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ORIGINAL ARTICLE

Physical activity and mental health in an Irish population

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Abstract

Background Physical activity represents a modifiable behaviour which may be associated with increased likelihood of experiencing positive mental health.

Aims The aim of this study was to examine the association between self-rated physical activity and subjective indicators of both positive and negative mental health in an Irish adult population.

Methods Based on data from a population-based, observational, cross-sectional study, participants were categorised using the International Physical Activity Questionnaire (IPAQ) into those who reported that they did and did not meet recommended physical activity requirements. Self-reported positive and negative mental health indicators were assessed using the Energy and Vitality Index (EVI) and the Mental Health Index-5 (MHI-5) from the SF-36 Health Survey Instrument, respectively. Binary logistic regression was used to identify variables independently associated with self-reported positive and negative mental health.

Results A total of 7539 respondents were included in analysis. Overall, 32% reported that they met recommended minimal physical activity requirements. Self-reported positive and negative mental health were reported by 16 and 9% of respondents, respectively. Compared with those who reported meeting-recommended physical activity requirements, those performing no physical activity were three times less likely to report positive mental health (adjusted odds ratio (OR) 0.39, 95% confidence interval (CI) 0.28–0.55) and three times more likely to report negative mental health (OR 3.27, 95% CI 2.38–4.50).

Conclusion Compared with those who do not, those who report meeting-recommended physical activity requirements are more and less likely to report experiencing positive and negative mental health, respectively. Future policy development around physical activity should take cognisance of the impact of this activity on both physical and mental health outcomes.

Keywords Negative mental health · Physical activity · Positive mental health

Introduction

One in four adults will experience a mental health problem in their lifetime [1]. In addition to individual disease impact, the consequences of mental ill-health have significant implications for economic development and societal welfare, placing additional burden on family life, increasing the risk of poverty and loss of economic productivity, and placing significant costs on health care systems [1, 2].

Mental health has two dimensions, positive and negative. Positive mental health considers mental health as a resource which contributes to subjective wellbeing and affective balance allowing one to manage life, maximise one's potential and participate and contribute to society [2]. Negative mental health, meanwhile, is an umbrella term for those who experience mental disorders (long-lasting symptoms which reduce functional capacity), symptoms and problems; it may exist and cause considerable burden without meeting criteria for a clinical disorder. Positive and negative mental health are not

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opposite ends of a single continuum but rather represent distinct but correlated axes [3]. The absence of a clinically diagnosed mental disorder does not necessarily imply the presence of positive mental health and individuals may experience varying degrees of positive or negative mental health in the absence of a clinical diagnosis [4].

Physical inactivity is the fourth leading risk factor for global mortality. In Ireland, it is responsible for 9% of disease burden from coronary heart disease; 11% of type 2 diabetes; 15% of breast cancers and 16% of colon cancers [5].

The evidence for a relationship between physical activity and mental health continues to grow [6–8]. Previous research has predominantly focused on the association between negative mental health and physical inactivity. A definite causal relationship between physical inactivity and mental ill-health is difficult to determine as the majority of studies are observational. However, a consistent association between physical inactivity and negative mental health has been shown, as has a temporal relationship, with prospective research demonstrating that exercise has a protective effect against subsequent development of depression [9, 10], and the role of physical activity in both the prevention of and management of negative mental health is increasingly accepted [11–13].

There has also been increasing interest in the relationship between physical activity and positive mental health. The limited available research suggests a positive association between physical activity and psychological wellbeing and happiness [14], although this association has not yet been studied in an Irish population. The aim of this study was to examine the association between self-reported physical activity and both positive and negative indicators of mental health in an Irish adult population.

Methods

Study design and setting

This analysis is based on publicly available data collected as part of the Healthy Ireland 2015 Survey (data are archived in the Irish Social Science Data Archive and are available on written request) [15]. This survey, carried out between November 2014 and August 2015, was a population-based, observational, cross-sectional study. The Healthy Ireland survey is an annual interviewer-administered face-to-face survey which covers a variety of topics including self-reported physical activity and wellbeing [16, 17].

Participants

Individuals aged 15 years and over living at residential addresses listed in the An Post/Ordnance Survey Ireland GeoDirectory (a complete database of every building in the Republic of Ireland) were eligible for inclusion in the study. In order to ensure a representative sample of the Irish population, a multistage probability sampling process was undertaken. Interviewers visited pre-selected addresses and sought to interview a randomly selected individual at each selected address [16, 17].

