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The association between the longitudinal course of common mental disorders and subsequent physical activity status in young adults: A 30-year birth cohort study

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ABSTRACT

Low physical activity is a major public health concern. There has been extensive research examining the role of physical activity as a potentially modifiable risk factor for the onset of mental illness. However, fewer studies have reported how mental disorders affect future physical activity. Using data from a large birth cohort, the current study explored the association between the longitudinal course of common mental disorders (affective disorders, anxiety disorders, and substance use disorders, as well as any common mental disorder) and subsequent physical activity status among young adults living in Australia. Prospective data from the Mater-University of Queensland Study of Pregnancy, consisting of 1611 young adults, were analyzed. The longitudinal course of mental disorder diagnoses between ages 21 and 30 was derived from the Composite International Diagnostic Interview. Physical activity status at age 30 was estimated using International Physical Activity Questionnaire long form. Logistic regression was used to examine the association between the longitudinal course of common mental disorders between 21 and 30 years and subsequent physical activity status at age 30. After adjusting for confounding factors, there was no association between the longitudinal course of affective disorders, anxiety disorders, substance use disorders, or any common mental disorder at ages 21 and 30 and physical activity status at age 30. Our findings suggest that there is no longitudinal association between the common mental disorder diagnoses and physical activity status among young adults living in Australia.

1. Introduction

Low physical activity (PA) is associated with a wide range of adverse outcomes such as increased mortality risk (Lee et al., 2012), cardiovascular disease risk (Lear et al., 2017), and mental health burden (Chekroud et al., 2018). Common mental disorders (CMDs) are highly prevalent and are associated with substantial burden of disease (Whiteford et al., 2013). In particular, the association between CMDs and physical comorbidities (Scott et al., 2016), as well as associated excess mortality (Walker et al., 2015) is well established.

Most existing studies have explored PA status as a risk factor for future CMD diagnoses. To our knowledge, there are few longitudinal studies (Hiles et al., 2017; Jerstad et al., 2010; Naicker et al., 2013; Patten et al., 2009) that examined the impact of having CMD diagnoses (as opposed to symptoms) on subsequent PA status. For instance, two studies (Hiles et al., 2017; Jerstad et al., 2010) found reciprocal associations between diagnoses of affective disorders and anxiety disorders and subsequent low PA status. Hiles et al. (2017) found that adults with anxiety and those with comorbid anxiety and depression had significantly reduced PA engagement two years later compared to the

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healthy control group. There was, however, no association seen in those who had a diagnosis of depression alone. Jerstad et al. (2010) also found the association between the baseline depression diagnosis and subsequent reduced PA status. However, it should be noted that their sample cohort consisted of female adolescents (mean age 13) only, and the findings may not be generalizable to other population cohorts. On the other hand, a larger study of 1027 adolescents (initial age between 16 and 17) that included both males and females (Naicker et al., 2013) found no association between baseline adolescent depressive disorder diagnosis and PA status over the subsequent ten years. Furthermore, we are not aware of any longitudinal study that has explored the association between substance use disorder diagnosis using structured diagnostic questionnaire and subsequent PA status.

Using data from a large birth cohort, the current study examined the association between the longitudinal course of CMDs - including affective disorders, anxiety disorders, and substance use disorders – on subsequent PA status among young adults living in Australia.

2. Material and methods

2.1. Study cohort

The Mater-University of Queensland Study of Pregnancy is a prospective longitudinal cohort study of mothers and their offspring who received antenatal care at a major public hospital in Queensland, Australia, between 1981 and 1983. Data were collected on 7223 singleton live-birth offspring and their mothers. The cohort members and their mothers were followed up at six months, five, 14, 21, and 30 years. For the current study, young adults who completed questionnaires related to both CMD diagnoses and PA status at the 30 year follow-up were included. As the data collection occurred over four years, the ages of cohort members at the 30 year follow-up ranged from 27 to 33 years. Written informed consent was obtained from the young adult at the 21 and 30 year follow-ups. Ethical approval of the study was obtained from the University of Queensland Ethics Committee.

