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Better together: How group-based physical activity protects against depression

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ABSTRACT

Against the backdrop of evidence that physical activity can protect against depression, there has been growing interest in the mechanisms through which this relationship operates (e.g., biological adaptations), and the factors that might moderate it (e.g., physical activity intensity). However, no attempt has been made to examine whether, or through what mechanisms, depression-related benefits might arise from belonging to *groups* that engage in physical activity. Across two studies, we addressed these shortcomings by (a) examining whether engaging in physical activity specifically in the context of sport or exercise groups protects against depression and (b) testing two pathways through which benefits might arise: greater physical activity and reduced loneliness. Study 1 ($N = 4549$) used data from three waves of a population study of older adults residing in England. Sport or exercise group membership predicted fewer depression symptoms four years later. This relationship was underpinned by sport or exercise group members engaging in physical activity more frequently and feeling less lonely. Clinical depression rates were almost twice as high among non-group members than group members. Study 2 ($N = 635$) included Australian adults who were members of sport and exercise groups, recruited during the enforced suspension of all group-based sport and exercise due to COVID-19 restrictions. The more sport or exercise groups participants had lost physical access to, the more severe their depression symptoms. Clinical depression rates were over twice as high among those who had lost access to >2 groups compared to those who had lost access to <2 groups. The relationship between number of groups lost and depression symptom severity was mediated by greater loneliness, but not by overall physical activity. Overall, findings suggest that belonging to groups that engage in physical activity can protect against depression, and point to the value of initiatives that aim to promote people's engagement in such groups.

Depression is a leading cause of disability, currently affecting approximately 264 million people worldwide (James et al., 2018). Characterised by symptoms including low mood, fatigue, disinterest in activities, and suicidal thoughts or attempts, it has a substantial negative impact on quality of life and is a strong predictor of premature death (Jia et al., 2015; Steensma et al., 2016). Moreover, estimates suggest that, in the United States alone, the total economic cost of major depression disorder is US$210million per year (Greenberg et al., 2015). Like mental health more generally, depression is best viewed as a continuum on which everyone falls (Keyes, 2002). A majority of people will experience sub-clinical symptoms at some point in their lives such that, while they may not be included in estimates of depression prevalence or cost, they nevertheless experience psychological distress and impaired functioning. Indeed, given that the onset of a first depression episode can also happen at any time in life, identifying malleable risk and protective factors for depression in the population is a vital agenda for research.

Over the last two decades, growing evidence has indicated that physical activity can play a valuable role both as a protective factor against depression, and as a treatment that can ameliorate depression symptoms (for recent reviews see Dishman et al., 2021; Schuch and Stubbs, 2019). There has also been growing interest in the mechanisms through which physical activity might confer depression-related benefits (see Kandola et al., 2019 for a review), and the factors that moderate the relationship between physical activity and depression (e.g., see Schuch et al., 2016a; Stanton and Reaburn, 2014). However, no effort has been made to examine whether depression-related benefits might arise from *belonging to groups* that engage in physical activity – crucial knowledge that could inform the design of interventions that might

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protect against, or treat, depression. In the present paper, we address this shortcoming by examining the depression-related benefits of belonging to sport or exercise groups, and test two pathways through which these benefits might arise.

1. Sport or exercise group memberships, physical activity participation, and depression

One pathway through which belonging to one or more sport or exercise groups might protect against depression is via facilitating greater overall physical activity participation. Speaking to this possibility, recent research suggests that sport or exercise group members tend to maintain greater overall levels of physical activity over time compared to those who belong to no groups. Specifically, in a large sample of older adults ($N = 3896$), Stevens and Cruwys (2020) found that sport or exercise group members experienced an attenuated decline in their overall physical activity over a 14-year follow-up period, compared to non-sport or exercise group members who were equally physically active at baseline, and matched on key demographics. Indeed, the benefits of sport or exercise group membership were sufficiently strong that the odds of dying across a 10-year period were 1.27 times higher among physically active non-sport or exercise group members than for those who were sport or exercise group members. Along similar lines, there is also good evidence that people's adherence to group-based exercise programs is typically greater than their adherence to individual exercise programs (see Burke et al., 2006; Harden et al., 2015).

As alluded to above, there is also considerable evidence that the frequency of people's physical activity participation is, in turn, associated with their better mental health, including fewer depression symptoms (Dishman et al., 2021; Schuch and Stubbs, 2019). Positive psychosocial changes (e.g., increased self-esteem, self-efficacy, and social support) and biological adaptations that are linked to lower levels of depression have both been proposed as reasons for this (Kandola et al., 2019). With regard to the latter, although empirical research remains in its infancy, evidence suggests that sustained engagement in physical activity can promote adaptations including positive changes in brain anatomy (e.g., increased hippocampal volume), and in markers of inflammation (e.g., reduced interleukin-6 levels) and oxidative stress (e.g., reduced thiobarbituric acid reactive substances serum levels; Eyre et al., 2013; Lavebratt et al., 2017; Schuch et al., 2016b). Taken together, the research summarised in this section indicates that greater physical activity is a plausible mechanism through which sport or exercise group membership might protect against depression.

2. Group memberships, loneliness, and depression

Research from the broader health domain also points to an additional psychological mechanism through which the relationship between sport or exercise group membership and attenuated depression might operate: reduced loneliness. Loneliness is defined as feelings of isolation, disconnectedness, and lack of belonging that reflect the discrepancy between one's actual and desired social relationships (Hughes et al., 2004). It is a strong and well-established risk factor for depression. For instance, longitudinal research has shown that loneliness predicts depression over and above various demographic characteristics (e.g., age, gender, relationship status), personality traits (e.g., neuroticism), and psychosocial factors (e.g., stress; Cacioppo et al., 2006, 2010).

There is also good evidence that social connectedness—particularly in the form of connections to social groups—can alleviate loneliness. Of particular note, Groups 4 Health—a five-module intervention designed to reduce loneliness by furnishing participants with the skills to develop and maintain social group memberships—has proved effective in achieving this goal in both clinical and community samples of people experiencing loneliness (Haslam et al., 2016, 2019). For example, in a randomised controlled trial, Haslam et al. (2019) found that participants who took part in a Groups 4 Health program experienced significant reductions in loneliness from pre-intervention to follow-up—reductions which also exceeded those experienced by participants in the waitlist control group (many of whom were receiving other forms of mental health treatment). To date, there is no evidence that sport and exercise groups specifically protect against loneliness. There is, however, good evidence that engaging in physical activity in group contexts (e.g., through team sport) confers various psychosocial benefits (e.g., increased social interaction; Eime et al., 2013a, 2013b).

