Psychosocial outcomes of sport participation for middle-aged and older adults: A systematic review and meta-analysis

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ABSTRACT

Recent narrative reviews indicate several psychological and social benefits of sport participation for the ageing population. However, no quantitative synthesis of quantitative studies on this topic has been conducted to date. We aimed to evaluate the magnitude and heterogeneity of the effects of sport participation on psychosocial outcomes for middle-aged and older adults. Ten databases were searched in July 2020. Quantitative studies of middle-aged and older adults (> 35 years), measuring at least one psychosocial outcome of sport participation were included. We identified 25 eligible papers. Multilevel meta-analysis showed that the association between sport participation and psychosocial outcomes was small, yet significant. Moderation analyses revealed that the overall pooled effect differed according to outcome type: small to moderate associations were observed for social, positive psychological, perceived physical, and cognitive outcomes, but not for negative psychological outcomes. Risk of bias, assessed using the QualSyst tool, indicated low quality of evidence. Our findings suggest that sport participation is associated with multiple psychosocial benefits for middle-aged and older adults that appear invariant across participant-related and sport-related characteristics. We found no evidence of publication bias, but studies were underpowered and rated as low quality. Our review provides quantitative evidence for the psychosocial benefits of sport participation for adults, complementing existing qualitative literature on this topic.

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Keywords: Sport participation, mental health, middle age, older adults, psychological well-being, psychosocial outcomes, ageing

Introduction

With the rapid pace of ageing of the world's population (World Health Organisation, 2019), there is a need to understand approaches that could foster positive experiences of individuals later in life (Kim et al., 2021). Ageing is defined as a process associated with 'declines in function of the senses and activities of daily life and increased susceptibility to and frequency of disease, frailty, or disability' (National Institute on Aging, n.d.). As such, this can bring many challenges such as the deterioration of cognitive ability and well-being, and increased risk of physical and mental ailments (Choi et al., 2019; Deary et al., 2009). Physical activity (PA) is defined as any bodily movement (structured or unstructured) that leads to the expenditure of energy (Eime et al., 2013). Across all age groups, PA has widespread benefits, spanning the physical, psychological and social domains of health (Penedo & Dahn, 2005). Sport participation, which refers to a subset of PA, is defined as partaking in a specific form of PA requiring physical exertion, in which actions are governed by a set of rules, focusing on the development of physical/motor skills, and competing against other individuals or teams (Eime et al., 2013). Sport participation, particularly in team settings, can confer some additional benefits, over and above those derived from some types of PA, such as providing a social support network (Allender et al., 2006; Dionigi, 2005; Dionigi et al., 2011; Roper et al., 2003; Son & Dionigi, 2020). Recently, numerous sport-based programs are being developed and targeted towards middle-aged and older adults (Heo et al., 2018; Holt et al., 2009).

Several meta-analyses have shown that recreational football (soccer) is a health-promoting activity with broad-spectrum benefits, including improvements in cardiovascular, metabolic, and musculoskeletal functioning (Krustrup et al., 2010; Luo et al., 2018; Milanović et al., 2019). Recent narrative systematic reviews have also shown that sport participation affects psychological and social outcomes in middle-aged and older adults, such as improved well-being, emotional social-support, sense of belonging, self-esteem, and life satisfaction, as well as reduced stress, depression, and anxiety (Andersen et al., 2019; Eime et al., 2013; Gayman et al., 2017; Kim et al., 2020). Some sport-specific characteristics may influence such effects. For instance, participation in team sports has stronger dose-response associations with positive mental health indices than other forms of sport or PA (Chekroud et al., 2018; Hamer et al., 2009). This might be because of the inherent social network team sport affords (Nielsen et al., 2014). As for the evidence on the effects of highly competitive versus less competitive (i.e., recreational) sport on psychosocial outcomes, some research suggests that recreational athletes may experience greater improvements in psychological well-being than competitive athletes due to higher intrinsic aspiration towards sport participation (Chatzisarantis & Hagger, 2007).

All reviews to date on the psychosocial outcomes of sport participation have been narrative in nature (Andersen et al., 2019; Eime et al., 2013; Gayman et al., 2017; Kim et al., 2020). Andersen et al. (2019) conducted an integrative review of the social and psychological outcomes of team sport participation, and suggested that, compared with individual sports, team sports may be associated with greater positive psychological and social outcomes. They also highlighted that the inherent competitive nature of sport may be associated with either positive or negative outcomes depending on a combination of demographic factors (e.g., sex, age, health status) of the participants considered (Andersen et al., 2019). Eime et al. (2013) systematically reviewed the psychological and social benefits of sport participation for adults, and concluded that sport participation may be associated with improved psychosocial health. These authors speculated that, relative to individual sports, club-based and team-based sport may afford even better psychosocial outcomes due to the intrinsic social nature of team sports (Eime et al., 2013). Gayman et al. (2017) conducted a systematic review of older adults' sport participation and noted the possibility of gender differences in how adults' perceived their own ageing. They also highlighted that sport participation affords positive cognitive outcomes for older adults, but may be associated with both positive and negative emotional and social outcomes; although perceived as enjoyable and a means to build social relationships, sport participation has also been a source of increased frustration resulting from changed functional capacity and performance declines, as well as a perceived lack of support from peers and family (Gayman et al., 2017). Kim et al. (2019) concluded that sport participation may be associated with psychosocial benefits including enhanced life satisfaction, social life, and psychological health.

However, narrative reviews have methodological shortcomings in that such reviews may be subject to biased interpretations of findings (Hunter & Schmidt, 2004). Contrastingly, a meta-analytic approach enables a more objective evaluation of the direction and magnitude of the associations in the reviewed literature (Lipsey & Wilson, 2001). Further, a meta-analysis enables a quantitative assessment of potential moderators and explanation of heterogeneity that exists in the literature. This is important as there is a need to assess variations in psychosocial functioning of ageing adults resulting from demographic and sport-specific factors (Weir, 2010; Young et al., 2015). Further, in contrast to narrative reviews, a meta-analysis provides estimates of study quality, publication bias and statistical power of the literature, and can correct effect sizes for studies that are inadequately powered (Hunter & Schmidt, 2004).