2.2. Measurement of mental disorders

Both at the 21 year follow-up and the 30 year follow-up, mental disorder diagnoses were assessed using the Composite International Diagnostic Interview (World Health Organization (WHO), 1992). The 'caseness' was defined as having a Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) diagnosis of affective disorder (major depression, dysthymia or bipolar disorder), anxiety disorder (panic disorder, agoraphobia, social phobia, generalized anxiety disorder, specific phobia, or post-traumatic stress disorder), or substance use disorder (alcohol, opioid, cannabis, sedative, cocaine, amphetamine, hallucinogen, inhalant, phencyclidine, and other substance abuse or dependence). At the 21 year follow-up, life-time diagnoses for these disorders were utilized (that is, having had diagnoses at any stage up until the 21 year follow up). At the 30 year follow-up, diagnoses from the past 12 months were used. In addition, the three diagnostic categories were further combined to create "common mental disorder" diagnostic category (i.e. those who meet the criteria for a lifetime diagnosis of affective disorder, anxiety disorder or substance use disorder versus those who did not meet any of above diagnoses). The cohort was divided into four groups according to the mental disorder status at the 21 year follow-up and 30 year follow-up; (i) "no mental disorder" (no mental disorder diagnosis at either 21 year follow-up or 30 year follow-up), (ii) "recovered" (mental disorder diagnosis at the 21 year follow-up but not at the 30 year follow-up), (iii) "incident" (no mental disorder diagnosis at the 21 year follow-up but developed mental disorder diagnosis at the 30 year follow-up), and (iv) "persisting" (mental disorder diagnosis at both 21 year follow-up and 30 year follow-up).

2.3. Measurement of physical activity status

At the 30 year follow-up, PA status was measured using the International Physical Activity Questionnaire (IPAQ) long form (Craig et al., 2003). The IPAQ long form is a self-report questionnaire that measures frequency and duration of moderate PA (≥ 4 metabolic equivalent of task (MET)), vigorous PA (≥ 8MET), and walking over the preceding seven days. It measures PA in each of the following domains; work-related PA, transport-related PA, domestic and gardening activities, and leisure-time PA (The IPAQ Group, 2005). PA assessment consisted of activities undertaken for at least 10 min as part of everyday life. In the current study, the widely used IPAQ scoring protocol categorized PA into three levels (low, moderate, or high) (The IPAQ Group, 2005). The categories were then further dichotomized into two PA status groups – low-moderate (low and moderate IPAQ PA levels combined) versus high (high IPAQ PA level only). In keeping with previous research using the Mater-University of Queensland Study of Pregnancy cohort (Suetani et al., 2018), responses to a range of questions relating to general measures of frequencies and types of PA were used to estimate the PA engagement at the 21 year follow-up. In this self-report, vigorous exercise was defined as 'exercise which makes you breathe harder or puff and pant'. Less vigorous exercise was defined as exercise 'which did not make you breathe harder or puff and pant'. Frequency of each type of PA was assessed with the following questions: 'How many sessions of vigorous exercise did you have over the 2-week period?', 'How many sessions of less vigorous exercise did you have over the 2-week period?' and 'How many times did you walk for recreation or exercise?'. Each PA subtype was dichotomized into either 'none' (those who engaged in no session in the last 2 weeks), or 'any' (those who engaged in more than one session in the last 2 weeks).

2.4. Statistical analyses

Descriptive statistics were used to summarize the demographic characteristics of the cohort and the main variables of interest. To examine the impact of the longitudinal course of CMDs on the PA status at age 30, odds ratios (OR) with 95% confidence intervals (CI) were used to estimate the likelihood of participants being in the high PA status group at the 30 year follow-up compared to those in the "no mental disorder group" for each diagnosis. As previous studies have shown that age, sex, and body mass index (BMI) are associated with both mental health and PA (Bauman et al., 2012; Scott et al., 2008), the analyses were adjusted for these variables. PA engagement at the 21 year follow-up was also added as a potential confounder as it is likely to be associated with the PA status at the 30 year follow-up. In addition, the sample was stratified by sex and the analyses were repeated for males and females separately. Finally, the differential attrition between age 21 and 30 was analyzed using two methods. First, the association between CMD diagnosis at 21 years and loss to follow-up at age 30 was examined. Second, based on the assumption that the data were missing in a non-random fashion, post hoc modelling exercises were conducted to explore the robustness of the main findings. In the modelled scenarios, two models were constructed. Model 1 assumed that those who were lost to follow-up at age 30 would have had the same diagnostic status (present or absence) as they did at age 21, and their PA status at age 30 was assumed to be low-moderate. Model 2 assumed that those who were lost to follow-up at age 30 would all have CMD diagnosis at age 30 regardless of their diagnostic status at age 21. The PA status at age 30 was likewise assumed to be low-moderate for those who were lost to follow-up. All analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC, USA).

