Emotion recognition and physical activity in severe mental illness patients with mild intellectual disability

Master thesis Neuropsychology

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Name: Robin Rubbens

Student number: 5484081

Supervisors:

Barbara Montagne	(PhD and Clinical Psychologist at GGZ Centraal)
Jeroen Deenik	(PhD and Health Psychologist at GGZ Centraal)
Carlijn van den Boomen	(PhD and Assistant Professor Social Sciences/Psychology at Utrecht University)

Abstract

Severe mental illness (SMI) and mild intellectual disability (MID) often co-occur and are both characterized by deficits in emotion recognition and low rates of physical activity (PA). This results in impaired social, cognitive and daily functioning. This study looked into the presence of an MID indication amongst SMI disorders and their differences in emotion recognition and physical activity (PA) compared to SMI patients without MID indications. With this additional knowledge, treatments could be tailored to the needs of patients which will contribute to more independence and effective reintegration. 47 inpatients (male n=37, female n=10, M_{age}=51.60, SD_{age}=13.64) from the wards of a long term psychiatric hospital in the Netherlands were assessed with a screening tool for MID indications, an emotion recognition task and accelerometers. The findings present a high overall prevalence of MID indications (77%) in SMI patients. Furthermore, a higher likelihood of an MID indication corresponded with lower emotion recognition performance. No further differences in emotion recognition and PA were observed, with an exception of the emotion of disgust being significantly more difficult for patients with an MID indication. These findings advocate for the adjustment of treatment for SMI patients towards the level of understanding of MID to increase overall effectiveness. Moreover, staff should get additional courses in the guidance and treatment of MID patients to provide them with necessary tools to do so. Future research should focus on higher order levels of social functioning and factors contributing to increasing the PA-rate of SMI patients. With this additional knowledge, treatments could be improved, resulting in more independence and reintegration of SMI patients.

Keywords: Severe Mental Illness, Mild Intellectual Disability, Social Cognition, Emotion Recognition, Physical Activity

Introduction

In the Netherlands, an estimated amount of 160.000 adults are currently hospitalized in mental healthcare institutions with a diagnosis of severe mental illness (SMI). Patients with SMI have a DSM-classification psychiatric disorder with a prolonged course, together with varying complaints and an impairment in social and/or societal functioning (Delespaul, 2013). Almost two thirds of this population suffer from schizophrenia (SZP). Other disorders commonly associated with the population of SMI are autism spectrum disorder, personality disorders, anxiety disorders and depression disorders (Cohen, 2015). Patients with SMI have a reduced life expectancy up to 20 years (Cohen, 2015; Walker, McGee, & Druss, 2015) and have diminished accomplishments of major life milestones. Their impairments are mainly the result of the symptoms of the disorder, the health status of the patients and the side effects of their medication cause impairments (Harvey & Strassing, 2012). Before, emphasis was given to the amelioration of cognitive functions to enhance daily functioning. However, currently more attention is given to enhance social functioning as this is thought to be more closely related to daily functioning than cognitive functions (Statucka & Walder, 2017). SMI disorders negatively affect social interactions, independent living and career options (Harvey & Strassing, 2012). The patients have a difficulty maintaining their social roles (Davis & Brekke, 2014) and often live isolated from society with a small social network (Brakel, 2015; Tsai, Desai, & Rosenheck, 2012). This study will look into the presence of an indication for mild intellectual disability (MID) amongst SMI disorders and their differences in emotion recognition and physical activity (PA) compared to SMI patients without an MID indication. With this focus, the study aims to contribute to the identification of factors influencing the lives of SMI patients to adjust treatment to their needs.

The current focus on social functioning of SMI patients originates in the importance of social cognition in daily functioning. Proper social cognition leads to adequate social functioning. Social cognition has received increasing attention over the last decades. Social cognition comprises the perception, cognitive understanding and interpretation of social processes and people's behavior and consists of different levels of processing (Green, Olivier, Crawley, Penn & Silverstein, 2005; Happé, Cook, & Bird, 2017). The first levels are the basic levels of processing, consisting of abilities such as face processing and motor detection. These basic levels of perception can vary in degrees of complexity. The higher levels of processing require integration of different inputs and consist of moral reasoning and mentalizing (Alcalá-López, et al., 2017; Beer & Ochsner, 2006; Kilford, Garrett, & Blakemore, 2016). Facial emotional expressions are important for interpersonal interactions and determined by social

cognition (Hari & Kujala, 2009). This is especially noticeable in newborns who have a preference to look at faces compared to other stimuli and the difficulty in interpersonal relationships in people who are unable to express facial emotions (Ekman, 1999; Hari & Kujala, 2009; Valenza, Simion, Cassia, & Umiltà, 1996). Because of the importance of the facial emotions in human interaction, further focus within social cognition in this study will be on emotion recognition.

