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ABSTRACT

Objective Regular exercise significantly benefits mental health, yet its therapeutic potential in psychiatric care remains underutilised. Understanding the factors influencing physical activity in individuals with mental illness is crucial to realising its full therapeutic potential. Our study seeks to explore motivational and socio-demographic determinants affecting exercise habits in individuals with mental illness and compare them to those without mental illness.

Design and setting Distribution of the link to a cross-sectional online survey at psychiatric clinics, practices, university events and sports clubs, via self-help group email lists and on social media.

Methods An online survey using validated questionnaires supplemented with self-developed items was conducted. Statistical analysis encompassed unpaired t-tests and χ^2 tests to compare individuals with and without mental illness, as well as multiple linear regression to investigate the relationship between childhood exercise experience, psychometrics and current physical activity behaviour in individuals with mental illness.

Participants 1564 individuals (66.5% female) including 417 diagnosed with any kind of mental illness.

Results In comparison with mentally healthy participants, individuals diagnosed with mental illness displayed notably lower activity levels (eg, engaging in regular physical activity 55.6% vs 69.3%, x2(1, n=1458) = 26.03, p<0.001), autonomous motivation (sport- und bewegungsbezogene Selbstkonkordanzskala Index: M=3.62, SD=3.07 vs M=4.62, SD=2.74, t(594.58)=5.4, p=0.009), self-efficacy expectancies (Allgemeine Selbstwirksamkeit Kurzskala: M=3.65, SD=0.81 vs M=4.10, SD=0.59, t(505.39)=9.76, p<0.001), and resilience (Brief Resilience Scale: M=2.81, SD=0.83 vs M=3.46, SD=0.70, t(555.52)=13.28, p<0.001), and a greater external locus of control (Internale-Externale-Kontrollüberzugung Scale: M=2.53, SD=0.89 vs M=2.13, SD=0.76, t(565.43)=−7.78, p<0.001). Throughout childhood and adolescence, they reported less activity (66.9% vs 78.0%, x2(1, n=1549) = 18.22, p<0.001) and lower grades in physical education (M=2.1, SD=0.8 vs M=1.8, SD=0.8, U=1 888 071.00, Z=−6.19, p<0.001). Individuals with mental illness favoured a structured sports programme led by professionals. Factors like self-concordance (ß=0.29, p<0.001), intrinsic motivation (ß=0.22, p=0.02), and self-efficacy expectations (ß=0.35, p<0.001) were strong predictors of current physical activity levels (eg, measured as training sessions per week) in this group.

Conclusion There is a dire need for professionally supervised, small group exercise programmes for people with mental illness incorporating cognitive-behavioural elements, to better address their individual needs and to positively influence previously mentioned psychometric determinants. Furthermore, the importance of sport and physical activity in childhood, and especially in adolescence, was reaffirmed, underlining the paramount importance of youth sport programmes in long-term health promotion from a public health perspective.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The survey was conducted online, allowing for a bigger sample size and a range of respondents from different (therapeutic) backgrounds.
⇒ An extensive record was made of the psychometric variables, along with comprehensive data on current sporting activities and sporting activities during childhood and adolescence
⇒ As the questionnaire was conducted in German, the results may not be generalisable to other populations.

INTRODUCTION

Physical activity (PA) and exercise (to be understood as a subform of PA) significantly reduce the risk of developing mental health conditions, such as depression or anxiety disorder.[1–4] Moreover, exercise appears to have a positive effect on both psychiatric symptoms and comorbidities in individuals with mental illness (MI).[5–8]

Irrespective of diagnosis, the quality of life of people with MI is limited especially by residual psychiatric symptoms as well as by social consequences and somatic illness.[6]

In addition, individuals with MI are also more prone to cluster poor health behaviours, which increases the likelihood of developing cardiovascular disease, obesity, metabolic syndrome and musculoskeletal disorders.[9–12] The use of psychopharmaceuticals further contributes to these risks.[13 14] Thus, mortality and morbidity are significantly increased in this group.[15–17] Regarding the aforementioned somatic diseases, PA has been recognised as a critical and modifiable risk factor and a valuable therapeutic strategy.[18 19]

But while PA promises to be an effective treatment strategy with few side effects in order to prevent MI or treat its symptoms and sequelae, conducting trials faces significant challenges, such as high dropout rates.[20–23] Therefore, better understanding the determinants of PA engagement is essential to improve study design, intervention lengths and dropout rates. Furthermore, they are necessary in order to conceptualise and implement appropriate health policies aimed at improving the mental and physical well-being of people with (and without) MI.[14]

In the general population, motivation for and preferences surrounding PA are assumed to be multifactorial. Extensive studies have indicated that exercise behaviour and PA levels are strongly linked to various determinants within the individual (self-efficacy, exercise history, personality traits, motives) as well as external factors (socioeconomic status, social support): Important determinants of regularly engaging in PA include high levels of self-efficacy and being extraverted and conscientious as well as intrinsically motivated. Conversely, low socioeconomic status, frequently engaging in adverse health behaviours and neuroticism were associated with lower levels of PA.[24–26]

For individuals with MI, data are more scarce and less coherent.[27] It has been suggested that individuals with MI perceive barriers to PA as higher and show lower self-efficacy, which is one of the most important determinants of PA in individuals both with and without MI.[24 28] Besides a lack of knowledge about the relationship between personality traits and exercise behaviour in individuals with MI, there also exists conflicting information about the preferred setting for exercise and the influence of social support on exercise behaviour.[9 29 30] It is also important to consider the level of daily functioning, which has been shown to be a predictor of adherence in people with schizophrenia.[31]

Therefore, the study 'BEWEGungsGRUENDE' sought to provide a comprehensive characterisation of preferences, motivational factors and determinants for PA in individuals with MI.