It is also important to systematically evaluate the use of theoretical frameworks in this literature. This is because in order to understand the mechanisms of action, psychological theory should underpin health behaviour change research (Michie et al., 2005). Previous reviews have discussed the theoretical implications of sport participation (e.g., Grima et al., 2017). Extending these reviews, we sought to examine the extent to which psychological theory has informed the design of sport interventions. In the extant literature, it is unclear how many interventions targeting sport participation for ageing adults were explicitly informed by psychological theory, and of those which did, which theories have been shown to be associated with improved psychosocial outcomes.

The purpose of this meta-analysis was to quantitatively assess the association between sport participation and various psychosocial outcomes, and moderators of these associations, for people over the age of 35. We also aimed to rate the quality of the included evidence, their statistical power, and the extent of publication bias. Another purpose was to assess whether psychological theories were utilised as a guiding framework for implementation in the included studies.

Method

The meta-analysis was registered with PROSPERO (Registration Number: CRD42020178043) and the Open Science Framework (OSF; https://osf.io/mqcu5/). Procedures were conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Page et al., 2021).

Search Strategy and Study Selection

The lead author (HS) developed the search strategy in collaboration with two academic librarians and with input from the co-authors. The systematic literature search was conducted in July 2020 using 8 databases: CINAHL Plus, Cochrane Library, Medline (Ovid), PsycINFO, PubMed, Scopus, SPORTDiscus, and Web of Science. Additionally, we hand-searched ProQuest Dissertations & Theses to locate any unpublished work, and manually searched Google Scholar (filtered from 01/01/2020 onwards) to identify 'in press' articles not catalogued in the databases searched. We also conducted forward and backward searches of eligible articles to identify further eligible articles. The search strategy involved a combination of 3 strings of key terms covering psychosocial outcomes, sport participation, and ageing (search strings and a detailed search strategy are provided in the Supplementary Material; see Table S1).

The study selection process is shown in the PRISMA flow diagram (Figure 1). We conducted a two-stage screening process – the titles and abstracts were reviewed by HS to assess eligibility, followed by a full-text review of the eligible articles conducted by two authors (HS and MDM) to identify articles for inclusion in the meta-analysis. A third author's (NN) input was sought when HS and MDM disagreed on the eligibility of some studies. The inclusion and exclusion criteria were constructed in accordance with the PICO framework (Table 1) (Schardt et al., 2007).

[Figure 1 near here]

[Table 1 near here]

Type of Participants

Middle-aged and older adults (aged 35 years and above) who participate in sport were included. This age criterion was chosen to reflect the fact that the majority of Masters' Sports and Senior Games events (i.e., sport competitions that are specifically designed for older people who may continue to partake in, or return to, a form of competitive sports following the conclusion of their sports careers) include participants aged 35 and older (Tayrose et al., 2015).

Type of Intervention

Any form of sport participation was included – from low level (i.e., recreational) to high level (i.e., competitive). If sport was one part of a multicomponent intervention, the study was not included. Contrived or adapted forms of sport (e.g., floorball, walking football) were included. Physical activities, such as running and swimming, were considered sports only if some competitive elements were evident.

Type of Comparator

Control (e.g., no intervention, wait-list control) and exercise (i.e., purposive, repetitive, planned, and structured PA with the objective of improving physical fitness) (Caspersen et al., 1985) groups were the comparators. Studies including other sport comparators were not included.

Type of Outcome

Psychosocial outcomes were the focus of this review. These were broadly classified as perceived physical functioning (e.g., perceived health status), cognitive functioning (e.g., memory), social functioning (e.g., social support), positive psychological outcomes (e.g., well-being), and negative psychological outcomes (e.g., depression). Positive and negative psychological outcomes were segregated to reflect their conceptualisation as independent constructs (Keyes & Lopez, 2009).

Data Extraction

HS extracted data using a data extraction form developed by the authors. Information pertaining to study characteristics (e.g., author, year), participant characteristics (e.g., gender, age), sport participation (e.g., sport type, context), and outcome characteristics (e.g., outcomes measured) were coded. Statistical information (e.g., means, standard deviations, sample size, test summary statistics) was extracted to calculate effect sizes (ES's). Where these details were unavailable, corresponding authors were contacted to request this information, and where possible, these were manually calculated based on the available information. When correlation coefficients were required for ES calculation but were unreported, we consulted previous literature and used the coefficients reported as a proxy for ES calculation. Data extraction was conducted by HS and checked by DFG for completeness.

Risk of Bias Assessment

Risk of bias was assessed using the QualSyst tool (Kmet et al., 2004). This 14-item tool was chosen as the items are applicable to all quantitative study designs included in this meta-analysis (i.e., experimental and correlational). Risk of bias was coded by HS and 30% was randomly checked by MDM to ensure agreement on the ratings assigned (K = .85). Consistent with previous research (Henry et al., 2016; Jenkin et al., 2017), studies were classified as ‘strong’, ‘moderate’, or ‘weak’ based on the classification used by Henry et al. (2016) where a quality rating summary score of over .8 out of a maximum of 1 is considered ‘strong’, a score between .61 and .8 is considered ‘moderate’, and below .6 is rated as ‘weak’.

Statistical Analysis

We conducted a three-level random-effects meta-analysis, in order to account for dependencies between ES’s and to allow for separating variances that could occur at three different levels (Cheung, 2014, 2019) (i.e., sampling variance of individual effects, variance between ES’s from the same study, variance between studies). Hedges’ *g* (Lakens, 2013) was the ES metric used, and standardised mean differences were calculated from the available information as a summary measure of ES, using formulae from the Cochrane Handbook of Systematic Reviews. Where this information was unavailable, we used summary statistics (e.g., *t* scores, *p* values) to calculate ES’s (Lakens, 2013). When studies included multiple comparison groups (e.g., exercise and control groups), ES’s were calculated for both pairs (i.e., sport vs exercise group and sport vs control group). When outcomes were measured at multiple time-points, ES’s were calculated for each of these time points, and dependencies were accounted for in the subsequent analyses. A forest plot was constructed to visualise the distribution of ES's. Statistical heterogeneity was assessed using I^2 (Higgins et al., 2003).