Amongst different cultures and populations, six emotions have been acknowledged to be universal. These 'basic emotions' are: anger, disgust, happiness, sadness, surprise and fear (Ekman & Friesen, 1971; Montagne, Kessels, De Haan, & Perrett, 2007; Panksepp, 1998). The basic emotions have facial characteristics that are associated with the same emotional experiences independent from gender and culture (Ekman & Friesen, 1971). Although the basic emotions are considered universal, age and level of education are known to be of influence on the performance of emotion recognition (Kessels & Montagne, 2016). The ability to recognize emotions and infer information from emotional faces, is impaired in patients with SMI. Due to inefficient facial scanning patterns (Kohler, Walker, Martin, Healey, & Moberg, 2009) and the cognitive deficits associated with the diagnosis (American Psychiatric Association, 2013; Schaefer, Giangrande, Weinberger, & Dickinson, 2013), patients with for example SZP have poor emotion recognition (Larøi, Fonteneau, Mourad, & Raballo, 2010). More specifically, impairments in the recognition of negative emotions have been found, especially for the emotions of disgust (Chambon, Baudouin, & Franck, 2006; Ruiz et al., 2013; Schneider et al., 2006; Scholten, Aleman, Montagne, & Kahn, 2005). It can therefore be stated that SMI patients are impaired in their social cognition.

Though more focus is currently given to social functioning, impaired cognitive functions such as an MID are often present in SMI patients and should therefore not be left unattended when looking into factors of their functioning (Morgan, Leonard, Bourke, & Jablensky, 2008; Schaefer et al., 2013). MID is a disorder that is characterized by a low intelligence quotient (IQ) (between 50 and 85) and limitations in adaptive behavior and communication. The impact of an MID on daily functioning is significant (Wieland, Kapitein, Otter, & Baas, 2014) and impairments in social cognition are prevalent. It can often result in difficulties in perspective taking, social information processing and self-regulation (Gilmore & Cuskelly, 2014; Shevell, 2008). The limited insight in their own and other people's behavior frequently results in overestimation by themselves and by others (Neijmeijer, Moerdijk, Veneberg, & Muusse, 2010). Moreover, impaired practice and observation of correct social skills is common (Scotland, McKenzie, Cossar, Murray, & Michie, 2016).

Apart from these deficits in the higher order levels of social cognition, more specific deficits can be found when looking at a lower level of social cognition, namely emotion recognition (Hetzroni & Oren, 2002; Rojahn, Esbensen, & Hoch, 2006; Scotland et al., 2016). Especially the recognition of emotions of fear and anger are impaired in MID (Cebula, Wishart, Willis, & Pitcairn, 2017; Memisevic, Mujkanovic, & Ibralic-Biscevic, 2016). Based on the emotion specificity hypothesis, this deficit in emotion recognition cannot be explained by only taking into account the intellectual disability. The impaired emotion recognition is therefore considered a separate characteristic of the disorder (Scotland et al., 2016; Zaja & Rojahn, 2008). Taken together, considering the intellectual and cognitive abilities of SMI patients is important when studying their social functioning as impaired intellectual abilities influence social cognition.

Furthermore, studies suggest several links between SMI and MID diagnoses. First of all, the neurodevelopmental hypothesis puts both disorders on the neurodevelopmental disorder spectrum. The neurodevelopmental hypothesis states that the activation of pathological neural pathways during the development of the brain is the cause of different developmental disorders. The positive and negative symptoms associated with SZP have been found to be the result of pathological neural pathway activation as well (American Psychiatric Association, 2013; Fatemi & Folsom, 2009). As a result, SZP can be considered a neurodevelopmental disorder like MID. Furthermore, studies have found commonalities between genetic risk factors for SZP and neurodevelopmental disorders (Owen, O'Donovan, Thapar, & Craddock, 2011) as well as common characteristics. Examples are cognitive impairment and a higher prevalence in males (American Psychiatric Association, 2013; Owen et al., 2011; Owen, 2012). In conclusion, MID frequently co-occurs with SMI, both disorders have similar deficits in social cognition and cognitive functioning and the foundation of both disorder is thought to be similar.