We expected that individuals with MI have lower levels of childhood/adolescent exercise experiences, self-efficacy, intrinsic motivation, extraversion and conscientiousness compared with individuals without MI (and in turn higher levels of psychometric variables associated with lower PA levels in the general population). In line with findings in the general population, we hypothesised that exercise experiences in childhood and adolescence, personality traits, intrinsic motivation, high self-efficacy, internal locus of control and social support are positively associated with current PA levels in the group of individuals with MI. Furthermore, we aimed to characterise the training environment preferences, potential barriers and sources of support voicing for individuals with MI to engage in PA on a regular basis.

METHODS

Study design and recruitment

We conducted a cross-sectional study, analysing data from an anonymous online survey which combined validated questionnaires as detailed below and self-designed items. Study participants were required to be at least 18 years old and provide informed consent prior to taking part in the study.

The survey was conducted between August and December 2022. To recruit participants, flyers and posters were displayed in psychiatric clinics and practices in the Munich area. Additionally, the questionnaire was distributed via several self-help group email lists and promoted at university events and sports clubs and on social media. Inpatients at the Clinic for Psychotherapy and Psychiatry of the LMU Munich (Ludwig Maximilian University of Munich) and the Department of Psychiatry, Psychotherapy and Psychosomatics of the University of Augsburg were also personally invited to participate in the survey. Completing the questionnaire resulted in the opportunity to enter a prize draw for 20 vouchers, which could be redeemed at a variety of retailers, rendering the prize appealing to people with a wide range of interests. Multiple entries to the prize draw were not possible in order to minimise the incentive to complete the questionnaire more than once. The personal data used to enter the prize draw were stored separately from the anonymous data collected through the questionnaire.

Assessment and questionnaires

We used validated instruments in full or abbreviated form where necessary, and supplemented these with self-developed items (a list of the questionnaires used including information on the psychometric properties can be found in the online supplemental file S1). The questionnaire consisted of six sections: (a) *sociodemographic characteristics*, (b) *somatic and psychiatric history*, (c) *childhood and adolescent PA patterns*, (d) *current PA habits*, (e) *motivation and personality traits*, (f) *barriers to regular PA and sources of support*.

Study completion took about 20–25 min (see the online supplemental file S2 for the full questionnaire in English). The questions were clearly arranged on individual pages and a progress bar was displayed to keep the motivation to continue high.

Medical history

In the medical history section, we asked the participants about their height and weight to calculate the body mass

index (BMI). They were asked about chronic physical illnesses, especially those that define metabolic syndrome. The questionnaire included numerical rating scales[32] for respondents to rate their subjective state of health and pain levels during rest and exercise. The psychiatric history comprised evaluations of diagnoses, current treatment, previous inpatient treatment and medication. Categorisation into the groups of people with MI or mentally healthy participants was based on self-reported psychiatric diagnoses in accordance with the ICD-10 (International Classification of Diseases, 10th revision).[33]

Childhood and adolescent physical activity patterns

Participants were then questioned about their sporting activities during childhood and adolescence (section c). This included school grades in physical education (P.E.), memberships in sports club and the overall amount of training. Information was also obtained on participation in competitions and on support from social networks, similar to Fuchs' questionnaire on exercise-related social support in adults.[34]

Current physical activity patterns

Next, the current PA level was assessed using the *Global Physical Activity Questionnaire*.[35]

Participants were asked to report what sports they currently partake in, the overall amount of training, and their actual and, if materialisable, desired training environments (eg, indoors/outdoors/alone/in a group). To assess participants' subjective accounts on perceived sport-related support from their social environments, we used an adapted version of the questionnaire on exercise-related social support by Fuchs.[34] Participants could also provide information on professional sporting activities.

Psychometric characteristics

The next section of the questionnaire covered motivational factors and personality traits (section e). The *sport- und bewegungsbezogene Selbstkonkordanz Scale* was used to measure sport and exercise self-concordance, subdivided into intrinsic, identified, introjected and extrinsic motivation.[36] Participants also completed an abbreviated form of the *Exercise Motivation Inventory* (*EMI*) to assess their motivation to exercise. This version of the questionnaire explores 14 possible motives, which can be categorised as intrinsic or extrinsic motivation.[37] In order to save time, we limited the number of items per motive to a maximum of two instead of four excluding redundant items. Personality traits according to the *OCEAN model*—an acronym for the five personality dimensions of Openness, Conscientiousness, Extraversion, Agreeableness and Neuroticism—were measured with the *Big Five Inventory 10*[38] and risk-taking with the *Short Scale Risikobereitschaft*.[39] Self-efficacy expectations towards PA were assessed by means of the eponymous questionnaire developed by Fuchs and Schwarzer (*Selbstwirksamkeit zur sportlichen Aktivität Skala*)[40] and general self-efficacy expectations with the *Allgemeine Selbstwirksamkeit Kurzskala*.[41] The *Internale-Externale-Kontrollüberzugung Scale* was employed to characterise participants' internal and external control beliefs (locus of control).[42] Resilience was assessed using the *Brief Resilience Scale*.[43]

Facilitators for and barriers to regular physical activity

In the concluding section of the questionnaire, respondents were requested to pinpoint factors that assist or hinder their ability to engage in PA on a regular basis.

Statistical analyses

The BEWEGungsGRUENDE study was designed as an investigation and is one of the first to directly compare exercise motivations between individuals with and without mental illness. As such, effect sizes for many of the psychometric variables were not available in advance. Nonetheless, a power analysis based on physical activity levels indicated a required sample size of just over 300 (sufficient physical activity in high income Western countries: 63.2% and in individuals with severe mental illness: 45.03, ß=0.2, a=0.05) (19, 20).

The questionnaire was created and administered using the SoSci Survey platform, and data downloaded as Excel files after the survey. After data cleaning and organisation in Microsoft Excel, analyses were performed using IBM SPSS V.29.0.0.0. We used descriptive statistics (eg, percentages, mean, median, variance) to characterise our study population. Testing for normal distribution was done graphically using Q-Q plots.