3. A direct link between group memberships and depression

Research from the health domain has also provided good evidence that people's social group memberships affect whether, and to what extent, they experience depression. For example, in a sample of 5055 older adults from the United Kingdom, Cruwys et al. (2013) found that increases in group memberships (a) protected against the development of depression among people who were not depressed and (b) predicted recovery from depression and reduced risk of depression relapse among people who were depressed. Indeed, the latter effect was such that depressed participants who joined one group reduced their risk of depression relapse four years later by 24%, while those who joined three groups reduced their risk of relapse by 63% (see also Cruwys et al., 2014). Similar patterns have been demonstrated in Groups 4 Health trials, which have found that the intervention is also effective in reducing the severity of participants' depression symptoms (Haslam et al., 2016, 2019).

To explain the positive health effects of group memberships, researchers have drawn on the social identity approach (Tajfel and Turner, 1979; Turner et al., 1987). This framework recognises that people can, and do, internalise their group memberships such that they become an important part of who they are (i.e., a meaningful social identity). Considerable research has shown that, through this process, these group memberships become valuable health-enhancing psychological resources on which people can draw in times of need: a form of 'social cure' (see Haslam et al., 2018 for a review). Indeed, social identity theorists argue that (a) possessing group memberships can protect and enhance people's health because of the associated access they provide to tangible resources (e.g., social support from other members), (b) perceiving oneself to share a social identity with another person makes any support one receives from that person more powerful, and (c) social identities can confer health benefits—including protection against depression—even in the absence of access to tangible support from, or contact with, fellow group members (e.g., see Cruwys et al., 2015; Haslam et al., 2012).

Recent studies have provided initial evidence that the benefits of social group belonging extend to sport and exercise group memberships. Specifically, studies have found that belonging to such groups is associated with greater life satisfaction, happiness, and self-rated health (Graupensperger et al., 2020; Stevens et al., 2019). However, this research has focused on the benefits of strongly identifying as a member of a particular sport or exercise group. No research has (a) examined the mental health and well being benefits of belonging to one or several sport or exercise groups, compared to belonging to less or no sport or exercise groups, (b) tested the mechanisms through which sport or exercise group memberships impact mental health and well being, or (c) focused on depression as the focal outcome.

4. The present research

We addressed these lacunae by examining the relationship between sport and exercise group memberships and depression. Our core hypothesis (H1) was that sport and exercise group memberships would protect against depression. Further to this, and in line with the research reviewed above, we also hypothesised that this relationship would be mediated by greater overall physical activity participation (H2), and reduced loneliness (H3). We evaluated these hypotheses in two samples.

Study 1 involved a large cohort of older adults, followed over a six-year period. Study 2 involved a large sample of sport or exercise group members who lost the capacity to engage with these groups due to COVID-19 restrictions. Materials for both studies are available on the OSF at: https://osf.io/5gnwa/.

5. Study 1

Study 1 drew upon an ongoing cohort study comprising a large nationally representative sample of older adults residing in England – the English Longitudinal Study of Ageing (ELSA). The ELSA collects data pertaining to a wide variety of constructs (e.g., social, health, and cognitive) from participants every two years. Drawing on the ELSA data thus allowed us to examine the focal relationships longitudinally.

6. Method

6.1. Participants

ELSA data collection began in 2002/3, with the most recent data available at the time of the current analyses from Wave 9 (2018/19). ELSA data collection involves a self-completion questionnaire and an interview, which is conducted in person using computer assisted interviewing. The London Multi-Centre Research Ethics Committee granted ethical approval for the ELSA.

Our sample comprised all ELSA participants who had data available for (a) sport or exercise group membership and each of our covariates at Wave 7 (baseline), (b) all loneliness and physical activity items at Wave 8, and (c) all depression items at Wave 9. Waves 7, 8, and 9 were selected primarily because (a) utilising data for the independent, mediator, and dependent variables at three consecutive time points enabled a rigorous longitudinal test of the focal relationships (see Maxwell et al., 2011), and (b) they were the three most recent waves of data available when the analyses were conducted.

Applying the aforementioned criteria resulted in a final sample of 4549 ELSA participants (2560 [56.3%] female, 1989 male). At Wave 7, participants were aged between 50 and 99 years ($M = 67.47$, $SD = 8.49$), 67.1% were married or in a civil partnership; 19.8% were single, separated, or divorced; and 13.1% were widowed or a surviving civil partner. According to deciles of total non-pension wealth—a variable that takes into account participants' investments, savings, and assets, as well as any debts they owe, and on which higher scores indicate greater wealth—participants were relatively diverse in terms of socioeconomic status ($M = 6.27$, $SD = 2.79$, range = 1–10). Comparison of our subsample to all ELSA cohort members who had data available for these demographic variables at Wave 7 revealed close similarity (i.e., demographics for the full ELSA sample were as follows: $M_{age} = 67.45$, 55.5% female, 66.5% married or in a civil partnership, and $M_{wealth\ decile} = 5.89$).

Monte Carlo power analyses (using the MARlab application; Schoemann et al., 2017) indicated that, with alpha set at 0.05, 5000 replications, and given our sample size ($N = 4549$) and observed standard deviations (see below), we had >80% power to detect indirect effects if standardised beta values for the *a*, *b*, and *c'* paths were ≥ approximately .05 (noting that power is sensitive to unequal standardised beta values for the individual paths).

6.2. Measures

6.2.1. Sport or exercise group membership

Participants were asked: "Are you a member of any of these organisations, clubs or societies?" and were presented with eight response options. These included "sports clubs, gyms, exercise classes". In line with previous research (Stevens and Cruwys, 2020), participants who ticked this response option (coded as 0 = no, 1 = yes) were considered members of one or more sport or exercise groups.

6.2.2. Physical activity

Three items measured the frequency of participants' engagement in vigorous, moderate, and mild physical activity on a 4-point scale (hardly ever or never; 1 to 3 times a month; once a week; more than once a week). Example activities were available to guide responses. In line with previous research (Stevens et al., 2021), we obtained a total physical activity score (between 3 and 12) by summing participants' responses to the three items (such that a higher number indicated a greater overall frequency of physical activity). Although internal reliability for this measure was relatively low ($\alpha = 0.52$), this was not unexpected given that we would not necessarily expect the frequency of people's engagement in different intensities of physical activity to be strongly related (e.g., an older person may regularly engage in gardening as a hobby, but this may not mean they are more likely to engage in frequent vigorous running or cycling than someone who does not regularly garden). Given (a) that participants' engagement in physical activity of each intensity contributes to the overall frequency of their physical activity participation, and (b) evidence that scores on this measure predict health outcomes (e.g., walking speed, number of chronic health conditions; Stevens et al., 2021), we considered this summed score the most appropriate way to operationalise this variable.

6.2.3. Loneliness

Loneliness was measured using the Three-Item Loneliness Scale (Hughes et al., 2004). This asked participants to report how frequently they feel (a) a lack of companionship, (b) left out, and (c) isolated on a three-point scale (hardly ever or never; some of the time; often). Participants' responses were summed to obtain a total score between 3 and 9, with a higher score indicating greater loneliness ($\alpha = 0.83$). This measure has demonstrated high discriminant and convergent validity (see Hughes et al., 2004).