Apart from focusing on enhancing the social functions in SMI patients to ameliorate their daily functioning, a better lifestyle has been pointed out to enhance daily living of these patients as well. Taking into account variables of lifestyle like PA can therefore be beneficial to the enhancement of treatments. Recently the literature has been expanding on the lifestyle of SMI patients. Studies show that the life expectancy of SMI patients can be up to 20 years less than healthy people (Cohen, 2015; Walker, McGee, & Druss, 2015). One of the main causes of this reduced life expectancy is the presence of cardiometabolic diseases which are commonly the result of the antipsychotic drugs prescribed for SMI patients (Laursen, 2011). Looking into a specific domain of lifestyle, PA comprises different types of activities. Low

PA is often classified as sedentary behavior, requiring little energy. Other intensities considered for PA are light PA: little energy requirements but not limited to sitting behavior; and moderate to vigorous PA: PA required for sports (Owen, Healy, Matthews, & Dunstan, 2010). Firth, Cotter, Elliott, French, & Yung (2015) stated that PA reduces the risk of cardiometabolic diseases and could therefore improve daily functioning in SMI patients. Furthermore, PA has been found to have a positive effect on cognitive functioning in general (Erickson, Hillman, & Kramer, 2015; Sofi et al., 2010) and in patients with SZP (Firth et al., 2017; Firth, Cotter, Carney, & Yung, 2017). This link is thought to be the result of a reduction of disease development in people that engage in PA together with the increase of neurogenesis that results from PA (Kramer & Erickson, 2007; Tivadar, 2017). However, for SMI and MID patients PA is very low and high rates of sedentary behavior are common (Koritsas & Iacono, 2016; Kruisdijk et al., 2017; Oviedo, Travier, & Guerra-Balic, 2017; Vancampfort et al., 2017). More specifically, within the group of SMI patients, patients with SZP engage in PA the least (Vancampfort et al., 2017) and the amount of PA in SZP patients is associated with the severity of their negative symptoms (Scheewe et al., 2019). Furthermore, as PA is known to enhance cognitive functions, more PA for patients with MID would also ameliorate the functional impairments associated with MID (Erickson et al., 2015; Sofi et al., 2010).

Enhancing daily and social functioning of patients with SMI and MID by gathering more knowledge within the domains explained above, contributes to the shift in attitude towards long term psychiatry. Whereas before, this patient group was often alienated from society, currently more focus is given to their reintegration and the reinforcement of their independence from mental health care. This opinion is also carried out by GGz Centraal ("GGz Centraal: Behandeling en herstel – Wonen," n.d.). With more knowledge on the co-occurrence of the disorders and their impact on social cognition and PA, the treatment of the patients can be structured better to enhance the daily and social functioning of the patients. Improvements in this field could improve the transfer to more independent living and reintegration for the patients and their environment. Therefore, the current study will focus on SMI patients with co-occurring MID indications, their social cognition with emotion recognition in particular, and their PA. The research questions are as follows:

What is the distribution of MID indications across the different SMI disorders?

Because of the many similarities found between SZP and MID, especially coming from the neurodevelopmental hypothesis (Owen et al., 2011; Owen, 2012), it is expected that the

presence of MID indications is significantly higher in SZP patients compared to patients with other SMI disorders.

How does the presence of an MID indication influence the ability to correctly recognize different emotions in SMI patients?

It is expected that patients with a comorbid MID indication show the same performance on emotion recognition as patients without MID indications. This is hypothesized based on the neurodevelopmental hypothesis which states that SZP and MID are developmental disorders on the same continuum (Fatemi & Folsom, 2009) and the impaired emotion recognition in MID is thought to be independent of the low intelligence (Schotland et al., 2016; Zaja & Rojahn, 2008).

Does the rate of PA differ between patients with co-occurring MID indications compared to patients without co-occurring MID indications?