Unpaired t-tests (using the Welch method to correct for unequal variances where necessary), Mann-Whitney tests and χ^2 tests were used to compare PA patterns, sporting activities during childhood and adolescence as well as psychometric scores of participants with and without MI. We include Cohen's d as a measure of effect size when there is evidence of significant group differences in the t-test. To illustrate the strength of the relationship in χ^2 tests, the phi coefficient is included.

We also conducted multiple linear regressions to establish possible associations between determinants of PA and PA levels in the group of individuals with MI, controlling for sociodemographic factors (age, gender, educational level), health status and the level of functioning (severity of MI approximated by number of psychiatric diagnoses and number of inpatient psychiatry admissions, subjective pain during PA). If individual items were not answered, they were excluded from the corresponding analysis and coded as 'missing'. Additionally, the sample size (n) is always reported to provide an overview of the number of missing data points. Bonferroni-Holm correction was applied to account for multiple testing, reflecting a compromise between the more liberal Benjamini-Hochberg method and the more conservative Bonferroni correction.[44 45] For all statistical analyses, alpha was set to 0.05.

Patient and public involvement statement

Patients and the public were not involved in the design, conduct, reporting and dissemination of this research.

The conceptual framework for the design of this study was informed by insights gained through interactions with individuals diagnosed with mental illness during the ESPRIT C3 study,[46] a randomised controlled clinical trial involving 180 participants diagnosed with schizophrenia who took part in a 6-month professionally supervised exercise intervention.

RESULTS

Descriptive statistics for individuals with mental illness and comparison to results of mentally healthy participants

Demographic characteristics

Of 3921 individuals, who accessed the invitation link to the questionnaire, 1746 subjects answered the questionnaire in part or in full (44.5%). Of these, 1372 reached the last page of our online survey (completion rate 35.0%). A total of 1564 participants (female n=1040, male n=518) reported the presence or absence of a psychiatric diagnosis and, hence, were included in the present analysis. 417 respondents (26.7%) reported at least one confirmed psychiatric diagnosis and were therefore defined as individuals with MI. Sociodemographic data among individuals with MI were comparable to those of their healthy counterparts in most regards. However, where a significant difference between groups was found, it was of little significance due to the small effect size (phi approximately 0.1), with the exception of the following: More than twice as many individuals with MI reported financial concerns compared with those without MI (19.4% vs 7.1%) and a lower monthly income. In addition, individuals with MI were more likely to be receiving welfare or an invalidity pension (4.6% vs 0.1%) and were less likely to make a living wage on their own (69.8% vs 82.2%). The evidence of a significant difference in gender distribution is due to the fact that only the group of individuals with mental illness reported a non-binary gender (n=6). There is no statistical difference in the distribution of binary gender categories between the groups with and without mental illness.

An overview of participant characteristics, including the χ^2 test, can be found in online supplemental file S3.

Medical history

Table 1 shows the main findings regarding participants' somatic and psychiatric histories (further details on the medical history can be found in online supplemental file S4).

Lower physical activity levels during childhood and adolescence in individuals with mental illness

Whereas 78.0% (n=895) of individuals without MI reported regular PA besides P.E. at school in their childhood, only 66.9% (n=279) of the individuals with MI did so. Correspondingly, grades in P.E. were significantly lower for individuals with MI both under and over the age of 12. In line with said findings, fewer individuals with MI were members of a sports club during adolescence (49.9% vs 64.1%). Also, individuals with MI exercised less often per week during adolescence. Moreover, social support for exercise during childhood and adolescence was perceived as significantly lower in individuals with MI compared with those without. Only 50.4% (n=210) of individuals with MI reported having at least one physically active family member while growing up. To summarise, individuals with MI were less likely to witness significant others exercising and be encouraged to engage in PA themselves and, thus, were prone to physical inactivity. Comprehensive statistical data are provided in online supplemental file S5A and B.

Less favourable current physical activity patterns in individuals with mental illness

Both the amount of recreational and total vigorous-intensity physical activity (VPA) as well as recreational were significantly lower for individuals with MI. Furthermore, significant differences were found in the amount of total moderate physical activity (MPA) between individuals with and without MI. Similarly, there was a difference in the average amount of recreational MPA reported by those with MI and those without (please see figure 1). While 69.3% of mentally healthy individuals reported exercising on a regular basis, only 55.6% of individuals with MI did so. For training sessions per week, duration of night sleep and inactivity per day, no significant differences were found.

Overall, the above-described activity levels imply that individuals with MI are considerably less likely to meet the minimum PA recommendations (78.2% vs 87.2 %) and targets for additional health benefits set by the WHO (65.7% vs 76.3 %) in comparison to mentally healthy individuals.

Most individuals with MI tend to exercise on their own and indoors, which is in disagreement with their respective preferences, namely wanting to exercise outdoors and with familiar individuals (fixed training group, family, friends). The most popular activities include fitness training, weight training, cycling, running/walking, outdoor sports and swimming. These preferences were consistent with the results from the group of mentally healthy participants.

Noteworthy differences were found in the proportion of participants with memberships in sports clubs (33.0% of mentally healthy individuals vs 18.7% of individuals with MI). However, no such discrepancy was observed for gym membership (20.9% vs 17.0%) or participation in free training groups (9.9% vs 8.9%). A detailed overview of exercise behaviour in tabular form is included in online supplemental file S6.