6.2.4. Depression

Depression symptoms were measured using the revised eight-item Center for Epidemiological Studies-Depression Scale (CES-D; Turvey et al., 1999). This widely used measure assesses symptoms of negative affect (e.g., "felt sad much of the time") and somatic complaints (e.g., "felt that everything I did was an effort") over the past week. Participants responded to each item on a dichotomous (yes/no) scale. Positive items (e.g., "was happy much of the time") were reverse scored (such that a 1 was allocated where participants responded 'no' and a 0 allocated where participants responded 'yes'). The items were then summed to obtain a total score ranging from 0 to 8, whereby higher scores indicated more depression symptoms ($\alpha = 0.77$). This scale has been shown to be a valid measure of depression, including among older adults (Karim et al., 2015).

6.3. Analytic strategy

To examine the hypotheses, we tested two multiple mediation models in PROCESS (Model 4; Hayes, 2017) using bias corrected bootstrapping with 5000 resamples. Both models examined the relationship between Wave 7 sport or exercise group membership and Wave 9 depression through Wave 8 loneliness and Wave 8 physical activity. Model 1 was a prospective model that tested whether sport or exercise group membership predicted subsequent physical activity and loneliness, and whether physical activity and loneliness predicted subsequent depression. In Model 2, to provide a more stringent test of the relationships, we added baseline (i.e., Wave 7) measures of physical activity, loneliness, and depression as covariates, such that their effect on both the mediator and dependent variables were controlled for. Model 2 is therefore best interpreted as testing whether sport or exercise group membership predicted subsequent *changes* in loneliness, physical activity and, in turn, depression. Baseline measures of established demographic predictors of depression—gender, age, relationship status, and socioeconomic status (e.g., see Inaba et al., 2005; Stordal et al.,

2003)—were included in both models as covariates. We also tested Models 1 and 2 without any of these covariates specified. The focal effects in these models (i.e., relating to our hypotheses) were consistent with those reported below.

To assess H1, we examined the total effect in each model (equivalent to a regression predicting the dependent variable from the independent variable without the mediator in the model; Hayes, 2017). To assess H2 and H3, we examined the indirect effects of sport or exercise group membership on depression through total physical activity and loneliness respectively (with significant indirect effects indicated by [95%] confidence intervals [CIs] that did not cross zero; Hayes, 2017).

7. Results

7.1. Preliminary analyses

Means, standard deviations, and correlations are shown in Table 1. At baseline, 1326 participants (29.1%) belonged to at least one sport or exercise group. A series of independent samples *t*-tests (equal variances were not assumed, because Levene's test was significant in all instances) indicated that, at baseline, sport or exercise group members were (a) significantly more physically active ($M = 10.33$, $SD = 1.78$) than non-sport or exercise group members ($M = 8.62$, $SD = 2.18$; $t(2989.97) = -27.49$, $p < .001$, Hedges $g = 0.83$), (b) significantly less lonely ($M = 3.79$, $SD = 1.25$) than non-sport or exercise group members ($M = 4.09$, $SD = 1.48$; $t(2895.13) = 7.01$, $p < .001$, Hedges $g = 0.21$), and (c) reported significantly fewer depression symptoms ($M = 1.28$, $SD = 1.79$) than non-sport or exercise group members ($M = 0.86$, $SD = 1.45$; $t(3004.56) = 8.91$, $p < .001$, Hedges $g = 0.25$).

7.2. Main analyses

In Model 1 (see Fig. 1), the total effect of sport or exercise group membership on depression was significant: $\beta = -.23$, $p < .001$ (supporting H1), as was the direct effect ($\beta = -.11$, $p < .001$). Supporting H2, the indirect effect of sport or exercise group membership on depression through physical activity was significant: $\beta = -.08$, CI [-0.10, −0.06], $SE = 0.01$. Sport or exercise group membership predicted greater subsequent physical activity ($\beta = .57$, $p < .001$), and physical activity predicted lower subsequent depression ($\beta = -.14$, $p < .001$). Supporting H3, the indirect effect of sport or exercise group membership on depression through loneliness was significant: $\beta = -.04$, CI [-0.06, −0.02], $SE = 0.01$. Sport or exercise group membership predicted lower subsequent loneliness ($\beta = -.12$, $p < .001$), and loneliness, in turn, predicted greater subsequent depression ($\beta = .37$, $p < .001$).

In Model 2 (see Fig. 2), the total effect of sport or exercise group membership on depression was significant: $\beta = -.09$, $p = .004$ (supporting H1), as was the direct effect ($\beta = -.07$, $p = .014$). Supporting H2, the indirect effect of sport or exercise group membership on change in depression through change in physical activity was significant: $\beta = -.02$, CI [-0.03, −0.01], $SE = 0.004$. Sport or exercise group membership predicted a positive change in physical activity ($\beta = .23$, $p < .001$), and increased physical activity predicted a reduction in depression ($\beta = -.07$, $p < .001$). H3 was not supported, the indirect effect of sport or exercise group membership on depression through loneliness was non-significant: $\beta = .004$, CI [-0.006, 0.01], $SE = 0.005$. Sport or exercise group membership was not a significant predictor of a change in loneliness ($\beta = .02$, $p = .475$), although increased loneliness did predict an increase in depression ($\beta = .19$, $p < .001$).

Table 1
Means, standard deviations, and correlations for all variables in Study 1.

Variable	Mean	SD	1	2	3	4
1. Wave 7 sport or exercise group membership	–	–	–	.32***	-.08***	-.14***
2. Wave 8 physical activity	8.93	2.34		–	-.16***	-.26***
3. Wave 8 loneliness	4.03	1.45			–	.42***
4. Wave 9 depression	1.29	1.73				–

Note: *$p < .05$; **$p < .01$; ***$p < .001$.

7.3. Additional analyses

We conducted three further analyses. First, to facilitate further, more concrete insight into the relationship between sport or exercise group membership and depression, we considered participants' risk of exceeding the cut-off for clinical depression on our scale at Wave 9 (i.e., of reporting ≥3 symptoms on the eight item CES-D; White et al., 2016). Participants who belonged to a sport or exercise group at Wave 7 had a 11.8% chance of scoring above the clinical cut-off for depression four years later at Wave 9, while non-sport or exercise group members at Wave 7 had a 20.4% chance of scoring above this cut-off four years later.