Considering the limitation in adaptive behavior in patients with MID (Gilmore & Cuskelly, 2014; Shevell, 2008) combined with the already lower PA in SMI patients in general (Gilmore & Cuskelly, 2014; Shevell, 2008), it is expected that patients with co-occurring MID indications will have a significantly lower rate of PA compared to patients without co-occurring MID indications as they will less likely adapt to a more physically active lifestyle. More specifically, this is expected to be displayed in a higher prevalence of sedentary behavior together with lower prevalence of light and moderate to vigorous PA.

Methods

Study Design

The current study was a cross-sectional within-subjects study design with a cohort of inpatients from the wards for long-term SMI of GGz Centraal Zon & Schild in Amersfoort, The Netherlands. The assessment for the current study was carried out by two researchers and additional data from the study of Kruisdijk et al. (2017) was used. Data was attempted to be collected during a single appointment per patient.

Participants

The study population for the current study consisted of the full patient population of the wards for long-term SMI at GGz Centraal Zon & Schild which in total houses 102 patients. The wards are divided into three divisions based on different levels of daily functioning and medical background. The participation in the study was included into the treatment as usual. The nursing staff explained the purpose and content of the study together

with the researchers before the assessments. After participation, the patients were asked for their written informed consent to use their treatment as usual data for scientific purposes. This was done by their nursing staff to reduce reluctancy and mistrust in patients and to make sure they understood the full content of the informed consent.

In addition to data collection of the current study, accelerometer data to determine PA was used from the lifestyle study by Kruisdijk et al. (2017). In total *n*=21 patients from the current study population also participated in the study of Kruisdijk et al. in 2017 and were therefore included in the analyses for PA.

Procedure

All participants were admitted to the wards of the long term SMI unit of GGz Centraal, location Zon & Schild. Before starting the assessments, the nursing staff informed the patients about the content and purpose of the study and that participation was voluntary although recommended. The majority of the patients was approached by the researchers in the living rooms and in the hallways of the facility. In some cases the nursing staff approached the patients to participate. Before starting the assessment, the researchers shortly informed the patients about the purpose of the study again to make sure this was still clear for the patients.

The testing was performed in familiar locations at the wards to ensure that the patients felt at ease while participating and were not distracted by a new environment. The order of the assessment was flexible, though the researchers usually started with the Screener for Intelligence and Learning Disabilities (SCIL). Verbal feedback on the accuracy of the answers was occasionally given to keep the patient motivated. To avoid misinterpretations of the questions, the questionnaires were most often read to the patients and filled out by the researchers. Furthermore, based on the abilities of the patients they either navigated through the computerized task themselves or this was done by the researchers. The tests for the current study were part of a larger assessment which included other questionnaires and tests to measure social norms, anxiety and depression complaints and cognitive functioning.

Materials

During the assessment, different neuropsychological (screening) tests were administered. The questionnaires were administered on paper. One of the tasks (Emotion Recognition Task) was a computerized test and was conducted on an HP ProBook 4740s laptop with Metrisquare.

SCIL 18+ (Screener for intelligence and learning disability, Dutch version)

The SCIL is a 14-item screening questionnaire for people of the age of 18 years old and above. It gives an estimation of the intelligence of the participant to check for the presence of an (mild) intellectual disability (Nijman, Kaal, van Scheppingen, & Moonen, 2018). The patient is asked to complete calculation and questions like: "Do you read the newspaper or magazines?", "What does the saying: 'The apple doesn't fall far from the tree', mean?", "What is the highest education you have completed". Each question can be rewarded with a maximum of 2 points. The presence of an intellectual disability is determined by a cut-off score. Participants scoring 19 or lower are suspected of an intellectual disability (Kaal, Nijman, & Moonen, 2016). In the Netherlands, the term (mild) intellectual disability is given to people with an intelligence quotient (IQ) between 50 and 85 (Wieland, Kapitein, Otter, & Baas, 2014). The same IQ indication was used for the development of the SCIL (Seelen-de Lang et al., 2019). Given this information, based on the results of the SCIL participants scoring 19 or lower are expected to have an IQ of below 85 and will therefore have an indication for MID.