Moderation analyses were conducted to assess the extent to which study characteristics (e.g., study design), participant characteristics (e.g., age), and sport characteristics (e.g., sport type) explained heterogeneity in ES's. When studies did not report information required to code a particular moderator, these studies were excluded from that specific moderation analysis. As part of the moderation analysis, dose-response effects for intervention-based studies were to be assessed using frequency, intensity, and duration as moderators. However, due to unavailability of sufficient information regarding frequency and intensity, dose-response effects were assessed by examining intervention duration as a moderator. Publication bias was assessed using Egger's test (Egger et al., 1997) and funnel plots. A *p*-curve analysis was conducted to assess the evidentiary value of the summarised literature (Simonsohn et al., 2014). Risk of bias was also tested as a moderator to identify possible publication bias. Sensitivity analyses were also conducted to test robustness of findings by removing outliers and re-running analyses. All statistical analyses were conducted using the *metafor* and *dmetar* packages on R (Harrer et al., 2019; Viechtbauer, 2010). Additionally, to assess the overall quality of evidence contributing to the meta-analysis, the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) tool was used (Guyatt et al., 2008).

Results

Study Selection

A summary of the study selection process is presented in Figure 1. Of the articles screened in the database search, we identified 29 eligible studies. Forward and backward searches of these papers yielded 4 additional eligible articles. One pair of studies (Bjerre, Brasso, et al., 2019; Bjerre, Petersen, et al., 2019), and a set of three studies (Ide et al., 2020; Tsuji et al., 2019; Tsuji et al., 2018) reported results from the same cohort; we coded these individual papers as the same study for the purposes of accounting for dependency in the ES's. We were unable to obtain the information required to calculate ES's for 8 studies (see Table S2), despite two email requests to the authors. This resulted in 25 studies included in the meta-analysis.

Study Characteristics

The 25 included studies were published between 2010 and 2020, yielding 166 ES's. Across these studies, 166,252 participants were sampled, comprising 54% female participants, with an average age of 73.40 years (range: 35-92 years). Fourteen of these studies adopted an experimental design comparing sport participation with either exercise participation or control group comparators; eleven were cross-sectional studies. Of the 166 ES's, 38 were perceived physical outcomes, 57 were cognitive outcomes, 30 were positive psychological outcomes, 27 were negative psychological outcomes, and 14 were social outcomes (Table S3).

Risk of Bias

Overall, 11 studies were rated as 'strong', 12 studies as 'moderate', and two studies (Dahmen-Zimmer & Jansen, 2017; Würth et al., 2015) were rated as 'weak' (Table S4). In these two studies, the key criteria insufficiently addressed were: (1) performing random allocation, (2) blinding participants and investigators, and (3) controlling for confounding factors or reporting if or how this was done. Across all studies, the key sources of bias corresponded to poor reporting of outcome and exposure measures, low sample size, and insufficient reporting of all results. In most cases, this was due to the poor and inconsistent reporting of details within the papers, to fulfil the requirements of the scoring key of the

QualSyst tool (Kmet et al., 2004).

Overall Effect of Sport Participation on Psychosocial Outcomes

The overall effect of sport participation (166 ES's, k = 22) on psychosocial outcomes was small (g = .33, se = .09, 95% CI = .16, .50; Figure 2). Further, with 95% confidence, the ES from a new study is likely to be anywhere between the wide range of -0.65 and 1.31 (Hedges' g). Significant within-study (level 2; LRT = 186.44, $p < .001$) and between-study variances (level 3; LRT = 46.37, $p < .001$) were noted, which explained 42.72% and 50.86% of the total variance, respectively, as indicated by log-likelihood tests. Given the considerable heterogeneity among ES's (I^2 = 93.58%), moderation analyses were conducted to consider factors that may be responsible for the between-study variance (Higgins et al., 2003).

[Figure 2 near here]

Sensitivity tests

Sensitivity tests were conducted to assess the effect of extreme values on the pooled effects. For outliers that deviated extensively from the overall pattern observed, one study reported two effects for which residuals exceeded three standard deviations (dos Santos et al., 2019). By removing these two effects, the overall effect of sport participation on psychosocial outcomes reduced by .01 (g = .32, se = .08, 95% CI = .16, .48). For influential studies that have a large effect on the regression slope, 15 effects from 11 studies (Dahmen-Zimmer & Jansen, 2017; dos Santos et al., 2019; Ejiri et al., 2019; Geard, Rebar, Dionigi, Rathbone, et al., 2021; Geard, Rebar, Dionigi, & Reaburn, 2021; Ide et al., 2020; Leung et al., 2020; Östlund-Lagerström et al., 2015; Stone et al.; Witte et al., 2016; Würth et al., 2015) were found to have a Cook's distance of more than three times the mean; however, exclusion of these outliers did not influence the overall effect of sport participation on psychosocial outcomes (g = .33, se = .09, 95% CI = .14, .51). Therefore, the overall effects remained largely unchanged as a result of extreme values in the literature.

Moderator Effects

Of 13 candidate variables assessed (see Table 2), only the type of outcome moderated the overall effect previously observed, $F(4, 161) = 4.11$, p =.003. In particular, the effect of sport participation was strongest for social outcomes (g = .51 [.21, .81]). Small to moderate-sized effects were noted for positive psychological outcomes (g = .45 [.22, .68]) and perceived physical outcomes (g = .43 [.21, .65]). The effect of sport participation was small, yet significant, for cognitive outcomes (g = .25 [.00, .50]). No effects were observed for negative psychological outcomes (g = .01 [-.24, .26]). Outcome type, when included as a moderator within the overall model, significantly reduced heterogeneity: Cochran's $Q(165) = 990.62$, p <.001. However, the residual heterogeneity remained statistically significant, $QE(161)$ = 949.96, p <.001. Model comparisons suggest that the model that included outcome type as a moderator was a better fit (AICc = 236.86, BIC = 257.94), compared to the overall model without any moderators (AICc = 243.73, BIC = 253.07). No other moderators significantly modified the overall effect.