Second, to assess the robustness of the findings to different treatment of missing data, we repeated the analyses above after using a different approach to handling missing data. Data were considered missing when a respondent took part in the relevant ELSA wave but had missing data for one of the focal measures in the present study. On this basis, the percentage of missing data for our variables across the three waves was 14.5%–16% for sport or exercise group membership, 12.6%–13.4% for loneliness, <0.1% in all instances for physical activity, and 4.3%–5.5% for depression. This variation was primarily because physical activity and depression were assessed in the ELSA interview, while loneliness and group memberships were assessed in the ELSA self-completion questionnaire (for which response rates are lower). As an alternative to listwise deletion (the approach used above), we retained these participants (as well as those with missing data for our demographic covariates) in the sample for analyses by using Expectation Maximization imputation. The results for Models 1 and 2 were largely unchanged from those reported above when we re-tested the two models using this larger sample ($N = 6900$; see Supplementary file 1).

Third, to test for possible reciprocal effects, using this larger sample we conducted cross-lagged panel analyses in AMOS v27 (Arbuckle, 2020). In these analyses, we allowed all variables to covary at baseline, then specified paths from each Wave 7 variable to each Wave 8 variable, and each Wave 8 variable to each Wave 9 variable. Error terms were specified for all endogenous variables and were allowed to covary within, but not across, waves. Results provided evidence that some of the model's focal relationships are reciprocal. Specifically, in a cross-lagged panel model including sport or exercise group membership and depression at the three waves, depression predicted sport or exercise group membership at each subsequent wave (W7→W8; W8→W9). Paths pertaining to the hypothesised direction of this relationship (i.e., sport or exercise group membership predicting subsequent depression) were, however, stronger in each instance (for a schematic overview, see Supplementary file 2). We then tested a second cross-lagged model that additionally included physical activity and loneliness at each wave, and found similar trends. That is, paths between (a) physical activity and subsequent sport or exercise group membership, (b) depression and subsequent physical activity, and (c) depression and subsequent loneliness were all significant. However, these relationships were, in all instances, weaker than those in the hypothesised direction. Details of all the paths in this model are presented (in a table for practical reasons) in Supplementary file 3.

8. Discussion

Study 1 provided at least some support for each hypothesis. In line with H1, we found evidence in both models that sport or exercise group membership predicted fewer depression symptoms four years later. Supporting H2, we also found consistent evidence that one reason for this was that belonging to a sport or exercise group facilitated greater overall engagement in physical activity, which, in turn, helped reduce

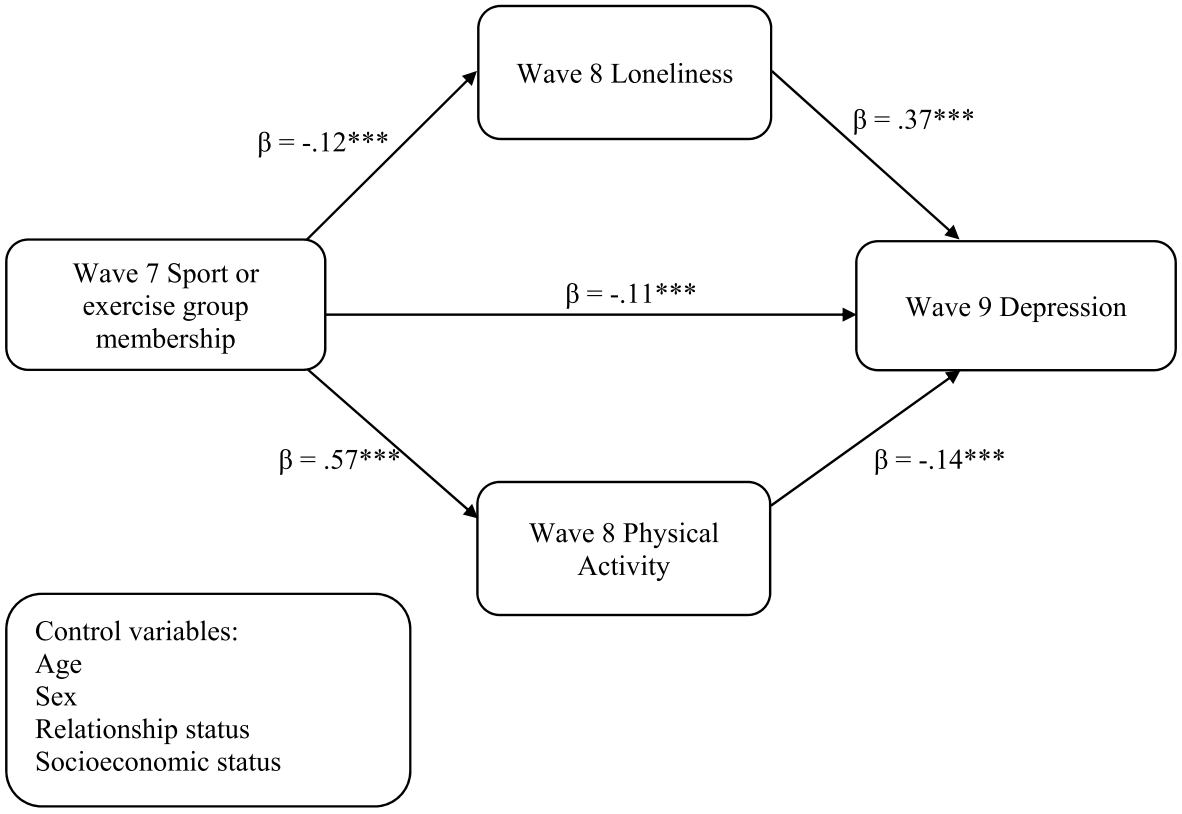

Fig. 1. Model 1 showing the relationship between Wave 7 sport or exercise group membership, Wave 8 loneliness and physical activity, and Wave 9 depression prospectively in Study 1 ($N = 4549$). Notes: The total effect of number of sport or exercise groups lost on depression was $\beta = -.23$, $p < .001$. *$p < .05$; **$p < .01$; ***$p < .001$.

depression symptoms. Regarding H3, in our prospective analyses, we found evidence for the hypothesised indirect effect such that sport or exercise group membership predicted reduced subsequent loneliness, which, in turn, predicted greater subsequent depression symptoms. This indirect effect was not, however, significant when we controlled for loneliness and depression at baseline.

In interpreting the results, it should be noted that our analyses involved highly conservative tests of the hypothesised effects. This is not least because we would expect that participants who belonged to sport or exercise groups at Wave 7 were likely to have already been concurrently experiencing most of the hypothesised benefits of this (i.e., greater overall physical activity and reduced loneliness and depression symptoms). Indeed, Model 2 tested whether sport or exercise group membership predicted *changes* in physical activity, loneliness, and depression. As our preliminary analyses showed, sport or exercise group members were already more physically active, less lonely, and reported fewer depression symptoms at baseline, restricting the capacity for these changes to occur.