Outcome variables

Positive mental health was measured using the Energy and Vitality Index (EVI) of the SF-36 Health Survey Instrument [18–21]. The EVI is recommended as an appropriate measure of positive mental health in EU populations [22]. It includes four items and assesses the respondent's own perception of energy and fatigue levels over the previous 4 weeks [18]. The resulting scores, which range from 0 to 100, give an indication of a respondent's level of positive mental health, with higher scores indicating greater wellbeing. Respondents obtaining scores equal or over 1 standard deviation of the mean are defined as falling within a 'High Energy and Vitality group' (High EVI) and are deemed to be displaying optimal levels of positive mental health [4]. This group is referred to as experiencing positive mental health.

Negative mental health was measured using the Mental Health Index-5 (MHI-5) taken from the RAND 36-item Short Form Health Survey (SF-36), a patient-reported generic measure of health status [21]. The MHI-5 has been recommended as the most appropriate indicator of negative mental health for population studies in the European Union [22]. The MHI-5 index measures the occurrence and extent of psychological distress over the previous 4 weeks. The questions are based around different dimensions of mental health; anxiety, depression, loss of emotional/behavioural control and psychological wellbeing. Each respondent is allocated a score from 0 to 100 [20, 23]. A respondent is considered to have a 'probable mental health problem' if they report a score equal to or below 56, an established cut-off point for detection of a probable mental health problem [2, 4, 16]. This group is referred to as experiencing negative mental health.

Respondents who fell outside these two defined categories, negative mental health and positive mental health, were included in the logistic regression analysis so that those who experienced positive mental health were compared against all those who did not, and separately, those who experienced negative mental health were compared against all those who did not.

Predictor variables

Physical activity

The predictor variables were gender, age category (15–24, 25–44, 45–64 and 65 years and older), education (second level or

below, higher than second level), socio-economic class (higher, intermediate, routine manual, not classified) and physical activity. Physical activity was measured using the short form of the International Physical Activity Questionnaire (IPAQ), which is the recommended standard for national studies [24]. The IPAQ was tested for reliability and validity in 12 countries across six continents between 1998 and 1999 and was found to have acceptable measurement properties in terms of reliability and validity [24]. It measures the frequency, duration and intensity of physical activity over the previous 7 days. The questionnaire includes questions on vigorous activity, moderate activity and walking. Each of these activities has an allocated 'metabolic equivalent of a task' (MET) score [25]. The World Health Organization (WHO) defines vigorous activity as that which requires a large amount of effort and causes rapid breathing and a substantial rise in heart rate [26]. Vigorous activity = 8.0 METs (e.g. running a 12-min mile), moderate activity = 4.0 METs (e.g. cycling at < 10 mph), walking = 3.0 METs. Frequency and duration of activity are then used to calculate a MET-minutes/week for each respondent. For example, a person who walks for 30 min 5 days a week has a score of, 30 × 5 × 3.0 METs = 450 MET-minutes/week.

Respondents are then categorised as low, moderate and high. To be categorised as high, one must perform vigorous-intensity activity on at least 3 days achieving a minimum total physical activity of at least 1500 MET-minutes/week. Alternatively, one must undertake 7 days of any combination of walking, moderate-intensity or vigorous-intensity activities achieving a minimum total physical activity of at least 3000 MET-minutes/week.

In this survey, only respondents classified as high were deemed to be meeting the minimal physical activity requirements. This cut off was determined by the Healthy Ireland Survey 2015 authors [15]. A study by Bauman et al. examining limitations of the IPAQ suggests using the 'high' category as a cut off for those meeting the recommended physical activity requirement of '30 minutes of moderate physical activity 5 days a week'. By using the 'high' category, it allows for background physical activity that may be reported as part of total physical activity [27]. A fourth category 'none' was included in this survey for respondents who reported none of the above forms of activity [17].

Statistical methods

Statistical analysis was performed using SPSS version 24. Results were weighted to conform to Irish population demographics for age, gender, education, working status and geographical region. Measures of association were calculated using Pearson's chi-squared test. Binary logistic regression was used to identify potential predictor variables independently associated with self-reported positive and negative mental health. Significance of the covariates were assessed by the p values (< 0.05), odds ratios (OR) and 95% confidence intervals (CI) for association between predictor variables and self-reported mental health.

Results

The survey achieved a response rate of 61% and a total of 7539 participants were included in the present analysis.