3. Results

Table 1 summaries the frequencies and proportion of demographic and clinical variables. Table 2 reports the associations between the

Table 1
Frequencies and proportions of demographic and clinical variables of participants[a,b].

Age (years)	
At the 21 year follow-up	20.6 ± 0.9
At the 30 year follow-up	30.2 ± 1.1
Gender (Male)	621 (38.6)
Physical activity status at age 21[c]	
Walking	839 (59.1)
Less vigorous	917 (64.8)
Vigorous	765 (53.7)
Physical activity status at age 30[d]	
Low	144 (8.9)
Moderate	542 (33.6)
High	925 (57.4)
Any Affective Disorder[e]	
No mental disorder	744 (74.0)
Recovered	171 (17.0)
Incident	50 (5.0)
Persisting	41 (4.1)
Any Anxiety Disorder	
No mental disorder	626 (62.0)
Recovered	136 (13.5)
Incident	140 (13.9)
Persisting	107 (10.6)
Any Substance Disorder	
No mental disorder	635 (63.1)
Recovered	215 (21.4)
Incident	54 (5.4)
Persisting	103 (10.2)
Any Common Mental Disorder	
No mental disorder	379 (37.6)
Recovered	263 (26.1)
Incident	96 (9.5)
Persisting	270 (26.8)

[a] Totals may vary due to missing variables.
[b] Mean ± standard deviation for means and N (%) for frequencies.
[c] Proportion of participants who engaged in more than one session of physical activity in the past two weeks.
[d] Categorized as per the International Physical Activity Questionnaire category.
[e] Diagnoses derived from the Composite International Diagnostic Interview.

longitudinal course of CMD from ages 21 and 30 and PA status outcomes at age 30. In the unadjusted analyses, those with persisting anxiety disorder diagnosis were less likely to be engaged in high PA status at age 30 (OR 0.65: 95% CI 0.43–0.98), and those in the incident substance use disorder group were more likely to be engaged in high PA (OR 1.98: 95% CI 1.08–3.63). However, once adjusted for PA engagement at age 21, as well as age, sex, and BMI at age 30, there was no association between the longitudinal course of CMD and PA status at 30 years. Furthermore, there was no association between the longitudinal course of CMD and PA status at 30 years in either males or females.

With respect to differential attrition, those who had CMD diagnosis at age 21 were more likely to be lost to follow up compared to those who did not ($p = 0.008$). Under the modelled scenarios, in Model 1 (assumed that those who were lost to follow-up at age 30 would have had the same diagnostic status at 30 years as they did at age 21, and their PA status at age 30 was assumed to be low-moderate), those who were in the recovered group were more likely to be in the high PA group at age 30 compared to the no mental disorder group. In Model 2 (assumed that those who were lost to follow-up at age 30 would all have CMD diagnosis at age 30 regardless of their diagnostic status at age 21, and their PA status at age 30 was assumed to be low-moderate), compared to the no mental disorder group, those who were in the incident group or in the persisting group were less like to be in the high PA group at age 30 (see Table 3).