Internal consistency of the 14 items of the questionnaire in the normal population is found to be of at least 0.82 and test-retest reliability is found to be 0.92. Based on the comparison of the SCIL outcome measures with the WAIS (Wechsler Adult Intelligence Scale), a high predictive value of 0.93 was found (Nijman et al., 2018). Furthermore, Seelen-de Lang et al. (2019) found an internal consistency coefficient of 0.73 and a predictive validity of 0.81 for the SCIL in outpatients with SMI.

ERT (Emotion Recognition Task)

This is a computerized task presented in Metrisquare on a 17.3" screen in which participants are presented with morphed faces showing emotions of four different intensities, namely 40%, 60%, 80% and 100%. The faces are shown in color and the expressions are performed by four Caucasian adults (two male, two female) (Frigerio, Burt, Montagne, Murray, & Perrett, 2002). Their faces were delineated at the hairline, making all important facial characteristics visual and dismissing non-relevant features (e.g. hair, ears, etc.) (Montagne, Kessels, De Haan, & Perrett, 2007). The faces start with a neutral emotion and morph into the specific intensity of the emotion (see Figure 1). The morphing faces were developed by an algorithm creating an interaction between two intensities, always starting with a neutral face and ending with the specified intensity of the emotion. The length of the morphing clips varied between 1 sec (40% intensity) to approximately 3 seconds (100%

intensity). Before starting the task, an instruction in Dutch was presented on the screen accompanied by verbal explanation by the examiner. The instruction was followed by three practice trials, respectively showing an angry, happy and disgusted face, to create familiarity with the test instructions. The expressions in the practice trials were performed by a different actor than the actors of the actual task. The order of intensity was the same for each participant, starting with lower intensities and finishing with the high intensities. The participant had to make a forced choice between the six basic emotions: anger, disgust, happiness, sadness, surprise and fear. In total 96 faces were shown to the patient (Kessels, Montagne, Hendriks, Perrett, & de Haan, 2014).

The ERT has been validated for clinical populations of various disorders, amongst others: SZP, autism spectrum disorder, generalized social anxiety disorder and personality disorders (Berenschot et al., 2014; Deckers et al., 2015; Kessels & Montagne, 2016; Kessels, Spee, & Hendriks, 2010; Montagne et al., 2006; Montagne et al., 2007; Scholten et al., 2005). Given the representation of SMI disorders within the study populations of studies that have validated the ERT, the ERT is considered suitable for the current study. Because the ERT shows emotions at different intensities, it is possible to distinguish between subtle problems with emotion recognition which enhances the ecological validity of the task (Smith, Montagne, Perrett, Gill & Gallagher, 2010). Furthermore, the norm-data available for the ERT is based on large sample sizes (N=373), therefore this norm-data can be used for clinical practice (Kessels & Montagne, 2016).

Physical Activity

To measure PA, data from the study of Kruisdijk et al. (2017) was used. That study was conducted in the same mental health care institution. As the cognitive functions of this population are thought to be rather consistent, the indications for MID found during current assessments are expected to be similar to the cognitive functions during the data collection of Kruisdijk et al. in 2017 which makes this data adequate for comparison in the current study. To measure the PA, Kruisdijk and colleagues (2017) used ActiGraph GT3x+ accelerometers (ActiGraph, Pensacola, Florida, US). The accelerometers were attached on the patient's hip and additional security measures were met to keep the device in place. During the data collection the patients did not get additional tasks, the aim was to get an indication of their PA on a regular day. Data of the accelerometers was analyzed with ActiLife 6.8.0 software. The collected data was considered valid when a minimum of six hours a day for three consecutive days was collected. PA was measured as total activity counts per hour. Furthermore, the

activity counts were classified according to activity intensity. Respectively, sedentary behavior (<150 counts/min), light PA (151 – 3207 counts/min) and moderate to vigorous PA (≥3208 counts/min) (Kruisdijk et al., 2017). The ActiGraph GT3X+ accelerometers are considered highly reliable and valid (Gatti, Stratford, Brenneman & Maly, 2016; Jarrett, Fitzgerald & Routen, 2015; Kruisdijk et al., 2017; McMinn, Acharya, Rowe, Gray & Allan, 2013).