Our confidence in the focal relationships is also strengthened by the findings from our cross-lagged analyses, which were consistent with those for Models 1 and 2. At the same time, although paths in these cross-lagged models were consistently weaker in the opposite compared to the hypothesised direction, these analyses indicated that some of the focal relationships are reciprocal. This points to the possibility that there may be self-maintaining cyclical relationships between our variables of interest that could operate in either virtuous or vicious ways. For example, people who belong to a sport or exercise group may experience few depression symptoms and this may make it easier for them to seek out new groups that provide further benefits. Conversely, people who do not belong to a sport or exercise group are more likely to experience several depression symptoms that make it hard to seek out new groups that might benefit them.

Study 1 had several strengths, including its large sample and longitudinal design. Nevertheless, it also had some limitations, in particular stemming from our reliance on the measures available in the ELSA dataset. Specifically, although the ELSA sport and exercise group membership and physical activity measures have been widely used in previous research (e.g., see Rogers et al., 2017; Stevens and Cruwys, 2020; Stevens et al., 2021), they have been less extensively validated than the measures of loneliness and depression. Indeed, along these lines, while not entirely unexpected (for the reasons outlined above), internal consistency for the physical activity measure was low. The sport or exercise group memberships measure also precluded insights into the *number* of sport or exercise groups participants belonged to. In this regard, in line with findings from research examining the benefits of possessing multiple group memberships (e.g., Cruwys et al., 2013), we would expect a 'more the merrier' effect such that, the more sport or exercise groups one belongs to, the more active, less lonely, and less depressed they will be. The dichotomous nature of the sport or exercise group memberships variable may therefore have attenuated the effects observed. We sought to address these limitations in Study 2.

9. Study 2

Study 2 used data from a large survey of Australian adults. The study was cross-sectional, but involved stronger and more comprehensive measures of sport or exercise group memberships and physical activity than Study 1. Moreover, rather than focusing on the protective effects of belonging to sport or exercise groups under 'normal' circumstances, we capitalised on a unique opportunity—afforded by the enforced suspension of group-based physical activity due to COVID-19—to test the hypothesised relationships in an alternative way: by assessing the relationships between *losing* physical access to one's sport and exercise groups and physical activity, loneliness, and depression. Following the

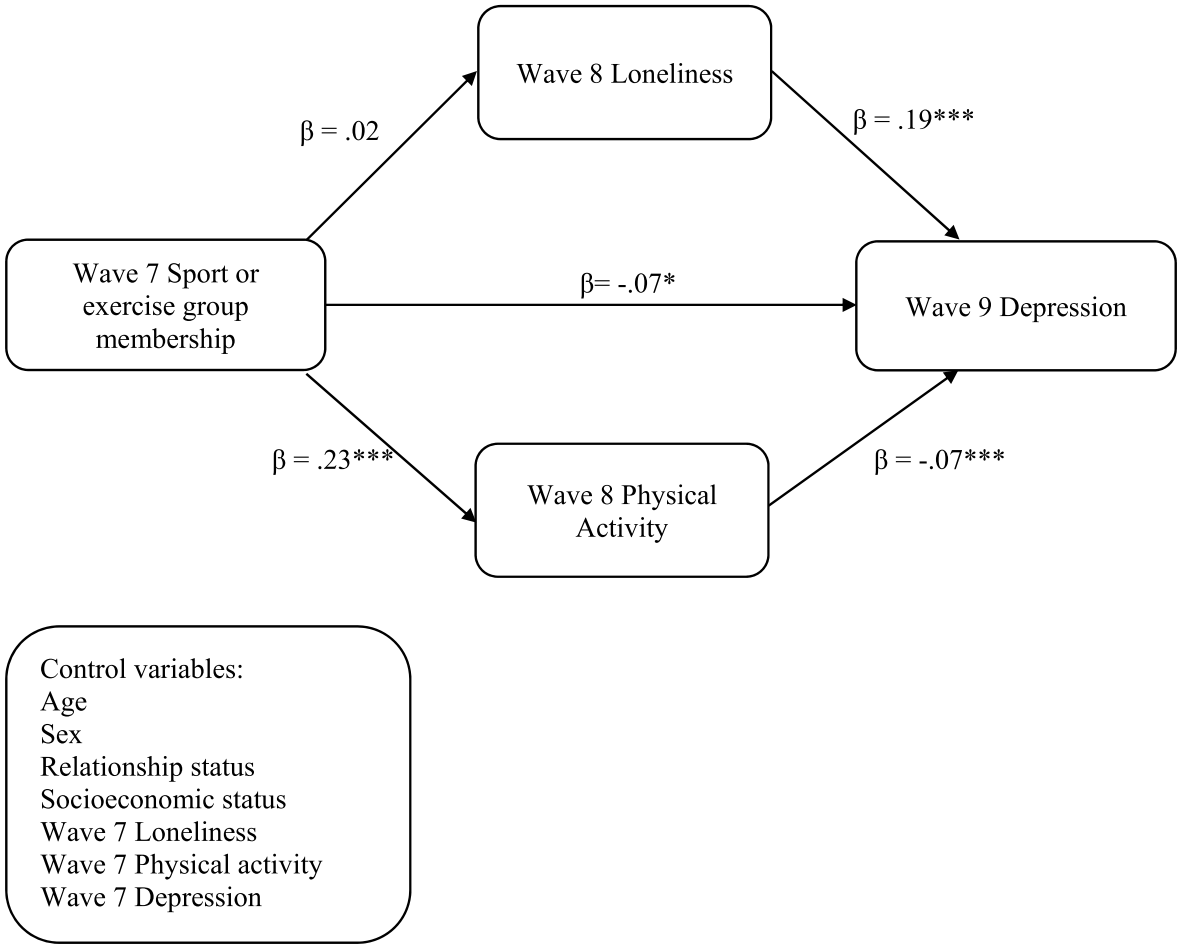

Fig. 2. Model 2 showing the relationship between sport or exercise group membership and changes in loneliness, physical activity, and depression in Study 1 (N = 4445). Notes: The total effect of number of sport or exercise groups lost on depression was β = −.09, p = .004. *p < .05; **p < .01; ***p < .001.

logic that belonging to more sport or exercise groups would, under normal circumstances, have a protective effect, we hypothesised that losing more groups would be associated with greater depression, and this would be at least partly because people who lost more groups would be (a) less physically active, and (b) lonelier.

10. Method

10.1. Participants and procedure

Participants were drawn from a large study examining thoughts, attitudes, behaviours, and health outcomes in the context of COVID-19. A panel of Australian residents stratified by age, sex, ancestry, and income was commissioned from Qualtrics Services. From a total of 3030 respondents, the sample for the present study comprised 635 participants (308 [48.5%] female, 326 male, and 1 who identified as other; M_{age} = 43.52, SD = 18.41) who had been a member of at least one sport or exercise group prior to COVID-19 restrictions, and for whom complete data were available for each of the variables of interest and covariates. 67.2% of the sample were married or in a relationship; 29.8% were single, separated, or divorced; and 3% were widowed. Participants' socioeconomic status was assessed using weekly income. For this, we provided 14 response categories that ranged from nil to $3000 per week or more. Our sample was diverse; between 3.3% and 9.9% selected each response category. Comparison of our sample to all respondents in the stratified panel revealed close similarity, although our sample had a greater percentage of men (i.e., demographics for all respondents were as follows: M_{age} = 47.77, 52.5% female, 64.9% married or in a relationship, and between 3.6% and 10.1% selected each weekly income response category).