4. Discussion

Using data from 1611 participants over the period of nine years between ages 21 and 30, we found no longitudinal association between CMDs and PA status. Our null-findings were at least partially consistent with previous studies. For example, even though Hiles et al. (2017) found that adults with anxiety and those with comorbid anxiety and depression had significantly reduced PA engagement two years later, there was no association between depression at baseline and the subsequent PA status. Likewise, a larger study of 1027 adolescents (Naicker et al., 2013) found no association between adolescent depressive disorder diagnosis and PA status over the subsequent ten years. Compared to the study by Jerstad et al. (2010), which found an association between the baseline depression diagnosis and subsequent reduced PA status among adolescent females, the current study had a significantly older cohort (initial mean age 21 compared to 13) as well as having both male and female participants. Even when analyzed by gender, there was no association between the two variables in either sex in the present cohort. Furthermore, Suetani et al. (2018) recently found no longitudinal association between adolescent psychopathology at age 14 and PA status at age 21 using the same dataset. The current findings build on to the previous study in that they suggest even those with CMDs in young adulthood are not disadvantaged from engaging in PA in the future. This is encouraging, especially as there is a rapidly accumulating body of evidence indicating that PA benefits people with mental disorders (Rosenbaum et al., 2014, 2016).

Of note, the current study utilized well-validated measurement tools (a structured diagnostic interview (Composite International Diagnostic Interview) for CMD diagnoses and a self-report questionnaire (IPAQ) for PA status) to measure the main variables of interest. In particular, the use of Composite International Diagnostic Interview allowed us to examine diagnostic entities rather than symptoms. In addition, given that most CMDs are episodic in their natural illness courses, the current study utilized three comparison groups with different proximity of illness (i.e. past experience of symptoms ("recovered"), new onset of symptoms ("incident"), and ongoing experience of symptoms ("persisting")), to allow for a more fine grained examination of the association between CMDs and PA status. Thus, compared to many existing cohort studies examining the associations between PA and mental illness which often rely on non-validated measurement tools, the findings from the current study are likely to have a higher validity.

Several limitations are notable and the interpretation of our findings requires caution. First, the current study relied on two different self-report measures to estimate the PA status at ages 21 and 30. While IPAQ (used at age 30) was a validated self-reported questionnaire, the exercise questionnaire at age 21 was not. Moreover, the recent review of reviews found that objective measurements such as accelerometers demonstrated more methodological robustness compared to self-report measurements (Dowd et al., 2018). In large longitudinal cohort studies like this, however, factors other than methodological robustness, such as cost and feasibility, need to be considered. Even though there are some concerns that the IPAQ may overestimate PA compared to more objective measurements both in the general population (Lee et al., 2011) and in those with mental illness (Firth et al., 2018), it remains one of the most widely validated and used research tools in population studies. Given its practical advantages combined with the fact that IPAQ has been designed for, and tested in, adults aged 18 and 69 for population-level surveillance (Bauman et al., 2009), the use of this particular questionnaire in the current study is appropriate. Second, like other longitudinal studies, the generalizability of the findings may be affected by differential attrition. While this was primarily due to lack

Table 2
Longitudinal association between the mental disorder diagnoses at ages 21 and 30 and physical activity status at age 30.

Mental Disorder Diagnosis at 21 and 30 years	Physical activity status at age 30			
	Unadjusted odds ratioa (95% CI)	Adjustedb odds ratio (95% CI)	Males Adjusted odds ratio (95% CI)	Females Adjusted odds ratio (95% CI)
Any affective disorder[c] No mental disorders	*Reference*			
Recovered	0.81 (0.58–1.14)	0.90 (0.61–1.33)	0.98 (0.47–2.04)	0.87 (0.54–1.39)
Incident	0.84 (0.47–1.49)	0.86 (0.46–1.59)	0.90 (0.33–2.45)	0.85 (0.38–1.89)
Persisting	0.75 (0.40–1.41)	0.71 (0.35–1.45)	0.54 (0.13–2.27)	0.81 (0.36–1.85)
Any anxiety disorder No mental disorders	*Reference*			
Recovered	1.02 (0.70–1.49)	1.07 (0.68–1.66)	0.92 (0.41–2.08)	1.16 (0.68–1.98)
Incident	0.93 (0.64–1.34)	0.98 (0.64–1.50)	0.90 (0.44–1.87)	1.06 (0.62–1.79)
Persisting	**0.65 (0.43–0.98)**	0.74 (0.45–1.20)	0.37 (0.11–1.25)	0.87 (0.51–1.49)
Any substance use disorder No mental disorder	*Reference*			
Recovered	1.23 (0.90–1.68)	0.92 (0.63–1.34)	0.81 (0.46–1.41)	1.04 (0.62–1.74)
Incident	**1.98 (1.08–3.63)**	1.27 (0.63–2.56)	2.15 (0.58–8.06)	1.03 (0.43–2.44)
Persisting	1.32 (0.86–2.01)	1.18 (0.71–1.95)	1.32 (0.64–2.73)	1.05 (0.51–2.17)
Any common mental disorder No mental disorder	*Reference*			
Recovered	1.07 (0.78–1.47)	0.91 (0.63–1.32)	0.75 (0.42–1.35)	1.00 (0.62–1.62)
Incident	0.93 (0.59–1.46)	0.80 (0.48–1.33)	1.27 (0.48–3.34)	0.67 (0.36–1.24)
Persisting	0.96 (0.70–1.31)	0.88 (0.61–1.26)	1.02 (0.55–1.89)	0.82 (0.51–1.30)