[Table 2 near here]

Assessment of Meta-Bias

Visual inspection of the funnel plot suggested some degree of uneven distribution of ES's on either side of the mean effect; smaller studies appear to exhibit stronger positive effects of sport participation on psychosocial outcomes (Figure 3). However, Egger's test, t (20) = -.12, p = .90, indicates symmetry in the funnel plot. A power-enhanced sunset funnel plot (Figure 3) revealed that the median power of the primary studies is 18.2%, assuming an effect of g = .30; the true ES's required to achieve a median power of 33% and 66% is more substantial (δ = .44 and δ = .68, respectively). The summarised literature may be unlikely to replicate (R-index = 1.5%), assuming a true effect of .30 (the smallest effect size of interest; p = .05). Moderation analyses for meta-bias suggest that the magnitude of effects noted were invariant to differences in sample size, $F(1, 164) = 0.05$, $p = .82$, publication status, $F(1, 164) = .01$, $p = .92$, and study quality, $F(1, 164) = 0.04$, $p = .84$. A *p*-curve analysis demonstrated right skewness, with 89% of statistically significant p-values being $\leq .025$ with high power (99%, 90% CI = 99%, 99%), suggesting evidential value (i.e., a true underlying effect) in the present findings (see Figure S1).

[Figure 3 near here]

GRADE Assessment

Serious concerns were noted pertaining to risk of bias (Table S5) (Guyatt et al., 2008). A large proportion of the summarised literature presented correlational evidence and was rated as providing low certainty of evidence. A large proportion of between-study heterogeneity remained unexplained, even after moderation analyses. As we were unable to obtain data for eight studies (24% of the eligible studies), these studies were not included. Therefore, the level of certainty of evidence was classified as low.

Deviations from Protocol

There were minor deviations from the protocol. Our protocol stated that behavioural outcomes (e.g., psychomotor skills, physical activity engagement) would be assessed. However, we subsequently deemed these outcomes to be physical in nature, rather than psychosocial, and therefore, excluded them from our analysis. The protocol also mentioned the use of the *metaSEM* package (Cheung, 2015) for statistical analysis, however, we decided to use *metafor* (Viechtbauer, 2010) and *dmetar* (Harrer et al., 2019) because we focused on group differences rather than testing a theoretical sequence. Furthermore, none of the studies explicitly mentioned utilising psychological theories to guide their research. Therefore, although our protocol stated that the different psychological theories used would be coded and analysed as a moderator, it was impossible to do so.

Discussion

Our meta-analysis provides the first quantitative synthesis of quantitative studies on the psychosocial outcomes associated with sport participation for middle-aged and older adults. The main findings from the 25 included studies suggest that sport participation in these age groups is positively associated with an array of psychosocial outcomes. However, the overall effect was small and heterogeneous.

Narrative systematic reviews highlight that sport participation stands as a unique opportunity for adults to build social networks and provides a sense of belongingness (Allender et al., 2006). Our findings further reinforce these assertions, indicating that sport participation may be particularly important for social outcomes (e.g., social support, reduced social isolation). Oja et al. (2015) meta-analysed a body of literature showing the relevance of sport participation for some indicators of objective physical health (i.e., VO_{2max}, resting heart rate, and fat mass); our findings extend such findings for perceived physical health outcomes. In terms of cognitive outcomes, the small significant effect we found aligns with results of another meta-analysis evaluating the influence of PA on cognitive functioning in adults over 50 years of age (g = .29) (Northey et al., 2018). Sport participation could have the greatest influence on cognitive outcomes for children and young adults, a period of high neuronal plasticity and neurocognitive development (Felfe et al., 2016). As adults age, PA may protect against age-related cognitive decline (Paillard, 2015; Tyndall et al., 2018).

Prior systematic reviews suggest that sport participation could improve adults' psychological health and reduce negative psychological outcomes (Andersen et al., 2019; Eime et al., 2013; Gayman et al., 2017; Kim et al., 2020). However, our meta-analysis suggests that although there may be an overall effect on psychosocial outcomes, this is modest in size, and is stronger for positive (e.g., well-being, life satisfaction), rather than negative (e.g., depression, anxiety), outcomes. Individuals experiencing poor psychological health report low enjoyment of PA, as well as high dropout from PA (Rosenberg et al., 2010). Hence, these individuals may be less likely to choose to participate in sport.

All other moderators tested were non-significant – in some cases, these findings are encouraging. For example, demographic characteristics such as age, sex, and health status did not explain the heterogeneity observed. These findings are in line with Eime et al. who advocated that sport enables adults of all ages to experience several psychosocial benefits (Eime et al., 2013). Andersen et al. (2019) also concluded that team sport participation is associated with improved psychosocial outcomes, regardless of age or health status. Individuals, irrespective of age, sex, or health status, may be aware of their physical capabilities and skill level, and engage in sports that are appropriate for them, allowing for enjoyment of the activity and associated psychosocial benefits. Taken together, our moderation analysis suggests that sport participation may have significant positive, albeit small to moderate, associations with diverse psychosocial outcomes for population groups aged 35 year or older, supporting public health initiatives encouraging sport participation for all (Khan et al., 2012). However, sport participation does not automatically translate into sustained exercise behaviour change across the ageing population (Kelly & Barker, 2016). Therefore, policies promoting sport participation for the ageing population should consider the social, economic, cultural, and political environment that provides the conditions which enable people to make healthy lifestyle choices and maintain sport participation long-term (Gard et al., 2018). Further, in the context of research, a selection bias, such as the healthy user bias, is important to consider (Shrank et al., 2011); compared with individuals not engaging in sport, individuals participating in sport are more likely to already be experiencing good health, and are more likely to have the ability, means, and desire to maintain such participation (Dionigi & Gard, 2018; Eime et al., 2013).