Monte Carlo power analyses (Schoemann et al., 2017) indicated that in this case, with alpha set at 0.05, 5000 replications, and given our sample size (N = 630) and observed standard deviations (see below), we had >80% power to detect indirect effects if standardised beta values for the a, b, and c' paths were ≥ approximately .13.

Data collection took place between 11 May and 27 May 2020. In Australia, strict restrictions linked to COVID-19 were established in late March 2020, including the suspension of all group-based sport and exercise and the closure of gyms and fitness facilities. These restrictions remained in place during the data collection period. Participants were paid the standard Qualtrics panel rate for completing the questionnaire. The Australian National University Human Research Ethics Committee approved the research (#2020/341).

10.2. Measures

10.2.1. Sport or exercise group memberships lost

Participants were first asked: "Prior to the COVID-19 outbreak, were you a member of any sport or exercise groups? E.g., a sports team, a running club, or a walking group". Participants who indicated 'yes' were then asked to indicate how many sport or exercise groups they were a member of. Because *all* group-based forms of sport and exercise were suspended at this time, this provided a measure of the number of group memberships participants had, at least temporarily, physically lost access to. As noted above, respondents who indicated that they were *not* a member of any sport or exercise groups prior to the COVID-19 outbreak

(N = 2366) were excluded (rather than assigned a value of 0). This decision was taken because our focus was on relationships between the loss of sport or exercise group memberships and physical activity, loneliness, and depression; those who belonged to no sport or exercise groups prior to COVID-19 had experienced no such loss (and we would not expect losing zero groups to affect people's levels of physical activity, loneliness, or depression).

10.2.2. Physical activity

Physical activity was measured using the Godin-Shephard Leisure Time Physical Activity Questionnaire (GSLTPAQ; Godin and Shephard, 1985). Participants indicated the number of times they engaged in strenuous, moderate, and mild exercise for more than 30 min during their free time in the last seven days, with example activities provided to guide their responses. Scoring the GSLTPAQ involves (a) multiplying the weekly frequencies of strenuous, moderate, and mild activities by standard metabolic equivalent energy expenditure values (nine, five, and three respectively), and (b) computing a total score—the leisure score index—by summing the resulting values. The GSLTPAQ's leisure score index has been validated against both objective physical fitness indicators (e.g., VO_2 max; Godin and Shephard, 1985) and objectively estimated energy expenditure values (obtained using accelerometers; see Miller et al., 1994).

10.2.3. Loneliness

Loneliness was measured using the same scale as Study 1 (Hughes et al., 2004). On this occasion (in line with the scale recommended for the full Revised UCLA Loneliness Scale from which the Three-Item Loneliness Scale is derived), a four-point scale was used (never; rarely; sometimes; often), and a total score between 4 and 12 was calculated. Higher scores again indicated greater loneliness ($\alpha = 0.90$).

10.2.4. Depression

Severity of depression symptoms were measured using the seven-item depression subscale of the Depression Anxiety and Stress Scales (DASS-21; Lovibond and Lovibond, 1995). This measure asks participants to indicate the extent to which a series of statements (e.g., "I felt down-hearted and blue") applied to them over the preceding week on four-point scales from 0 (did not apply to me at all) to 3 (applied to me very much, or most of the time). In line with recommendations (Lovibond and Lovibond, 1995), and to ensure the comparability of scores with other studies using the DASS, responses were summed and multiplied by two to obtain a total score between 0 and 42, with higher scores indicating greater depression ($\alpha = 0.95$). This measure has demonstrated excellent validity, including in non-clinical samples (e.g., see Henry and Crawford, 2005).

10.3. Analytic strategy

To examine the hypotheses, we employed the same approach as Study 1 and tested a multiple mediation model in PROCESS (Model 4; Hayes, 2017) using bias corrected bootstrapping with 5000 resamples. This model (Model 3) examined the relationship between the number of sport or exercise group memberships lost and depression through physical activity and loneliness. To assess the hypotheses, we again examined the total effect (H1), and the indirect effects pertaining to our two hypothesised mediators (H2 and H3). Measures of gender, age, socio-economic status, and relationship status were again included as covariates. As in Study 1, we also tested the model without any of these covariates specified. The focal effects (i.e., relating to our hypotheses) were consistent with those reported below.

11. Results

11.1. Preliminary analyses

Consistent with previous research using the GSLTPAQ (e.g., Homan and Tylka, 2014), initial inspection of the data revealed extreme scores for a small number of participants on the physical activity measure that indicated these participants had misread or misunderstood the physical activity questions. Indeed, two participants' scores for the physical activity measure corresponded to more hours of physical activity than there are hours in a week. This suggested that they had, perhaps, indicated the number of minutes they had engaged in physical activity for during the week, rather than the number of times they had engaged in each intensity of physical activity for at least 30 min. An outlier analysis indicated that five participants' scores for the physical activity measure were outliers (i.e., their scores exceeded the $z > 3.29$ cut-off; Tabachnick and Fidell, 2013), all of which were high scores with the most extreme 17.2 *SD*s above the mean. Because it was not possible to confidently discern the specific error each participant had made (and thus the answer that they had 'meant' to provide), we opted for a conservative approach and excluded all five outliers from the analysis.

11.2. Main analyses

Means, standard deviations, and correlations are presented in Table 2. In Model 3 (see Fig. 3), the total effect of sport or exercise group memberships lost on depression was significant: $\beta = .45$, $p < .001$ (supporting H1), as was the direct effect ($\beta = .36$, $p < .001$). H2 was not supported: the indirect effect of sport or exercise group memberships lost on depression via physical activity was non-significant: $\beta < .001$, CI [-0.005, 0.004], $SE = 0.002$. The loss of sport or exercise group memberships was not significantly associated with physical activity ($\beta = .07$, $p = .12$), and physical activity was not associated with depression ($\beta = .004$, $p = .89$). However, supporting H3, the indirect effect of sport or exercise group memberships lost on depression via loneliness was significant: $\beta = .09$, CI [0.06, 0.12], $SE = 0.02$. Loss of sport or exercise group memberships was associated with greater loneliness ($\beta = .19$, $p < .001$), which, in turn, was associated with greater depression ($\beta = .46$, $p < .001$).