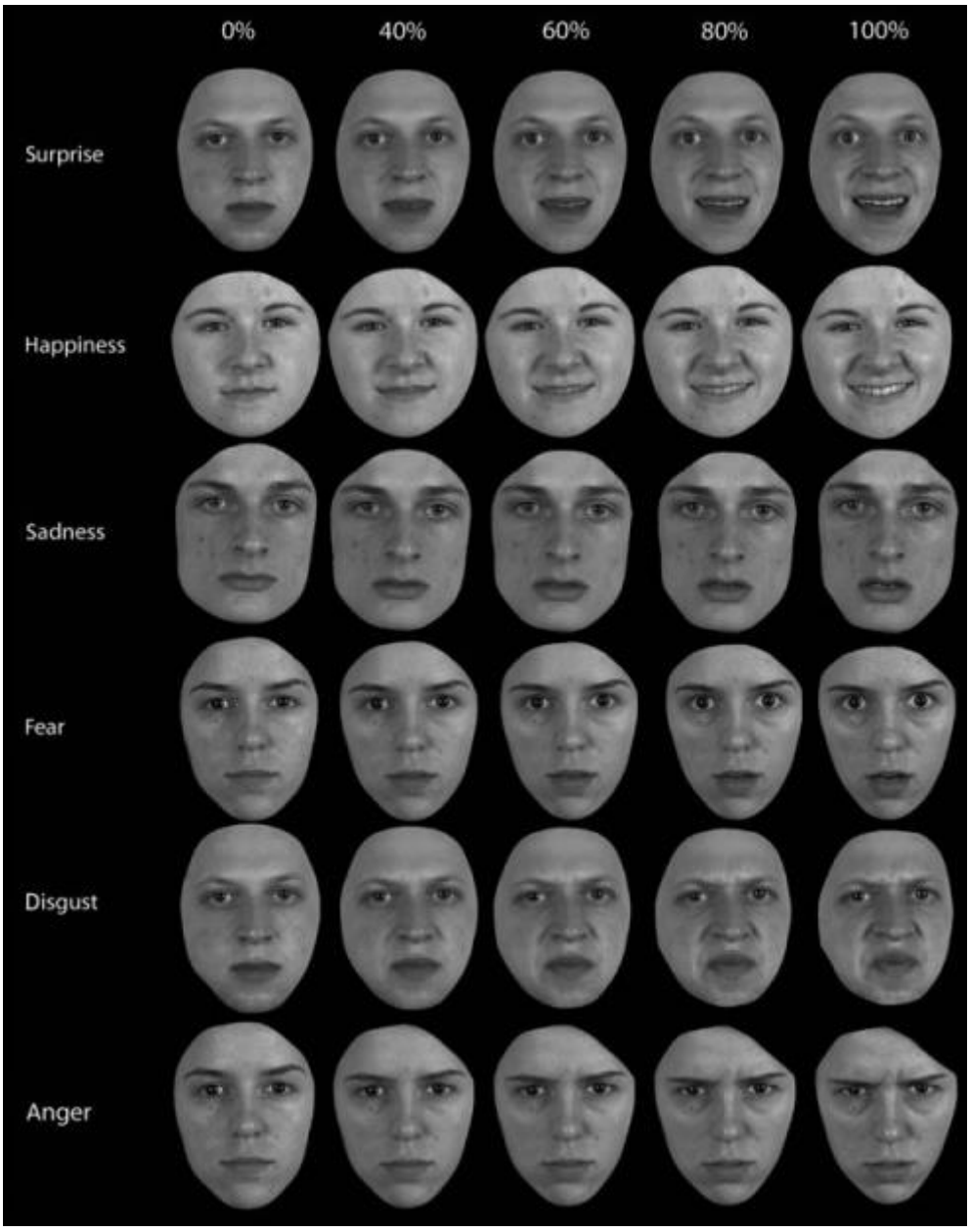

Figure 1. Facial stimuli at different intensities used in ERT. Reprinted from "Assessment of perception of morphed facial expressions using the Emotion Recognition Task: Normative data from healthy participants aged 8–75." By Kessels, R. P., Montagne, B., Hendriks, A. W., Perrett, D. I., & de Haan, E. H., 2014. *Journal of neuropsychology*, *8*(1), 75-93.