Systematic reviews suggest that, broadly, team sports and recreational participation, as opposed to individual sports and competitive level participation, may afford better psychosocial outcomes (Andersen et al., 2019; Eime et al., 2013). In contrast, our meta-analysis revealed that the type of sport (i.e., team or individual sport) and context of participation (i.e., recreational or competitive) were not significant moderators. Sport participation, whether within team or individual sports, may still provide a social network of others involved in the sport through affiliation with a sports club, particularly for ageing adults who may have fewer avenues to seek out social interaction (Nicholson, 2012). Sport variation (i.e., adapted or normal version of sport) was also unable to explain the observed heterogeneity. Older adults are known to have some specific challenges to participate in sport due to poor physical health, lack of appropriate sport opportunities, and limited accessibility of sport facilities and resources (Bethancourt et al., 2014; Schutzer & Graves, 2004). Older adults also have some unique motives to participate in sport such as maintaining health, finding opportunities to build relationships and feeling part of a team (Stenner et al., 2020), which ultimately could result in different outcomes for middle-aged and older adults. Middle aged and older adults are a heterogeneous group, and therefore, require unique and diverse strategies to create appropriate and viable opportunities for sport participation (Jenkin et al., 2017). However, our findings indicate that participating in sport in any form and context can enable both middle-aged and older adults to experience the associated psychosocial benefits.

Program duration for sport interventions was not found to influence psychosocial outcomes, indicating that a dose-response association between sport participation and the measured psychosocial outcomes, in terms of duration, may be unlikely. This contradicts evidence from large-scale surveys concluding that a dose-response association may exist between sport participation and mental health outcomes (Chekroud et al., 2018; Hamer et al., 2009). However, these studies assessed frequency in addition to duration of PA. Our meta-analysis only included intervention programs (with an average duration of 19.6 weeks) to examine the dose-response association. Information pertaining to other parameters of dose (i.e., frequency and intensity) was inconsistently reported in the literature, and hence, could not be tested. Therefore, the dose-response association noted in prior literature (Chekroud et al., 2018; Hamer et al., 2009) may depend on frequency and intensity to a greater extent than merely duration. We did not have information for duration of prior sport participation in correlational studies, and therefore this could not be included in testing the dose-response association. Therefore, it is not possible to generalise our findings to existing community-based sport participation. Volitional long-term sport participation within the community, outside research intervention projects, may be more intrinsically enjoyable and provide the dose-response benefits highlighted in the existing literature (Eime et al., 2013).

From a methodological perspective, although the funnel plot indicates that smaller sample size studies tended to report larger effects, this is quite commonly noted for underpowered studies (Brysbaert, 2019). Sample size, study design, comparator used, publication status, and study quality were not significant moderators of the overall effect, and did not explain the observed heterogeneity. Further, we found no evidence of publication bias. These findings suggest that the strength of the observed effects was invariant to the methodological aspects considered. Given the overall low observed power among eligible studies, it may be that the experimental studies were insufficiently powered to detect stronger effects than correlational studies.

Strengths of this study include the use of multilevel analyses to account for dependencies among effect sizes, the wide range of moderators assessed to explore heterogeneity, and the testing for power of studies. Our findings also highlight different ES's for different types of psychosocial outcomes, which has not been identified previously.

There are some limitations to consider when interpreting the findings of this review. To facilitate ease of the moderation analyses, we classified outcomes into broad groups (e.g., social, cognitive). When sample sizes permit, future meta-analyses may consider more specific psychosocial outcomes within the broad categories considered; for instance, the effect of sport participation on attention and processing speed may differ from that on memory.

Limitations of the primary studies restricted the scope of our analyses. None of the included studies explicitly mentioned utilising psychological theory to inform their research. However, interventions driven by psychological theory are shown to effectively improve long-term adherence and psychosocial outcomes, such as psychological need satisfaction, in other PA settings such as exercise (Ntoumanis et al., 2017; Teixeira et al., 2012). The lack of information regarding theoretical frameworks meant that it was impossible to consider the effectiveness of different conceptual frameworks as originally intended. Authors may consider reporting intervention-based studies in accordance with the TIDieR checklist, to ensure completeness of information provided (Hoffmann et al., 2014).

Several moderators tested in the analysis were exploratory in nature. Education level of participants, location of sport participation, and whether sports were single-gender or mixed-gender were inconsistently reported in the literature, and hence, we were unable to test these variables as moderators in the present meta-analysis. Some moderators, namely publication type and health status, were underpowered, due to unavailability of information and inconsistent reporting of these details in the primary studies, yet we included and reported these in the analysis to ensure transparency of reporting. Therefore, these findings should be interpreted with caution, and verified in future research. A large proportion of included studies ($n = 11$) were cross-sectional, and therefore, causality cannot be inferred from those studies. Following GRADE recommendations (Guyatt et al., 2008), the empirical base needs to be carefully considered due to the low quality of evidence. In the future, researchers should aim to address potential confounding factors and may wish to adopt more rigorous methods such as randomisation and blinding of participants.

Many studies failed to report factors known to have a key role in influencing psychosocial outcomes of sport participation. Motivation is one such factor that is widely known to influence well-being outcomes across a range of contexts (Ryan & Deci, 2000). Specifically, a meta-analysis by Ntoumanis et al. (2020) concluded that, within a health context, motivational variables based on self-determination theory are significant predictors of psychological well-being. Equally, forming strong social identities is of benefit for sport participants' health-related behaviours and outcomes (Stevens et al., 2020). Given that in our meta-analysis social outcomes were found to have the strongest ES's, it is likely that social identity may have been a contributing factor. Future research may consider testing such variables (i.e., motivation and social identity) as mediators of the effects of sport participation on psychosocial outcomes.

Conclusion

The meta-analysis found that sport participation was positively linked with a significant, albeit small, association with psychosocial outcomes in adults 35 years of age and older. The present findings reinforce the potential of sport as a health-supporting activity for individuals who might not be attracted to other types of physical activity, and affirm the psychosocial benefits of sport participation for a section of the ageing population. Further, these findings highlight the conditions under which these benefits are likely to be experienced, which provides valuable evidence to inform the design of future sport interventions to meet the preferences and needs of diverse sections of the ageing population. The psychosocial benefits of sport participation did not differ by participant-related or sport-related characteristics. Therefore, participation in any form of sport can reap benefits in terms of social, positive psychological, perceived physical, and cognitive outcomes, in addition to the widely known benefits for objective physical health.