11.3. Additional analyses

As in Study 1, to provide a further insight into the relationship between the loss of sport or exercise group memberships and depression, we considered participants' risk of exceeding the cut-off for clinical depression on our scale (in this case, of scoring ≥10 on the depression scale of the DASS-21; Guest et al., 2018). Among those who had lost access to <2 sport or exercise groups (N = 361), 40.4% fell into the range for clinical depression, whereas among those who lost access to 2 or more sport or exercise groups (N = 269) and >2 sport or exercise groups (N = 140), rates of clinical depression were 61% and 84.3% respectively.

We also conducted further analyses to assess the robustness of our findings to different treatment of the missing data. In this instance, among respondents who indicated they had belonged to a sport or

Table 2
Means, standard deviations, and correlations for all variables in Study 2.

Variable	Mean	SD	1	2	3	4
1. Sport or exercise group memberships lost	2.35	2.40	–	.11*	.22***	.53***
2. Physical activity	43.23	63.11		–	.04	.10*
3. Loneliness	7.61	2.55			–	.59***
4. Depression	12.63	12.25				–

Note: *$p < .05$; **$p < .01$; ***$p < .001$.

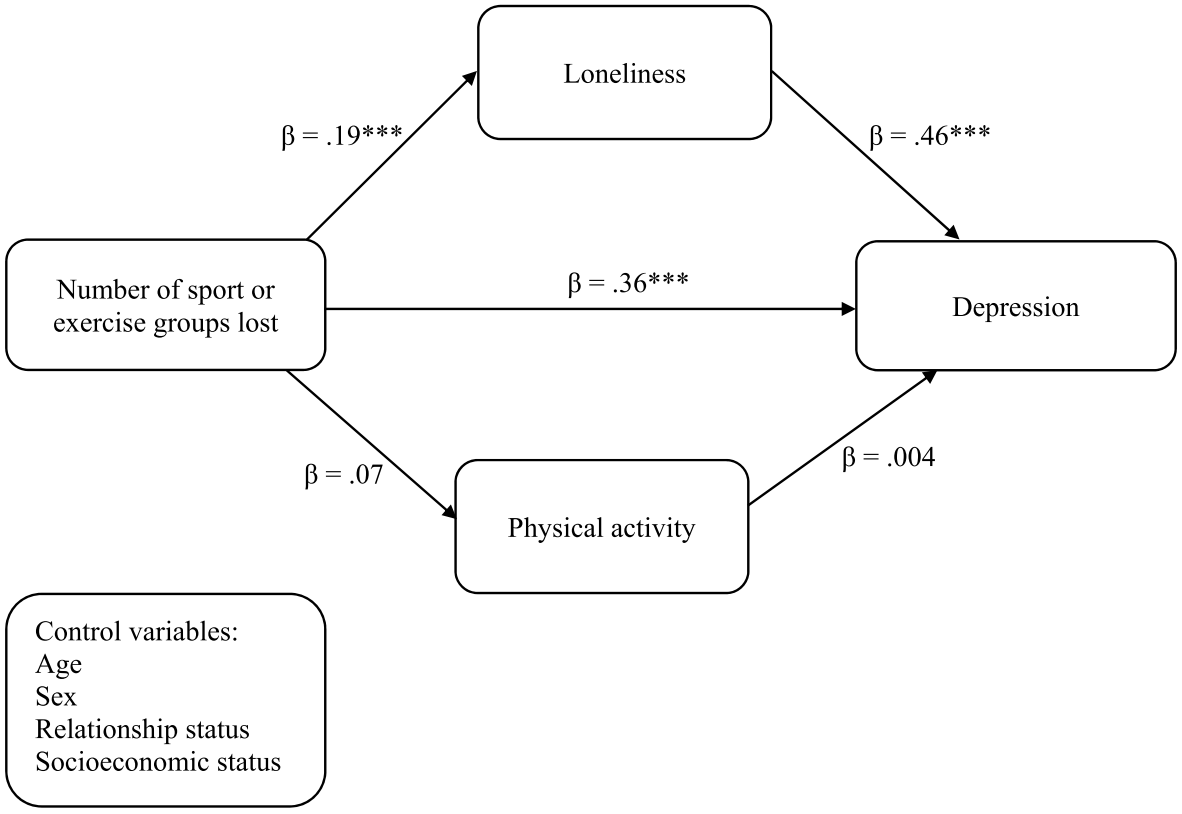

Fig. 3. Model 3 showing the relationship between the number of sport or exercise groups lost and depression through loneliness and physical activity in Study 2 (N = 630). Notes: The total effect of number of sport or exercise groups lost on depression was β = .45, $p < .001$. *$p < .05$; **$p < .01$; ***$p < .001$.

exercise group prior to COVID-19 restrictions (N = 660), there was minimal missing data (<2.5% for all variables and zero for several variables). As an alternative to listwise deletion (the approach used above), we again used Expectation Maximization imputation to retain participants with missing data for our variables of interest in the sample for analyses (while still excluding the five participants with out-of-range scores on the physical activity measure). The results were largely unchanged from those reported above when we re-tested the model using this slightly larger sample (N = 655; see Supplementary file 4).

12. Discussion

Study 2 provided further evidence for our core hypothesis (H1) that sport and exercise group memberships protect against depression. Specifically, in this instance we found that participants who had *lost* physical access to more groups reported more severe depression symptoms. There was no evidence that this was because participants who had lost more groups were less active (and thus H2 was not supported). However, supporting H3, there was evidence for the mediating role of loneliness such that the number of sport or exercise group memberships participants had lost was associated with greater loneliness, which, in turn, was associated with more severe depression symptoms.

Similar to Study 1, in interpreting the results it should be noted that the study's design yielded stringent tests of the hypothesised effects. In particular, the first part of the model (i.e., the *a* paths) and the total effect essentially tested whether participants who had lost physical access to more sport or exercise groups were less physically active, lonelier, and reported more severe depression symptoms *overall* than participants who had lost physical access to fewer sport or exercise groups. A more sensitive test of the hypotheses would have been afforded by pre-COVID-19 measures of physical activity, loneliness, and depression; this would have allowed us to assess whether the loss of more sport or exercise groups predicted *changes* in these variables (i.e., greater decreases in physical activity and greater increases in loneliness and depression symptoms)—more subtle effects that would be consistent with our hypotheses. However, in the absence of the ability to assess these changes, we found evidence that, despite all participants having physical access to an equivalent number of groups (i.e., zero) when the data were collected, the psychological effect of losing group memberships was such that there was a tendency for people who had previously belonged to relatively more groups to feel lonelier and report more severe depression symptoms.

Interestingly, experimental research has found that group memberships can act as psychological resources (e.g., that enhance resilience) even in situations where people are unable to directly access those groups and the tangible benefits they can provide (e.g., Green et al., 2018; Jones and Jetten, 2011). However, the present findings suggest that in the absence of an opportunity to meaningfully enact or 'live out' those group memberships, sport and exercise groups do not act as a 'resource' to buffer against loneliness and depression but may instead become a liability (see also Seymour-Smith et al., 2021).

