithium and clozapine are effective in reducing SI among adults (Zalsman et al., 2016). However, psychotropic medications may have detrimental cardio-metabolic side-effects in adults (Vancampfort et al., 2015b) and adolescents (Galling et al., 2016).

A potential approach to suicide prevention that has not been closely examined, but which holds promise in terms of widespread dissemination without major side-effects, is physical activity. Physical activity can be defined as any activity that involves bodily movement produced by skeletal muscles and that requires energy expenditure (Caspersen et al., 1985). There is robust evidence that physical activity has been shown to reduce several important risk factors for suicide including depressive symptoms (Schuch et al., 2016), anxiety symptoms (Stubbs et al., 2017), symptoms of psychosis (Firth et al., 2015; Rosenbaum et al., 2014), post-traumatic stress symptoms (Rosenbaum et al., 2015), disturbed sleep (Kredlow et al., 2015), alcohol abuse (Hallgren et al., 2017) and chronic somatic conditions (Pedersen and Saltin, 2015). Physical activity can be delivered at low cost and, unlike traditional mental health interventions, it is generally non-stigmatizing. However, to the best of our knowledge no systematic review and meta-analysis has examined the relationship between physical activity and SI, or the effect of physical activity interventions on SI levels. As suicide risks differ across the lifespan and between men and women, this review will assess associations between physical activity and SI in (pre-) adolescents, adults, and older adults and both genders separately.

Given the aforementioned, this systematic review and meta-analysis set out to: (a) explore cross-sectional and prospective associations between physical activity and SI levels, and (b) investigate the effect of physical activity interventions on SI.

## 2. Material and methods

This systematic review was conducted in accordance with the MOOSE guidelines (Stroup et al., 2000) and in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standard (Moher et al., 2009).

### 2.1. Search criteria and study selection

Two independent authors (DV, BS) searched PubMed, CINAHL and PsycARTICLES, from database inception to May 16th, 2017 without language restrictions. Key words used were “physical activity” OR “exercise” OR “sports” AND “suicid\*” OR “self-harm” OR “self-poisoning” in the title, abstract or index term fields. Manual searches were also conducted using the reference lists from recovered articles. Clinicaltrials.gov, [www.crd.york.ac.uk/prospero](http://www.crd.york.ac.uk/prospero) and [www.who.int/trialssearch](http://www.who.int/trialssearch) were searched to identify any unpublished trials. After the removal of duplicates, the reviewers screened titles and abstracts of all potentially eligible articles. Both authors applied the eligibility criteria, and a list of full text articles was developed through consensus. Next, the two reviewers considered the full texts of these articles and the final list of included articles was reached through consensus. A third reviewer (FS) was available for mediation throughout this process.

### 2.2. Eligibility criteria

We focused on the associations between physical activity and SI (as defined by each study) and on SI and associated mental health outcomes of physical activity interventions in clinical and non-clinical populations. Physical activity was, as described above, defined as any interventions that use bodily movement produced by skeletal muscles and which requires energy expenditure (Caspersen et al., 1985). Included were studies: (a) in pre-adolescents (less than 18 years old), adults (between 18 and 65 years old), and old age people (65 years or older); (b) containing quantitative research including observational studies (cross-sectional and cohort studies) or interventional studies (pre and posttest or randomized controlled interventions) and published in a peer-reviewed journal; (c) reporting any kind of effect size [e.g., odds ratios (OR) correlations,  $t$ -tests, and ANOVA]. If both uni-/bivariate and multivariate tests were used for assessing associations, only uni-/bivariate tests were reported for consistency across studies. We excluded studies that focused on: (a) hyperactivity as an eating disorder symptom, and (b) suicide attempts or suicide-related deaths only as these are different constructs which may need a different and more intensified prevention/treatment approach (Klonsky et al., 2016). We also excluded articles if the physical activity related variable was aerobic fitness, physical activity intention, self-efficacy, or other intermediate (non-behavioral) measures because these variables are less direct indicators of actual physical activity behavior (Caspersen et al., 1985). Case reports, meeting abstracts and expert opinions were excluded.

### 2.3. Data extraction

One author (DV) extracted data using a predetermined data extraction form, which was subsequently independently validated by two authors (BS and FS). The data extracted included the type of study (cross-sectional, prospective, clinical controlled or randomized controlled trial, one-group pre- and post-test design), the country where the study was performed, age (years), gender (% male) and any specifications of the target population, the SI assessment method, the quality of the physical activity assessment method, physical activity intervention characteristics (frequency, intensity, type and time), the physical activity provider (expert provider or not: experts are defined as physiotherapists, exercise physiologists and physical educators (Stubbs et al., 2016a)), and the primary outcomes of interest including the most

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