The demographic characteristics of respondents according to self-reported levels of physical activity, positive and negative mental health are reported in Table 1. Positive mental health was reported by 16% of the study population and was significantly more prevalent in men (20 vs. 12%, $p < 0.001$). The population group with the highest prevalence of reported positive mental health were males aged 15–24 years (29%). Negative mental health was reported by 9% of the study population and was significantly more prevalent among women (13 vs. 6%, $p < 0.001$). The population group with the highest prevalence of reported negative mental health were females age 15–24 (16%).

Overall, 32% of the study population were categorised as 'highly active' (i.e. meeting the recommended minimal physical activity requirements). Significant differences were seen between age groups; 46% of those aged 15–24 years were categorised as highly active compared with 15% of those aged 65 years and older ($p < 0.001$).

The proportion of males who were highly active was significantly higher than females (40 vs. 24%, $p < 0.001$). Although the size of this difference decreased with increasing age, a significantly greater proportion of males compared with females were highly active across all age groups (age 15–24, 56% males vs. 34% females highly active, $p < 0.001$; age 25–44, 46% males vs. 27% females, $p < 0.001$; age 45–64, 36% males vs. 22% females, $p < 0.001$; age 65+, 20 vs. 11%, $p < 0.001$). Compared with those with lower levels of education, those with higher levels of education were significantly more likely to report engaging in high levels of physical activity ($p = 0.006$).

As IPAQ category increases, the prevalence of positive mental health increases while the prevalence of negative mental health decreases. Compared with those who did not, those who reported positive mental health were significantly more likely to report being highly active (43 vs. 29%, $p < 0.001$) (Table 1). Similarly, compared with those who did not, those who reported negative mental health were significantly less likely to report being highly active (20 vs. 33%, $p < 0.001$).

Table 2 shows the results of logistic regression analysis which was used to assess the odds of experiencing self-reported positive and negative mental health according to IPAQ category, after adjusting for age, sex, social economic class and level of education. Those who were categorised as highly active (high IPAQ category) were more than twice as

Table 1 Self-reported engagement in recommended levels of physical activity and positive and negative mental health

		Total all (%) ($n = 7539$)	Physical activity		Mental health			
			High IPAQ		Positive		Negative	
			Yes (%)	p value	Yes (%)	p value	Yes (%)	p value
Gender	Male	3698 (49.1)	1491 (40.3)		721 (19.5)		220 (5.9)	
	Female	3841 (50.9)	914 (23.8)	< 0.001	456 (11.9)	< 0.001	484 (12.6)	< 0.001
Age	15–24	1103 (14.6)	503 (45.6)		228 (20.7)		113 (10.2)	
	25–44	2937 (39.0)	1064 (36.2)		483 (16.4)		243 (8.3)	
	45–64	2272 (30.1)	653 (28.7)		305 (13.4)		203 (8.9)	
	65+	1227 (16.3)	185 (15.1)	< 0.001	161 (13.1)	< 0.001	145 (11.8)	0.002
Education	Second level/less	5323 (70.6)	1647 (30.9)		854 (16.0)		548 (10.3)	
	Above second level	2216 (29.4)	758 (34.2)	0.006	324 (14.6)	0.121	156 (7.0)	< 0.001
Socio-economic class ($n = 6654$)[$]	Managerial/professional	1810 (27.2)	604 (33.4)		276 (15.2)		129 (7.1)	
	Intermediate	1972 (29.6)	662 (33.6)		301 (15.3)		149 (7.6)	
	Routine manual	2872 (43.2)	965 (33.6)	0.990	497 (17.3)	0.080	258 (9.0)	0.048
Positive mental health	Yes	1177 (15.6)	510 (43.3)		–	–	10 (0.8)	
	No	6362 (84.4)	1895 (29.8)	< 0.001	–	–	694 (10.9)	< 0.001
Negative mental health	Yes	704 (9.3)	137 (19.5)		10 (1.4)		–	–
	No	6835 (90.7)	2268 (33.2)	< 0.001	1168 (17.1)	< 0.001	–	–

IPAQ International Physical Activity Questionnaire

[$] 885 respondents were not classified according to socio-economic class; these were excluded from the above analysis of socio-economic class

likely to report positive mental health compared with those who did no exercise (adjusted odds ratio (OR) 2.56, 95% confidence interval 1.82–3.57, $p < 0.001$). Similarly, compared with those categorised as highly active, those who did no exercise were more than three times more likely to report negative mental health (OR 3.27, 95% CI 2.38–4.50, $p < 0.01$).