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Availability of data and material. The datasets analysed during the current study are available from the corresponding author on reasonable request.

Contributors. HS contributed to the development of the research idea, design of the study, the literature search, data screening and extraction, conducting of statistical analysis, and managed all aspects of manuscript preparation and submission. DFG contributed to data screening and extraction, and conducting of statistical analysis. MDM assisted with data screening, extraction and quality assessment. EQ contributed to the development of the research idea and design of the study. NN conceived the research idea, contributed to the design of the study, provided methodological and theoretical input, assisted with data screening, and writing and editing of the manuscript. All authors provided methodological input and theoretical expertise contributing to the production of this manuscript, and reviewed and approved the final version.

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Table 1. Inclusion and exclusion criteria

	Inclusion criteria	Exclusion criteria
Type of studies	English language Quantitative data (for effect size calculation) All study designs	All other languages Qualitative data (or insufficient quantitative data available, despite requests made to authors, for effect size calculation)
Type of participants	Middle-aged and older adults (35 years and older) Any health status Any gender	Children and young adults (aged below 35 years)
Type of interventions	Sport participation[a]	All other forms of PA Interventions using sport participation as part of a larger multicomponent program
Type of comparators	Exercise participation groups and control groups	Comparators involving other interventions (e.g., mindfulness training)
Type of outcomes	Psychosocial outcomes[b] pertaining to self-reported/perceived physical health, positive psychological outcomes, negative psychological outcomes, cognitive outcomes, and social outcomes	All other outcomes (e.g., physical, behavioural)

[a] sport participation was defined in a manner similar to prior reviews, namely, as partaking in a specific form of PA requiring physical exertion, in which actions are governed by a set of rules, focusing on the development of physical/motor skills, and competing against other individuals or teams (Eime et al., 2013). Contrived forms of sport (e.g., pickleball, lifeball) that have been specifically designed for older adults were included if they met the definition of sport participation. In the case of studies involving sports such as running and swimming, these were considered on a case-by-case basis, and included only if the study explicitly mentioned that participants competed against other individuals or teams.

[b] psychosocial outcomes were defined as constructs tapping psychological and/or social processes (Andersen et al., 2019). Broadly, these were classified as perceived physical outcomes (i.e., individuals' perceptions of their own health status and functioning), positive psychological outcomes (i.e., beneficial affect-based mental health outcomes), negative psychological outcomes (i.e., detrimental affect-based mental health outcomes), cognitive outcomes (i.e., involving thinking and information processing), and social outcomes (i.e., involving interpersonal interactions between individuals within a sport group).

Table 2. Moderator analyses of the effect of sport participation on psychosocial outcomes

		Psychosocial Outcomes
Moderator	K	*g* (95% CI)
Percentage female		
Intercept	19	.375 (.182, .567)***
Slope		-.129 (-.776, .518)
Sample size	22	
Intercept		.329 (.153, .504)***
Slope		.000 (-.000, .000)
Age[a]	22	
Aged 65 or older	17	.393 (.205, .580)***
Aged under 65	6	.162 (-.123, .446)
Sport Type	22	
Team sport	6	.427 (.098, .755)*
Individual sport	11	.185 (-.042, .413)
Both	5	.564 (.214, .914)**
Sport Context	22	
Recreational	16	.274 (.070, .477)**
Competitive	6	.466 (.152, .780)**
Comparator Type[a]	22	
Control group	18	.348 (.156, .540)***
Exercise group	6	.273 (-.038, .583)
Intervention Duration in number of weeks	12	
Intercept		.188 (.036, .340)*
Slope		.002 (-.003, .007)
Outcome Type[a]	22	
Perceived Physical	15	.426 (.206, .645)***
Cognitive	10	.248 (.001, .496)*
Positive Psychological	14	.449 (.222, .677)***
Negative Psychological	12	.007 (-.241, .255)
Social	6	.508 (.210, .806)***
Publication Type	22	
Published	21	.333 (.152, .513)***
Unpublished	1	.290 (-.494, 1.074)
Study Design	22	
Cross-sectional	10	.484 (.246, .721)***
Experimental	12	.193 (-.031, .417)
Risk of Bias as QualSyst summary score	22	

Intercept		.331 (.155, .506)***
Slope		-.147 (-1.559, 1.264)
Health Status	22	
Unknown	19	.361 (.176, .546)***
Diagnosed health condition	3	.123 (-.358, .605)
Variation of sport	20	
Adapted	9	.211 (-.077, .499)
Normal	11	.394 (.154, .634)**

Notes: K = number of studies, *g* = Hedges *g*, CI = confidence interval, * = p < .05, ** = p < .01, *** = p < .001.

Sport type was coded as 'team sport' if participation typically involved participants being embedded within a team, 'individual sport' if participants were not part of a team and played against other solo opponents, and 'both' if the sport could have been played either individually or as part of a team, or if the study included a combination of team and individual sports.

Sport context was coded as 'competitive' if participants: "(i) were preparing (engaging in a training programme) for a major competition (i.e., national, international competition), and had a clear competitive goal to accomplish; (ii) competed at international, national, or regional level; or (iii) were making a living out of competing in a sport." Context was coded as recreational if these criteria were not met.[21]

Health status was coded based on the information reported in each study. If a diagnosed health condition was explicitly used to describe sport participants, the studies were coded as such. If this was not explicitly mentioned, the studies were coded as 'unknown'.

Variation of sport was coded based on the type(s) of sport each study included. If participants engaged in the standard version of commonly played sports, these studies were coded as such. Contrived forms of sport specifically designed for older adults were coded as adapted sports (e.g., walking football).

[a] For age, comparator type, and outcome type, some papers reported results for multiple categories separately, and effect sizes were calculated and coded as such. Hence, as a result of this overlap, the reported K for each category does not add up to the total number of studies included within each of these moderation analyses.