Psychometric characteristics in individuals with mental illness differ from those in mentally healthy individuals

A detailed overview of the results from the psychometric characteristics section of our questionnaire is provided in table 2 (including unpaired t-test statistics). Participants with and without MI differed significantly with regard

Table 1 Medical history

% (n)		All participants (n=1564)	Participants diagnosed with a MI (n=417)	Mentally healthy participants (n=1147)
Chronic physical illness	Yes	27.5% (430)	40.5% (169)	22.8% (261)
	Hypertension	8.2% (129)	11.3% (47)	7.1% (82)
	Diabetes mellitus II	1.5% (23)	2.6% (11)	1.0% (12)
	Hyperlipidaemia / hypercholesterolaemia	4.1% (64)	7.9% (33)	2.7% (31)
	Chronic pain	5.0% (78)	8.9% (37)	3.6% (41)
	Other	15.7% (246)	25.2% (105)	12.3% (141)
	No	72.5% (1134)	59.5% (248)	77.2% (886)
	Missing	0% (0)	0% (0)	0% (0)
Smoking	Smoker	18.1% (283)	28.8% (120)	14.2% (163)
	Non-smoker	80.8% (1264)	70.5% (294)	84.6% (970)
	Missing	1.1% (17)	0.7% (3)	1.2% (14)
Psychiatric diagnosis	Yes	26.7% (417)	100% (417)	0% (0)
	Addiction		4.3% (18)	
	Psychosis/schizophrenia		5.0% (21)	
	Depression		72.2% (301)	
	Bipolar disorder		4.3% (18)	
	Borderline syndrome		7.7% (32)	
	Anxiety disorder		24.0% (100)	
	OCD		6.5% (27)	
	Eating disorder		14.4% (60)	
	Autism		3.8% (16)	
	ADHD		6.7% (28)	
	Other		14.4% (60)	
	No	73.3% (1147)	0% (0)	100% (1147)
Any past psychiatric /psychotherapeutic treatment	Yes		94.0% (392)	
	No		5.8% (24)	
	Missing		0.2% (1)	
Current setting of the treatment	Inpatient treatment		12.9% (54)	
	Day clinic		3.4% (14)	
	Outpatient treatment		39.8% (166)	
	No treatment		37.4% (156)	
	Missing		6.5% (27)	
Current use of psycho-pharmaceuticals	Yes		38.8% (162)	
	Antidepressants		32.4% (135)	
	Antipsychotics/neuroleptics		7.7% (32)	
	Benzodiazepines		5.3% (22)	
	Mood stabiliser		4.8% (20)	
	Hypnotics		4.6% (19)	
	Other		4.3% (18)	
	No		54.2% (226)	
	Missing		7.0% (29)	

The table shows frequencies of variables regarding the medical history for all participants, as well as specifically for people with and without MI. Absolute numbers in parentheses ().
ADHD, attention deficit hyperactivity disorder; MI, mental illness; OCD, obsessive compulsive disorder.