Almost two in five (38%) respondents reported that they would like to be more physically active. This varied significantly according to self-reported levels of physical activity; just a quarter (26%) of those who reported being highly active said that they would like to be more active while almost half of those who reported low levels (48%) or no physical activity (45%) reported that they would like to be more active ($p < 0.01$).

Discussion

The results of this cross-sectional survey demonstrate that just one third (32%) of the Irish population engage in high levels of physical activity. For comparison, the International Prevalence Study on Physical Activity (IPS) (2009) reported that prevalence of high levels of physical activity ranged from 63% in New Zealand to 21% in Japan [28]. Based on the results of the current study, Ireland would be placed 16th out of 21 countries in terms of levels of physical activity, highlighting the importance of the 'Getting Ireland Active' initiative and Ireland's first ever National Physical Activity Plan [29]. The latter, which was published in 2016, aims to increase the number of people taking regular exercise by 1% a year over 10 years and has specific targets for increasing physical activity in children, adults and older people. The present study demonstrates a significant disparity between the proportion of males (40%) and females (24%) engaging in high levels of physical activity. This correlates with the IPS in which there was an average 9% difference between the proportion of males and females categorised as highly active [28]. Differences in gender were noted across all age categories although the gender disparity reduced as age increased, findings consistent with those reported by the European Commission in their Sports and Physical Activity Report (2014), which found gender disparity to be particularly marked in the 15–24 year old age group (74% males vs. 55% females reported regular engagement in exercise or sport) [30]. Ireland attempted to address this issue through the 'Women in Sport' initiative, launched by the Irish Sports Council in 2005 [31]. While the results of the Irish Sports Monitor 2015, a population-based study with 8540 adult participants, suggest that this and similar programmes are having a positive effect with a substantial increase noted in the proportion of women in Ireland participating in regular sport over the past decade (from less than a third of women in 2005 to 42% in

Table 2 Factors independently associated with self-reported positive and negative mental health

		Positive mental health ($n = 6654$)[$]				Negative mental health ($n = 6654$)[$]			
		Yes (%)	No (%)	OR	CI	Yes (%)	No (%)	OR	CI
Gender	Male*	20.0	80.0			5.3	94.7		
	Female	12.1	87.9	0.60	0.52–0.69	10.9	89.1	2.05	1.70–2.49
Age Group	15–24*	21.0	79.0			9.8	90.2		
	25–44	16.7	83.3	0.81	0.67–0.99	7.5	92.5	0.73	0.56–0.96
	45–64	14.3	85.7	0.69	0.56–0.85	6.9	93.1	0.62	0.46–0.82
	65+	14.0	86.0	0.74	0.58–0.94	10.1	89.9	0.77	0.56–1.04
Education	Second level/less*	16.8	83.2			8.7	91.3		
	Above second level	14.7	85.3	0.90	0.76–1.07	6.8	93.2	0.81	0.64–1.02
Socio-economic class[$]	Managerial/professional*	15.2	84.8			7.1	92.9		
	Intermediate	15.3	84.7	0.98	0.82–1.19	7.6	92.4	0.94	0.72–1.22
	Routine manual	17.3	82.7	1.11	0.93–1.33	9.0	91.0	1.12	0.87–1.44
IPAQ	High*	21.3	78.7			5.3	94.7		
	Moderate	15.1	84.9	0.73	0.63–0.85	7.4	92.6	1.33	1.04–1.70
	Low	12.7	87.3	0.61	0.51–0.74	10.3	89.7	1.87	1.44–2.41
	None	8.5	91.5	0.39	0.28–0.55	17.3	82.7	3.27	2.38–4.50

*reference; *OR* adjusted odds ratio, *CI* 95% confidence interval, *IPAQ* International Physical Activity Questionnaire

[$] 885 respondents were not classified according to socio-economic class; these were excluded from the regression analysis

2015), the gender disparity remains (49% men participated in regular sport in 2015) and current and future policy initiatives need to remain cognisant of this disparity [32].