Figure 1. PRISMA flow diagram

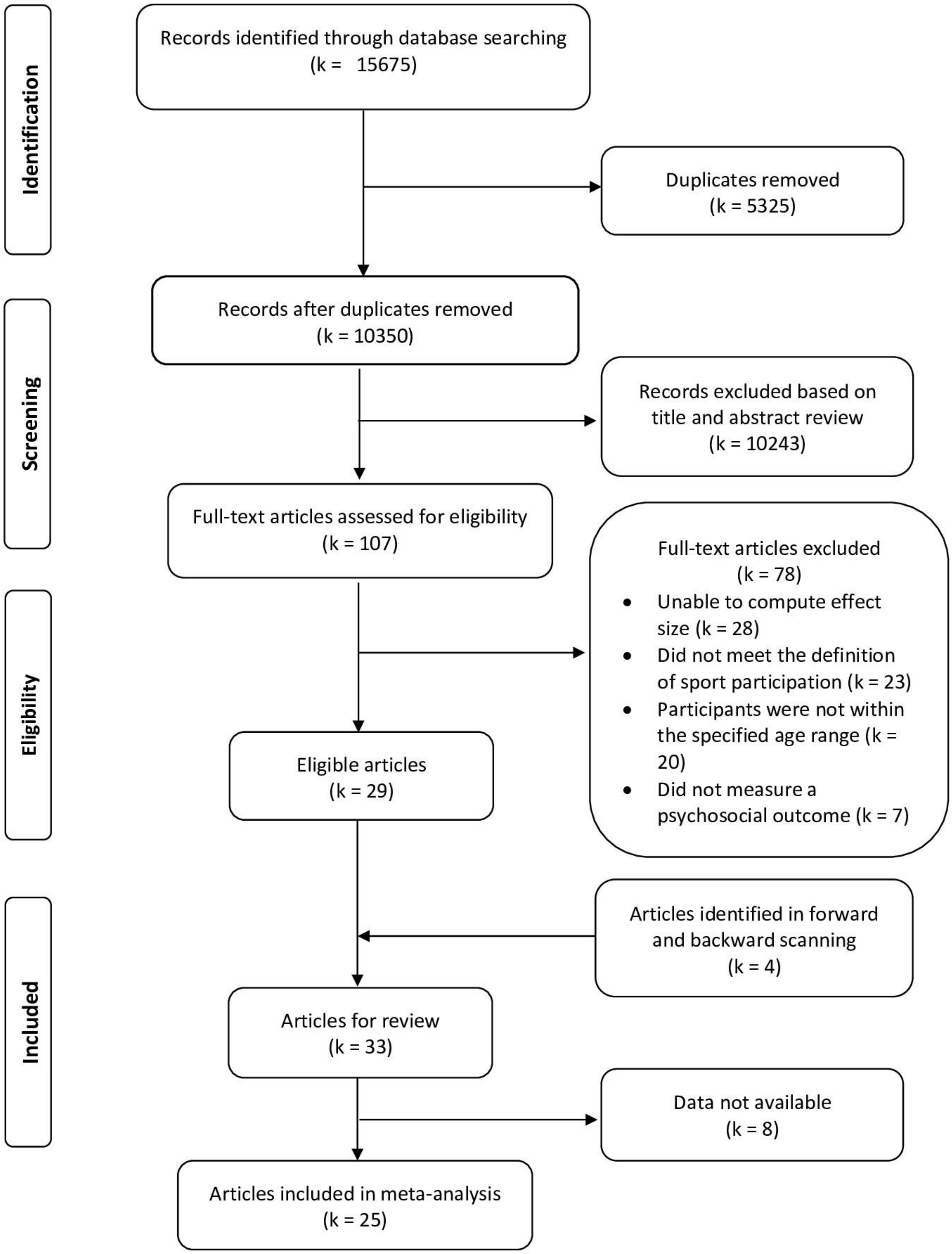
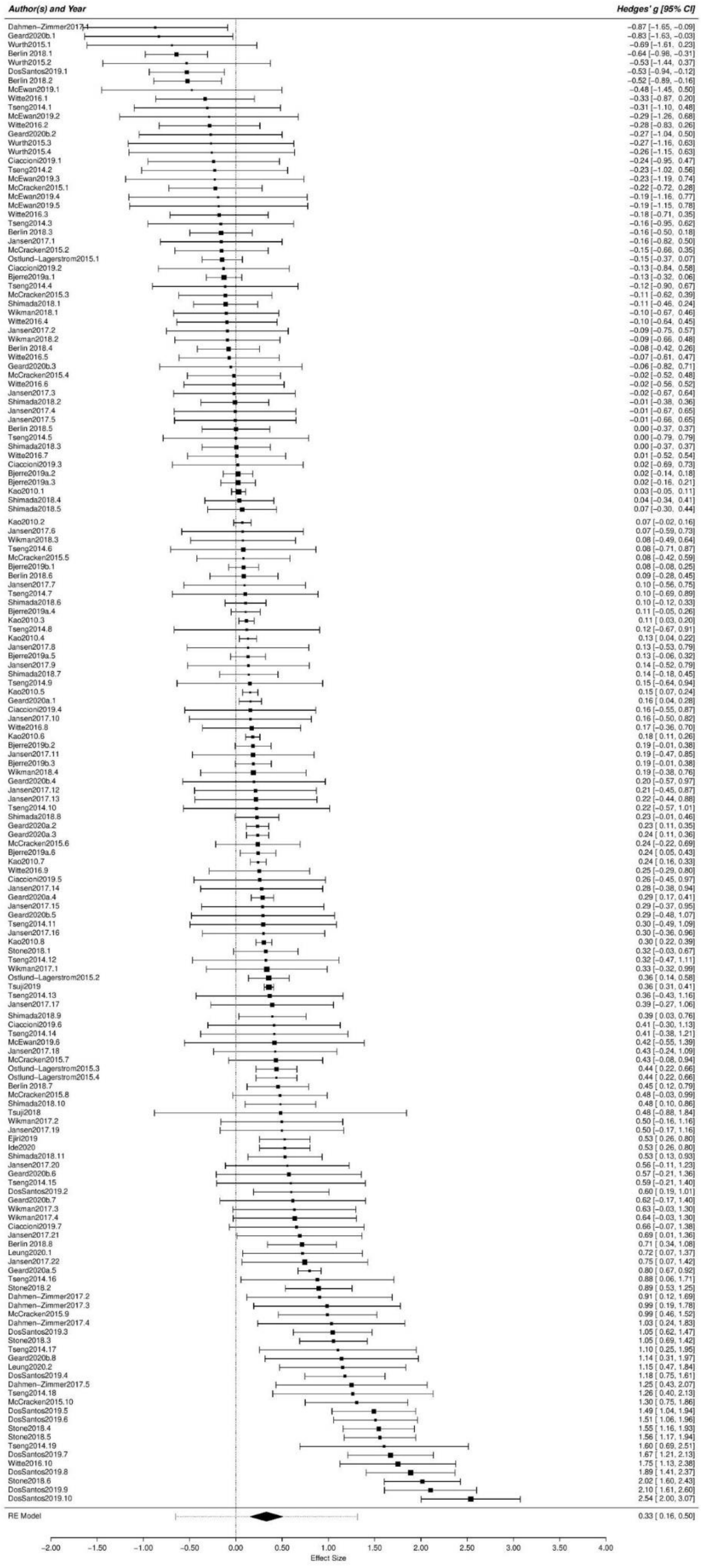
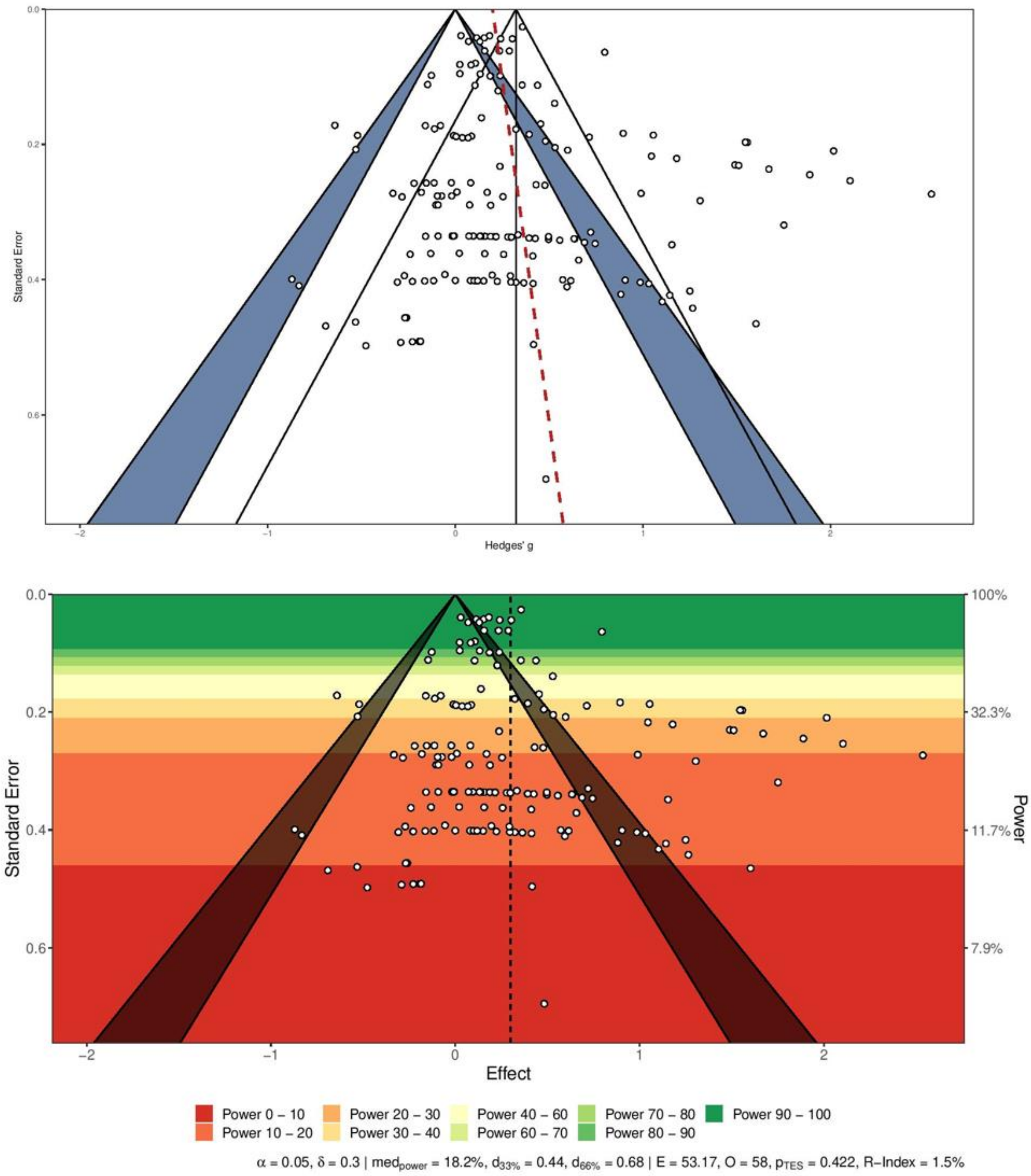


Figure 2. Forest plot of effect sizes and 95% CIs for all psychosocial outcomes



Note: Squares represent each individual effect size; the size of each square reflects the relative sample size. The diamond represents the overall effect size (g = .33) and 95% CI; horizontal lines represent prediction intervals for the overall effect and each individual effect size. The vertical line represents a null effect. CI = confidence interval; RE = random effects.

Figure 3. Contour-enhanced funnel plot (top) and power-enhanced sunset funnel plot (bottom) of effect sizes



Note: The sunset plot depicts effect sizes plotted within colour-coded power regions. Each individual effect size is plotted against its standard error, with the vertical line representing the overall summary effect size (g = 0.33). Shaded triangular panels represent the 95% and 99% confidence intervals for the overall effect size.