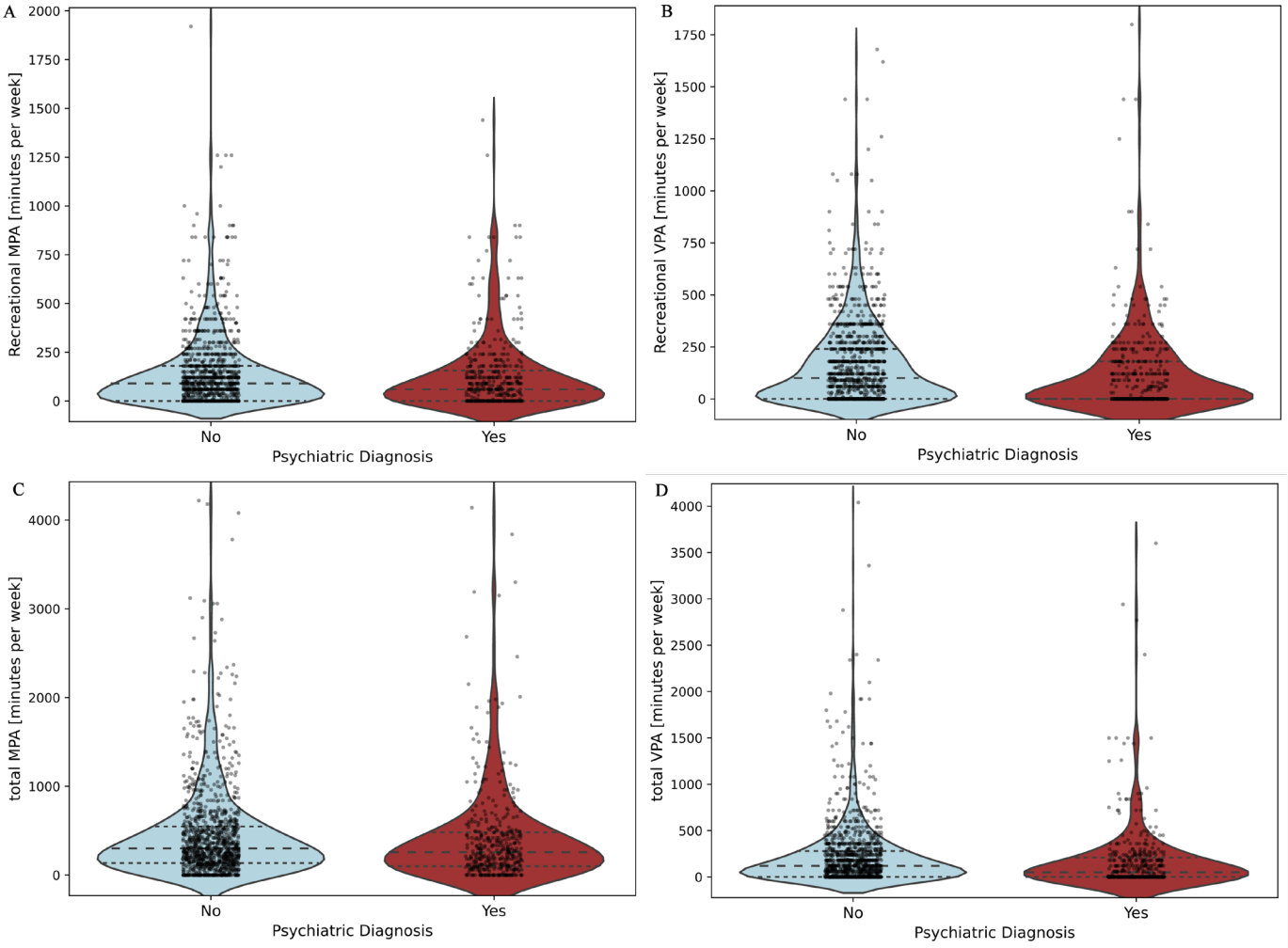

Figure 1 (A) Recreational moderate-intensity physical activity per week in minutes for the group of individuals with and without mental illness. There was a difference in the average amount of recreational moderate physical activity (MPA) reported by those with mental illness (MI) (M=128 min, SD=192) and those without (M=139 min, SD=188) (U=221 476.50, z=−2.27, p=0.03). (B) Recreational vigorous-intensity physical activity (VPA) per week in minutes for the group of individuals with and without mental illness. The amount of recreational VPA was significantly lower for individuals with MI. On average, this group reported 117 min (SD=205) of recreational VPA per week, compared with 170 min (SD=260) reported by mentally healthy participants (U=192 714.50, z=−5.98, p<0.001). (C) Total moderate-intensity physical activity per week in minutes for the group of individuals with and without mental illness. Significant differences were found in the amount of total MPA between individuals with (M=423 min, SD=591) and without MI (M=449 min, SD=525) (U=218 584.00, z=−2.54, p=0.01). (D) Total VPA per week in minutes for the group of individuals with and without mental illness. Individuals with MI reported approximately 179 min (SD=377) of total VPA compared with an average of 236 min (SD=420) for those without MI (U=194 786.00, z=−5.70, p<0.001).

to intrinsic motivation surrounding engagement in PA as shown by EMI and SKSS. Individuals with MI scored significantly lower overall and on most subscales (online supplemental file S7). Only the subdomains *nimbleness* and *stress management* were like those of mentally healthy participants. On the other hand, extrinsic motivation proved to be a heterogeneous affair: Overall scores, as well as those for *appearance* and *social recognition*, did not yield significant differences, whereas individuals with MI reported lower scores on matters of affiliation and ill-health avoidance as well as higher scores concerning social pressure and weight management.

The OCEAN personality model showed that individuals with MI scored higher on neuroticism, and openness to experience. Moreover, individuals with MI tended to exhibit an external locus of control when compared with healthy individuals. They also reported below average scores for measures of general self-efficacy expectancies, resilience and risk-taking as well as internal locus of control.

Facilitators for and barriers to regular physical activity

When individuals with MI were questioned about barriers to incorporating more PA into their daily lives, the main reasons given were a lack of motivation, a lack of capacity due to more pressing concerns and time constraints surrounding work. On the other hand, a

Table 2 Psychometric characteristics

		All participants (n=1564)			Participants diagnosed with MI (n=417)			Mentally healthy participants (n=1147)			t-test statistics			
		N	Mean	SD	N	Mean	SD	N	Mean	SD	t	df	P value	Cohen's d
Social support score (1; 4)		1012	2.17	0.79	231	2.07	0.79	781	2.20	0.79	2.13	1010	0.03	0.16
SSKS (1; 6)	Intrinsic motivation	1404	4.38	1.52	365	3.98	1.62	1039	4.52	1.46	5.66	584.61	<0.001	0.36
	Identified motivation	1382	5.03	1.15	367	4.83	1.32	1015	5.10	1.08	3.51	552.67	<0.001	0.24
	Introjected motivation	1412	3.45	1.40	371	3.56	1.42	1041	3.41	1.39	−1.71	1410	0.09	−0.10
	Extrinsic motivation	1413	1.61	0.82	367	1.68	0.88	1046	1.59	0.80	−1.71	594.58	0.09	−0.11
SSKS-Index (−10; +10)		1326	4.36	2.87	348	3.62	3.07	978	4.62	2.74	5.4	555.69	<0.001	0.36
EMI (0; 5)	Intrinsic motivation	1359	3.24	1.09	348	3.00	1.16	1011	3.33	1.05	4.69	552.53	<0.001	0.31
	Extrinsic motivation	1392	2.29	0.87	363	2.26	0.92	1029	2.30	0.85	0.91	1390	0.36	0.06
SSA Score (1; 7)		1322	4.40	1.39	326	4.02	1.46	996	4.52	1.34	5.47	514.32	<0.001	0.37
BFI 10 (1; 5)	Extraversion	1408	3.16	1.05	367	2.94	1.11	1041	3.23	1.01	4.50	595.34	<0.001	0.29
	Agreeableness	1407	3.35	0.81	367	3.26	0.83	1040	3.38	0.80	2.54	1405	0.01	0.15
	Conscientiousness	1408	3.69	0.82	367	3.51	0.85	1041	3.75	0.80	4.97	1406	<0.001	0.30
	Neuroticism	1408	3.02	0.99	367	3.56	0.93	1041	2.84	0.94	−12.70	1406	<0.001	−0.77
	Openness	1408	3.50	1.03	367	3.69	1.04	1041	3.43	1.01	−4.22	1406	<0.001	−0.26
Locus of control (1; 5)	Internal	1405	4.06	0.72	366	3.72	0.81	1039	4.18	0.64	9.73	536.47	<0.001	0.66
	External	1406	2.23	0.81	367	2.53	0.89	1039	2.13	0.76	−7.78	565.43	<0.001	−0.51
ASKU (general self-efficacy expectation) (1; 5)		1404	3.98	0.68	366	3.65	0.81	1038	4.10	0.59	9.76	505.39	<0.001	0.69
BRS (1; 5)		1400	3.29	0.79	364	2.81	0.83	1036	3.46	0.70	13.28	555.52	<0.001	0.88
Risk-taking (1; 5)		1393	2.94	0.93	360	2.79	0.94	1033	3.00	0.92	3.68	615.76	<0.0001	0.23

The table shows descriptive statistics and t-tests for the 'psychometric characteristics' section of the questionnaire. Descriptive statistics are reported for all participants as well as for participants with and without MI. t-test statistics compare the psychometric variables between individuals with and without MI.
ASKU, Allgemeine Selbstwirksamkeit Kurzskala; BFI 10, Big Five Inventory 10; BRS, Brief Resilience Scale; EMI, exercise motivation inventory; MI, mental illness; SSA Score, Selbstwirksamkeit zur sportlichen Aktivität Skala; SSKS, sport- und bewegungsbezogene Selbstkonkordanzskala.

lack of information regarding sporting facilities, courses and training groups and the fear of injury were rated as non-factors.