The proportion of respondents who reported that they were highly active declined with increasing age, with just 15% of respondents aged 65 years and older reporting high levels of physical activity and almost half of respondents in this age group reporting engaging in low levels or no physical activity, reflecting previously reported national and international trends [30, 33]. This latter finding is of particular importance because there is a growing acceptance that while real-world considerations may prevent many older people from meeting recommended levels of physical activity, there is a need to place greater emphasis on the benefits that can be accrued from any increase in current levels of activity, with the greatest health and functional benefits found for increments in activity within the lower end of the overall spectrum [34–36].

The overall prevalence of self-reported positive mental health in this study was 16%. Huppert et al. assessed the prevalence of self-reported positive mental health in 43,000 adults in 23 European countries, including Ireland, in 2006/2007 [37]. The overall prevalence of self-reported positive mental health among participants was 16% (range 9% (Portugal)–41% (Denmark)); Ireland ranked 6th (25%). Ireland experienced an economic recession in the years between 2007 and 2015. Evidence suggests that the global economic crisis and consequent austerity measures had a significant impact on the prevalence of mental ill-health both in Ireland and internationally [38, 39], and it is plausible that the discrepancy seen between our study and that of Huppert et al. is a consequence of this crisis.

Compared with women (12%), a greater proportion of men (20%) reported positive mental health. Similarly, the prevalence of self-reported negative mental health was significantly higher in women (13%) compared with men (6%). These findings reflect international evidence which suggests that mental ill-health is more common in women [40, 41], with depression generally reported to be twice as common in women compared with men across diverse societies and social contexts [42]. Although, multiple intertwined factors (biomedical, psychosocial, epidemiological) are likely to contribute to gender disparities in mental health, the results of this study suggest that, even after adjusting for some of these factors including age, education and social class, women who engage in higher levels of physical activity are more likely to report better mental health, a finding which should be considered in future policy developments in this area.

Our finding of a significant positive association between self-reported positive mental health and increasing levels of physical activity is supported by a growing body of evidence which supports this relationship [43–45]. However, the precise frequency and intensity of physical activity needed for positive mental health remains unclear. A population study from Finland reported that regular but not daily exercise was associated with greater psychological wellbeing, with a slightly higher prevalence of depression seen in those who exercised daily compared with those exercising two–three

times a week or once a week [43]. This finding was also noted by McMahon et al. who reported that, while a positive correlation between frequency of activity and wellbeing was found for adolescents across Europe, this relationship was curvilinear for girls, with those who reported exercising very frequently or daily also reporting reduced levels of wellbeing and higher levels of depression compared with their counterparts who exercised regularly but slightly less frequently [44].

The type of physical activity undertaken by respondents was not assessed in this study. This may be important because it has been demonstrated that the domain in which physical activity occurs can influence the relationship between physical activity and mental health; for example, White et al. (2017) reported that while leisure-time and transport-related physical activity were positively associated with positive mental health, work-related physical activity was positively associated with mental ill-health [46]. Similarly, lower levels of anxiety and depression and higher levels of wellbeing have been reported in those participating in team—as opposed to individual—sports [44], and this would benefit from additional research and consideration for intervention, particularly given that data from the Irish Sports Monitor in 2015 suggested that just 9% of adults in Ireland participate in team sports (a decline from 11% in 2011) [32].

It should also be noted that this was a cross-sectional study and as such, it was not possible to investigate potential causal or temporal relationships between physical activity and mental health. In addition, the use of a self-report instrument to assess quantity of physical activity was subject to recall bias and the categorisation of respondents according to IPAQ category meant that it was not possible to assess the shape of the dose-response curve between volume of physical activity and self-reported positive or negative mental health. Unfortunately, the Healthy Ireland 2015 Survey did not collect data on baseline mental health status or specific past medical history and therefore this information, which may be a potential confounding factor, could not be included in our study.

Conclusion

Those who meet recommended physical activity requirements are more likely to experience positive mental health and less likely to experience negative mental health. These associations suggest that policy developments around physical activity should take cognisance of the impact on both physical and mental health outcomes.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval This study is an observational study using publicly available data which was collected as part of the Healthy Ireland Survey 2015. This survey was ethically approved by the Research Ethics Committee at the Royal College of Physicians of Ireland.

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Key Points

- One third (32%) of the Irish population engage in high levels of physical activity
- Positive mental health is reported by 16% of the population and negative mental health by 9%.
- Compared with those who meet recommended physical activity requirements, those who do not engage in physical activity are three times less likely to report positive mental health and three times more likely to report negative mental health.
- These associations suggest that policy developments around physical activity should take cognisance of the impact on both physical and mental health outcomes.