With regard to H2—the physical activity pathway—our model would predict that people who belonged to more sport or exercise groups before COVID-19 would have been more active at that time. Given that past behaviour is among the strongest predictors of current behaviour (e.g., see Rhodes and Courneya, 2003), it is possible that such people were effective in maintaining their relatively higher levels of physical activity while strict COVID-19 restrictions were in place, meaning their overall physical activity levels at the point of measurement remained higher than participants who previously belonged to less groups (resulting in a non-significant *a* path). With regard to path *b*, in contrast to previous research in a COVID-19 context (e.g., Jacob et al., 2020; Stanton et al., 2020), we found no evidence for a relationship between physical activity and depression. It should be noted, however, that our measure captured only a 'snapshot' of participants' physical activity (i.e., over the last week). Evidence suggests that the biological adaptations

proposed to contribute to the depression-related benefits of physical activity (e.g., changes in markers of inflammation) develop following sustained periods of frequent physical activity (e.g., see Lavebratt et al., 2017). The short timeframe over which we assessed physical activity may therefore have contributed to the absence of a significant relationship.

Key strengths of Study 2 included its large diverse community sample, validated measures of the key constructs, and unique approach to testing our focal research question (afforded by the opportunity provided by the COVID-19 context to assess the impact of people losing access to their sport and exercise groups). Indeed, understanding the consequences of people losing their sport or exercise group memberships has relevance beyond the context of COVID-19. For example, many common (and less extreme) life events such as moving house or transitioning from school to university can similarly place sport and exercise group memberships under threat. The study's cross-sectional design was a key limitation, preventing definitive conclusions regarding the directionality of relationships. However, given the context in which the study was conducted (i.e., such that the loss of sport and exercise groups was forced upon all participants), the reverse causal pathway (greater depression leading to the loss of sport and exercise groups) is not plausible in this instance. It is also noteworthy that the approach we used to assess the number of sport or exercise group memberships participants had lost relied on their accurate recall of the groups they belonged to before COVID-19. Recall bias was therefore possible, although data were collected less than two months after COVID-19 related restrictions had been put in place.

13. General discussion

This research examined the depression-related benefits of belonging to sport or exercise groups. In line with our core hypothesis, Study 1 found that sport or exercise group membership protected people against depression over time, while Study 2 found that losing the ability to interact face-to-face with one's sport or exercise groups was associated with more severe depression symptoms. We also found some evidence that the benefits of sport or exercise group memberships for depression may be underpinned by the greater overall levels of physical activity, and reductions in loneliness, that these group memberships promote. Findings have several important theoretical and practical implications.

First, findings make a novel contribution to our scientific understanding of the link between physical activity and depression. Against the backdrop of good evidence for a relationship between greater physical activity and reduced depression symptoms (Dishman et al., 2021; Schuch and Stubbs, 2019), in recent times research has increasingly focused on how to maximise the depression-related benefits of physical activity. To this end, researchers have sought to establish how frequently, and at what intensity, people should undertake physical activity, as well as the type of activities (e.g., aerobic or resistance exercise) they should engage in (e.g., see Farris et al., 2019; Stanton and Reaburn, 2014). The present findings extend understanding by providing novel evidence that more attention is warranted to the role that sport and exercise *groups* could play in combatting depression.

Along these lines, from a practical perspective findings suggest that, while engaging in physical activity remains a strategy that people seeking to protect themselves against depression can use, their focus may be best placed on joining one or more sport or exercise groups. This would enable them to reap the dual benefits that our findings suggest may arise from them subsequently both (a) engaging in a greater amount of physical activity (and thus experiencing the biological and psychosocial benefits that this confers; Kandola et al., 2019), and (b) feeling less lonely (and thus experiencing the psychological benefits that this confers; e.g., see Cacioppo et al., 2006, 2010).

Encouragingly, some initiatives that align with this recommendation already exist. *Social prescribing*—whereby health professionals refer a patient to a Link Worker who, in turn, develops a plan with the patient to engage them in community groups or programs—is increasingly being used with the goal of improving patients' mental health and well being (Rempel et al., 2017). However, in the case of social prescribing, joining sport or exercise groups is just one option for the patient. A more recent initiative—*parkrun practices*—focuses specifically on encouraging patients presenting to general practice to engage in a form of group exercise (i.e., parkrun). Over 1500 general practices in the United Kingdom have subscribed to this initiative (parkrun, 2020), which involves them displaying flyers and posters, and resident general practitioners encouraging patients and staff to participate in parkrun. Although this initiative remains in its infancy, there is already anecdotal evidence for its benefits (Fleming et al., 2020). However, both of these initiatives only seek to engage people who have already developed health problems (i.e., after they have presented to primary care). Given the present evidence for the *protective* effects of sport or exercise group membership, more proactive approaches (e.g., whereby workplaces, universities, or schools develop and facilitate initiatives encouraging staff and students to join sport or exercise groups) would be valuable.

13.1. Strengths, limitations, and future research

This program of research had several strengths. Notably, the two studies comprised large community samples from different countries and involved distinct approaches to assessing our hypotheses. Moreover, the longitudinal design used in Study 1 allowed us to examine changes in our variables of interest over time, while, in both studies, we controlled for several established predictors of depression.

Notwithstanding these strengths, some limitations and avenues for future research should be noted. First, we did not assess the frequency with which participants typically interacted with their sport or exercise groups, or the subjective value that they attached to their group memberships. Both of these factors are likely to shape the extent to which groups confer depression-related benefits. Indeed, relationships between sport or exercise group membership and physical activity, loneliness, and depression are all likely to be stronger among people who interact with their group (or groups) frequently and strongly value their group (or groups). Future research assessing these nuances would afford insights into the extent to which belonging to a smaller number of 'higher quality' sport or exercise groups can be equally (or more) protective against depression than engaging less often or being less committed to a greater number of groups.

Future research could also explore other potential mechanisms through which sport and exercise group memberships protect against depression. Such knowledge would be valuable for those implementing initiatives aimed at engaging people in sport or exercise groups to understand why these initiatives have or have not been effective. The satisfaction of basic psychological needs (e.g., for belonging, meaning, and self-esteem) is one plausible mechanism that future research could test (see also Greenaway et al., 2016). Finally, there is a need for research examining whether joining sport or exercise groups reduces depression symptoms among those that already have depression (and the mechanisms through which this occurs).

14. Conclusion

This research found evidence across two studies that belonging to sport or exercise groups can protect people against depression. It also found evidence that this may be at least partly because belonging to such groups facilitates greater overall engagement in physical activity and reduced loneliness. Initiatives focused on increasing people's engagement in sport or exercise groups may thus be an effective way to protect people from depression by giving rise to benefits through the dual pathways of greater physical activity and reduced loneliness.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2021.114337.

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