Statistical Analysis

For the statistical analysis, IBM SPSS Statistics 25 was used. Before conducting the statistical analyses, general characteristics of the sample were investigated and statistical assumptions were tested (see Appendix). The variables were tested for normality and homogeneity using histograms and comparing the standard deviations with the means. For the Chi-Square Test of Contingencies, the alternative Fisher's Exact Test was used when the expected count of one of the groups was less than 5. When the assumption of normality was violated, the multiple regression analyses were performed using bootstrapping with 1000 samples, bias-corrected and accelerated. Furthermore, characteristics (age, gender and type of diagnosis) of the patients of the study population who were not able to participate in the assessments (see Figure 2) were analyzed with an Independent Sample T-Test and a Chi-Square Tests of Contingencies to determine the representativeness of the current study sample in comparison with the full study population. All analyses are interpreted based on a two-tailed $p \leq .05$ significance level.

To test whether the prevalence of MID indications is higher in patients with SZP compared to patients with other SMI diagnoses, the independent variable was operationalized as the primary diagnosis of the patient. A dichotomous variable was used to divide SZP diagnoses from 'other'-diagnoses. The dependent variable was the presence of an MID indication. This was tested with a Chi-Square Test of Contingencies. For the second research question, the difference in emotion recognition performance between patients with and without a co-occurrent MID indication was analyzed. In this analysis, the independent variable was the presence of an MID indication and the dependent variable was the performance on emotion recognition. Performance on emotion recognition was operationalized as a classification based on the percentile score for the overall performance on the task in addition to the percentile scores for the different basic emotions. In the current study the percentile score was interpreted as a continuous variable. To determine the association between an MID indication on emotion recognition a multiple linear regression analysis was executed. Since level of education and age are known to influence the performance on the emotion recognition task (Kessels & Montagne, 2016), these variables were taken into account as confounding variables. Finally, to test whether there was an association between the presence of an MID indication and the rate of PA, a multiple linear regression analysis was performed. The independent variable in these analyses was the presence of an MID indication. The dependent variable of PA was determined by activation per hour and was analyzed as a continuous variable. Age was taken into account as a

confounding variable in PA (Hallal et al., 2012; Kruisdijk et al., 2016). Moreover, additional multiple regression analyses were performed to test whether patients with co-occurring MID indications had more sedentary behavior and less light and moderate to vigorous activity compared to non-co-occurring MID indication patients. In addition to the analyses explained above, the multiple linear regression analyses for the associations of emotion recognition and PA with MID indications were also performed using a continuous variable for MID indication. By doing so, possible (in)significant findings based on the cut-off score used in the analyses were ruled out.

Results

In total 102 patients were part of the study population of the current study (*N*=62 male, *N*=40 female, M_{age}=52.44; SD_{age}=13.27). Two patients did not agree to the informed consent. Other reasons for exclusion of the patients (*N*=55) are presented in the flowchart of Figure 2. The remaining 47 patients of the wards for long-term SMI at GGz Centraal Zon & Schild were included in the analyses. The patients' characteristics are displayed in Table 1. The overall age of the included patients ranged from 22 years old to 75 years old and they had an education level between Verhage 1 and Verhage 6 (Verhage, 1964). The diagnoses of the patients are divided into 'SZP'-diagnosis and 'other'-diagnoses. The number of patients with other SMI disorders was too small to statistically analyze, therefore they were clustered together for the analyses. The study sample did not significantly differ from the full study population for age (p = .564) and type of diagnosis (p = .445). However, the distribution for gender did significantly differ (p = .002). Since the research questions of the current study did not assume gender differences, this significant difference was considered acceptable. Therefore, the study sample was considered representative.