Interestingly, individuals with MI perceived most barriers as more hindersome than their healthy counterparts. Solely, a *lack of time due to work and family matters* was considered equally deterring in both groups. When we asked individuals with MI about the factors that would encourage them to exercise regularly, the following factors were rated as particularly helpful: easy access to the sports facility, low costs and a fixed schedule. Regular appointment reminders were considered the least helpful of all the supportive measures suggested. However, individuals with MI found supporting measures such as *guidance in training theory*, *frequent reminders*, *affordability* and *coaches familiar with somatic* significantly more helpful than their healthy counterparts. A comprehensive list of facilitators and barriers to regular PA can be found in online supplemental file S8A,B.

Influence of psychological factors on physical activity in individuals with mental illness

Psychometric variables appear to correlate more strongly with levels of VPA than with levels of MPA. The following paragraph entails psychometric variables that show a particularly strong correlation (indicated by a high ß in the multiple linear regression) with recreational VPA and MPA.

In multiple linear regression, the *sport- und bewegungsbezogene Selbstkonkordanzskala* (*SSKS*) *Index*, *intrinsic and extrinsic motivation*, as measured by the EMI, and *self-efficacy expectancy towards PA* (*Selbstwirksamkeit zur sportlichen Aktivität* (*SSA*) *score*) were found to have moderate to strong associations with the amount and frequency of exercise per week. *Self-efficacy expectancy towards exercise* (*SSA score*) appeared to correlate moderately with exercise frequency, whereas scores on the *SSKS index*, *intrinsic and extrinsic motivation*, and *risk affinity* had a weak to negligible effect. In contrast, the SSKS Index, *intrinsic motivation* as measured by the EMI, and *self-efficacy expectancy towards PA* (*SSA score*) were found to correlate moderately to strongly with the amount of recreational VPA. Remarkably, *perceived social support* was not found to have a major influence on any form of activity. Figure 2 illustrates these associations for selected psychological factors.

In conclusion, our findings suggest that higher levels of PA are linked to intrinsic motivation and exercise-related self-efficacy expectations, making these the most relevant psychometric variables governing engagement in exercise in individuals with MI.

Influence of childhood and adolescence exercise behaviour on current physical activity in individuals with mental illness

We conducted multiple linear regression to assess the impact of childhood and adolescence exercise behaviour on current PA levels. The most comprehensive childhood-related predictor of the current activity level was weekly training frequency during adolescence. Specifically, we found a moderate effect on current exercise frequency as well as a weak to moderate effect on recreational VPA and MPA. Moreover, we observed that P.E. grades over the age of 12 and above had a significant but negligible impact on both current recreational and total VPA levels. Also, past experiences in competitive sporting events had a significant but weak effect on recreational VPA and training frequency.

Overall, activity levels during adolescence rather than those during childhood appeared to have a strong influence on present day exercise behaviours (please refer to S10 for further information).

DISCUSSION

The aim of the present study was to identify and describe determinants, facilitators and barriers to regular PA in people with MI and to compare these results to those of mentally healthy participants based on the assumption that individuals with MI display lower levels of PA and lower levels of psychometric variables that have been associated with higher PA levels in the general population.

We found lower levels of PA in people with MI compared with those without. Although participants with MI in our sample were less likely to be active than those without MI, they nevertheless reported higher levels of PA than what is typically stated in relevant literature regarding their peers.[27 47] This could be attributed to our recruitment process, which may have been biased towards people who had pre-existing interests in PA.

Contrary to findings by Tew *et al* and Fraser *et al*, who identified independent exercise as the most favoured setting for people with schizophrenia nd bipolar disorder and inpatients with MI in general,[9 48] the data from our study indicate that people with MI prefer to exercise outdoors in a group and place high value on receiving professional support. This is also in line with previous recommendations for designing and implementing sports programmes for individuals with MI: Whereas Perraton *et al* noted that the setting and group composition are irrelevant for individuals with depression as long as PA is professionally supervised,[49] Quirk *et al* emphasised the non-exercise-related benefits of group exercise for people with severe mental illness.[50] This is consistent with the observation that after a 12-week exercise programme for people with schizophrenia, activity levels dropped sharply in the post-intervention period without close personal sport science support.[51] However, in our sample, training alone and indoors was the most common setting, revealing a crucial shortcoming in caring for and catering to individuals with MI that needs to be resolved as soon as possible.

As previously noted, MI can have a significant impact on one's social life, meaning that reintegration into society is a vital component of the recovery processes.[6] Exercise in a group setting can be a non-stigmatising intervention to provide low-threshold opportunities in the area of secondary and tertiary prevention.[52] From a public health