[a]Odds ratio used to estimate the odds likelihood of participants being in the "High" group compare to "Low-Moderate" group.
[b]Adjusted for physical activity engagement at age 21 and age, sex and body mass index at age 30.
[c]Diagnoses derived from the Composite International Diagnostic Interview.

Table 3
Attrition analyses.

Mental Disorder Diagnosis at 21	Lost to follow up	Included at age 30
Common mental disorders		
No	645 (41.6)	476 (47.0)
Yes	904 (58.4)	537 (53.0)
		Chi-Square 7.12 $p = 0.008$
Mental Disorder Diagnosis at 21 and 30 years	Physical activity status at age 30	
	Model 1 Adjusteda odds ratiob (95% CI)	Model 2 Adjusted odds ratio (95% CI)
Common mental disorders No mental disorder	*Reference*	
Recovered	**1.82 (1.29–2.58)**	0.91 (0.63–1.33)
Incident	1.60 (0.98–2.60)	**0.19 (0.13–0.29)**
Persisting	0.72 (0.53–0.97)	**0.36 (0.26–0.50)**

Model 1 assumes that those who were lost to follow up at age 30 had the same diagnostic status as they did at age 21 at age 30, and the physical activity status age 30 was assumed to be low-moderate.
Model 2 assumes that those who were lost to follow up at age 30 all had diagnosis of common mental disorders at age 30, and the physical activity status age 30 was assumed to be low-moderate.
[a]Adjusted for physical activity engagement at age 21 and age, sex and body mass index at age 30.
[b]Odds ratio used to estimate the odds likelihood of participants being in the "High" group compare to "Low-Moderate" group.

of resources to track all original cohort members rather than refusal to participate, participants lost to follow up differed on a range of variables such as birth weight and various maternal variables at first clinic visit related to age, education, marital status, mental health, and smoking. In any event, extensive modelling of the impact of biased loss to follow up in the Mater-University of Queensland Study of Pregnancy study has consistently suggested that findings are only minimally affected (Najman et al., 2005, 2015). In our attribution analyses, however, those who had CMD diagnosis at age 21 were more likely to be lost to follow up at age 30, and the modelled scenarios found associations between CMD diagnosis and PA status. While the modelled scenarios were intentionally set up to over-estimate the association between the two variables by assuming that everyone who was lost to follow up had low-moderate PA status at age 30 (so that it would challenge the main null-finding), it is possible that the results of the current study may be affected by the differential attrition between age 21 and 30. Finally, the current study was conducted in Australia, thus the findings may not be globally generalizable.

5. Conclusion

Our findings suggest that there is no longitudinal association between the CMD diagnoses and PA status among young adults. More research is needed to clarify if the course of mental disorders is associated with future PA or not, using more robust assessment tools such as objective PA measurements, samples with different ages, and from different geographic locations. Studies that examine the factors that are (and are not) associated with future PA among individuals with CMDs are essential to delivering effective interventions to improve population health. Such interventions may in turn reduce the risk of excess mortality, physical comorbidities, and mental health burden.

Declaration of interest

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We have no conflict of interest.

Contributions

SS, JJM and JGS planned the study. JGS, and SS planned the statistical analysis which was conducted by SS. SS and JGS wrote the initial drafts of the manuscript. All authors were involved in later revisions and all authors approved the final manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpsychires.2018.12.003.

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