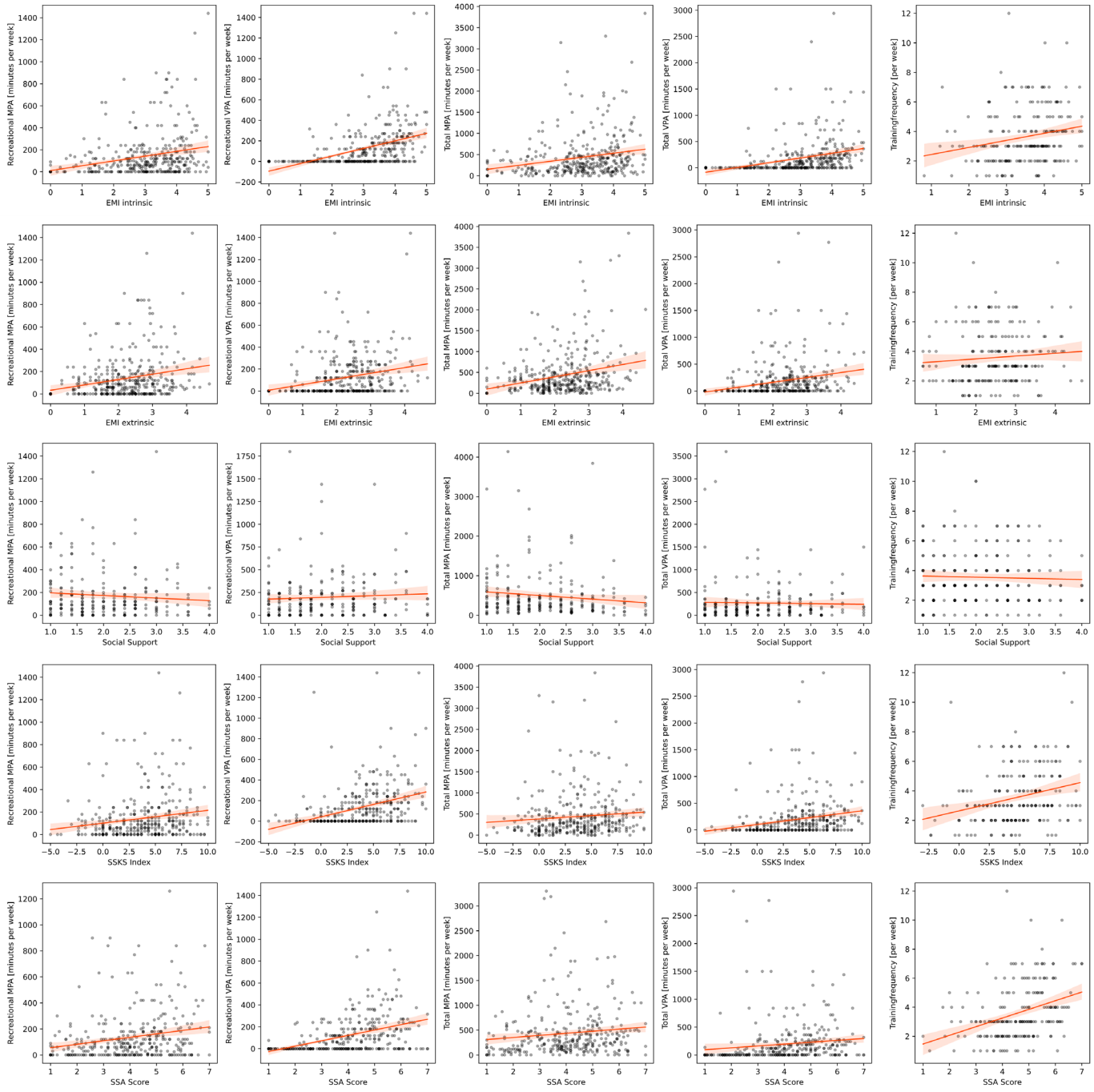

Figure 2 Visually demonstrates the association of psychological factors and physical activity in individuals with mental illness, controlling for sociodemographic factors (age, gender, educational level), health status and the level of functioning (severity of mental illness (MI) approximated by number of psychiatric diagnoses and number of inpatient psychiatry admissions, subjective pain during physical activity (PA)). The graphs show the relationship between the respective psychometric variable on the x-axis (intrinsic and extrinsic motivation as measured by the Exercise Motivation Inventory (EMI), social support, sport- und bewegungsbezogene Selbstkonkordanzskala (SSKS) Index, and Selbstwirksamkeit zur sportlichen Aktivität (SSA) Score) and the amount of physical activity on the y-axis (recreational moderate physical activity (MPA), recreational vigorous-intensity physical activity (VPA), total MPA, total VPA, training frequency per week). Depending on the shade of grey (the darker, the more participants), each dot represents one or more participants. The orange line visualises the multiple linear regression line fitted to the data, with the orange shade representing the 95% CI. A complete presentation of the ß-coefficients and scatter plots for all psychometric variables can be found in the online supplemental file S9A and B.

perspective, sports activities that involve people with and without MI training together can help to destigmatise MI. A first and relevant step should be to markedly increase the availability of easily accessible exercise programmes for people with MI, as well as creating more opportunities for those with and without MI to train together.

Simultaneously, outpatient treatment providers should raise awareness regarding such offers and emphasise their importance as a key aspect of therapy and recovery.

Moreover, exercise is an excellent intervention not only for tertiary but also for primary prevention. We found a distinct difference between people with and without MI in their PA behaviour in childhood and especially in adolescence. Various longitudinal studies have also come to similar conclusions, namely associating higher PA levels, particularly in adolescence, with lower levels of psychological distress and higher levels of well-being and resilience in later years.[53 54] This is consistent with our findings, as exercise history during childhood and adolescence revealed that individuals with MI engaged in PA less frequently and had worse P.E. grades than their healthy counterparts. Differences were also found in intrinsic and identified motivation for PA, general and exercise-related self-efficacy expectations, risk affinity, resilience, locus of control, and the personality dimensions extraversion, conscientiousness, neuroticism and openness.

Consistent with findings in the general population, we observed a positive association between the personality trait of conscientiousness and PA.[25] Our data further support previous studies that have highlighted the inextricable link between autonomous motivation (used here as a generic term for identified and internal motivation and assessed in our study via SSKS and EMI) and the amount of PA in both individuals with and without MI.[55–58] Moreover, self-efficacy towards PA, which has been discussed as the single most important determinant of PA, was found to be strongly associated with the overall amount of PA.[24 27 28 59 60] Furthermore, self-efficacy towards PA proved to be strongly associated with the amount of recreational VPA. This underscores the importance of implementing professionally supervised groups that incorporate cognitive behavioural elements in order to enhance sport-related self-eff-icacy in individuals with MI.

The strong correlations between personality traits and exercise behaviour demonstrate that PA programmes for people with MI should not be tailored to specific diagnoses but rather individuals, namely those with low levels of conscientiousness regarding their readiness to engage in PA. Additionally, it is promising to integrate specific elements dedicated to promoting autonomous motivation into the framework of therapeutic (exercise) regimens, such as specific goal-setting strategies and progress monitoring. Arnautovska *et al* have come to a similar conclusion from an integrative perspective on previous research on motivation, particularly in people with schizophrenia.[23] Another potential strategy could be to depart from traditional monotonous aerobic endurance training and to embark upon more varied forms of exercise which might be more to the liking of those partaking.

Social support, which has been discussed as an important influential factor in adopting and maintaining a healthy lifestyle, did not show a significant correlation with PA levels in individuals with MI in our sample. One possible explanation for this could be a U-shaped relationship between social support and PA levels, as observed by Fuchs in middle-aged people.[34] Fuchs theorises that the appropriate degree of support and the sense of being pressured are delicately balanced. Being pushed to perform, an extrinsic motivator, may not be conducive to engaging in regular PA. Notwithstanding, Quirk *et al* found that social support is an essential prerequisite for the adoption and maintenance of regular PA in individuals with serious MI.[50] Therefore, more research is needed to fully understand the subtleties of the relationship between social support and exercise behaviour in individuals with MI.

Among individuals with MI, a fixed schedule, easy access (both financially and in the literal sense of the word) and coaches with expertise in somatic and psychiatric illness were rated as particularly helpful for engaging in PA on a regular basis. Scores for barriers to regular PA reported by our samples were highly consistent with previous studies.[9 27 29 30 48 50 61 62] While fear of injury and access to sports facilities played a minor role compared with other barriers, stress/time conflicts and lack of motivation were the main barriers reported.

Many of the facilitators of regular PA that people with MI found most valuable have been successfully implemented in some capacity in prior intervention studies.[57 61 63–65] Nonetheless, our results indicate that prioritising providing easy access to sports facilities, a fixed schedule, appointment reminders, professional supervision and strategies to overcome a lack of motivation should not be limited to future interventions in clinical trials, but urgently implemented in inpatient and outpatient exercise programmes tailored for individuals with MI.

Strengths and limitations

There are several limitations to consider when interpreting our data. First, alongside validated questionnaires, we included self-developed, non-validated items to assess exercise-related social support during childhood. These items were modelled on the established questions developed by Fuchs for assessing sports-related social support in adults.

Second, we used a condensed version of the Exercise Motivation Inventory-2 (EMI-2) rather than the full instrument. Therefore, the findings should be interpreted with caution and are not directly comparable to results from studies using the complete EMI-2. This decision was made due to time constraints, as our survey already required 20–25 min to complete. Such duration may have contributed to non-response bias or questionnaire fatigue, particularly among individuals with cognitive impairments or reduced motivation. Nonetheless, the vast majority of participants were able to complete the survey in full, suggesting that the burden was acceptable for most respondents.

Third, our recruitment materials—focused on physical activity—may have been more appealing to individuals

already interested in or engaged with exercise, potentially introducing selection bias.

Fourth, both physical activity levels and psychiatric diagnoses were self-reported, which makes these data vulnerable to reporting and recall bias. This is especially relevant for retrospective assessments of exercise behaviour during childhood and adolescence.

Finally, due to the cross-sectional design of the study, no causal inferences can be made. Observed associations should therefore be interpreted with caution.

Given the exploratory nature of our study, an a priori power analysis was only feasible for selected variables, indicating a required sample size of approximately 300 participants to detect differences in sufficient physical activity between individuals with and without mental illness. With a final sample size exceeding this by more than fivefold, the statistical power was sufficient to address this research question while also enabling exploration of additional variables.

Despite these limitations, the study identified a broad range of factors influencing exercise behaviour in a large and diverse sample. We used validated instruments to explore personality traits and motivational factors, alongside a detailed assessment of perceived barriers and facilitators to regular physical activity. This knowledge can help inform the development of tailored exercise programmes that better address the specific needs of individuals with mental illness.

Conclusion

In summary, while the motivators and determinants of PA may be comparable among individuals with and without MI, the impact of each of these factors varies considerably. Our results emphasise the importance of high PA levels in childhood and adolescence as well as autonomous motivation and self-efficacy as the key determinants to facilitate the adoption and maintenance of regular PA. Further in-depth research is needed to translate our findings into real-life interventions that address aforementioned determinants to make better use of the benefits of regular PA for the physical and mental health of individuals with MI.

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Contributors Conception and study design: IM, AW, KLK, PF, AH, AS. Recruiting, data analysis and interpretation: AW, KLK, IM, AH. Statistical supervision: LR, TF, RS. Manuscript writing: KLK. Visualisation: RS, LR, KLK. All authors were involved in revising the article, read and approved the final version of the manuscript. Guarantor: IM.

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Competing interests AH was member of advisory boards of Boehringer-Ingelheim, Lundbeck, Janssen, Otsuka, Rovi and Recordati and received paid speakership by these companies as well as by AbbVie and Advanz. He is editor of the German schizophrenia guideline. PF is a co-editor of the German (DGPPN) schizophrenia treatment guidelines and a co-author of the WFSBP schizophrenia treatment guidelines; he is on the advisory boards and receives speaker fees from Janssen, Lundbeck, Otsuka, Servier and Richter. AS, KK, AW, IM, LR, TF, RS report no conflicts of interest.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants but local ethics comittee of the Faculty of Medicine at the LMU Munich.Registration Number: 22-0625KBThe authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008. The project has been reviewed by the local ethics committee of the Faculty of Medicine at the LMU Munich (registration number: 22-0625KB) and has been exempted from an ethics review. exempted this study Participants gave informed consent to participate in the study before taking part.

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