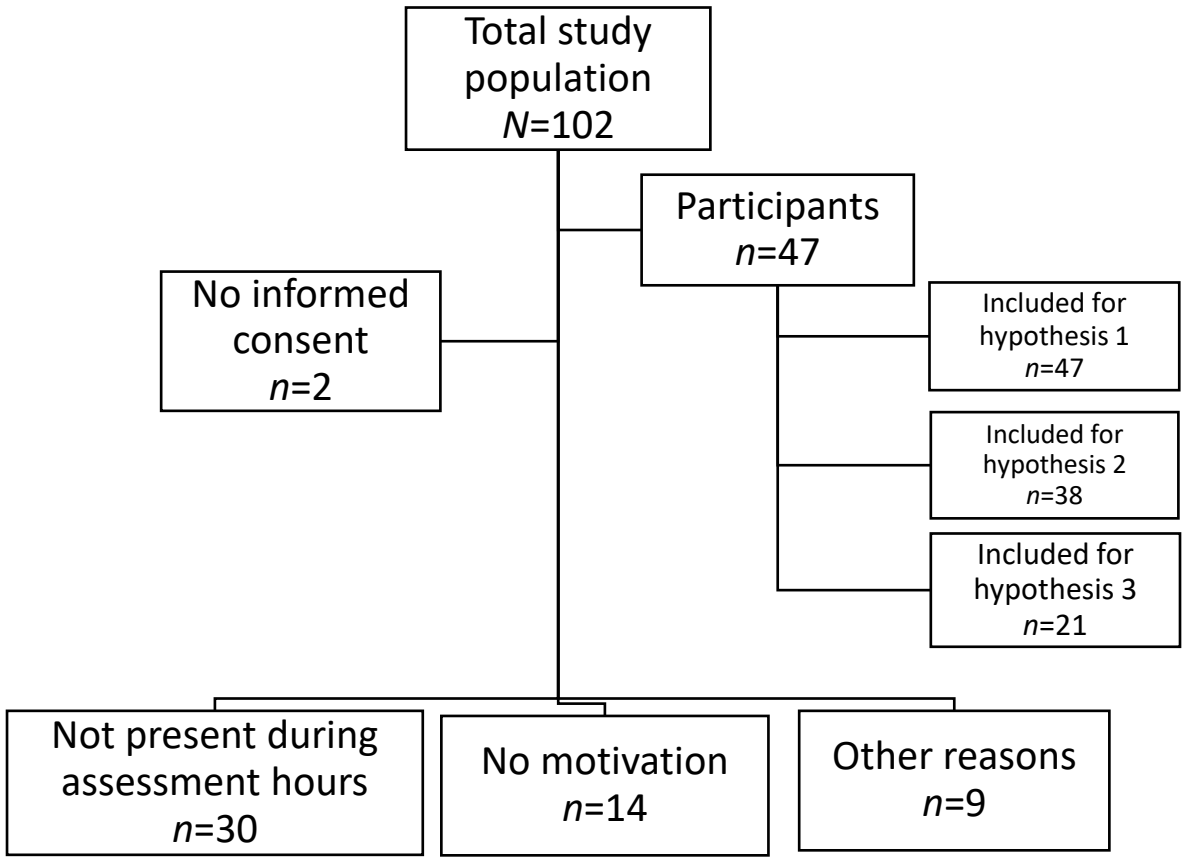

Figure 2. Flowchart of patient population for current study sample

Table 1

Patient characteristics of the current study sample

Variable	**Total (*n* = 47)**	**Men (*n* = 37)**	**Women (*n* = 10)**
Age in years	51.60 (13.64)	51.54 (13.65)	51.80 (14.31)
Education level based on Verhage, modus	4	4	4
Handedness, *n* (%)			
Lefthanded	6 (12.8)	4 (10.8)	2 (20)
Righthanded	41 (87.2)	33 (89.2)	8 (80)
Diagnosis, *n* (%)			
Schizophrenia	34 (72.3)	28 (75.7)	5 (50)
Other	13 (27.7)	9 (24.3)	5 (50)
Mood disorder	4 (8.5)	3 (8.1)	1 (10)
Psychotic disorder (n.o.s.)	2 (4.3)	2 (5.4)	0 (0)
Schizoaffective disorder	5 (10.6)	2 (5.4)	3 (30)

Pervasive developmental disorder	1 (2.1)	1 (2.7)	0 (0)
Delusional disorder	1 (2.1)	0 (0)	1 (10)
MID indication, *n* (%)			
MID	36 (76.6)	27 (73.0)	9 (90)
No MID	11 (23.4)	10 (27.0)	1 (10)
ERT percentile score			
Total	12.26 (14.46)	11.80 (12.64)	14.00 (12.46)
Anger	30.47 (29.61)	28.70 (27.66)	37.13 (37.42)
Disgust	17.79 (19.75)	18.87 (21.60)	13.61 (10.26)
Fear	23.05 (16.86)	22.03 (17.04)	26.88 (16.68)
Happiness	32.92 (29.19)	34.20 (30.96)	28.13 (22.35)
Sadness	35.66 (28.77)	33.17 (28.97)	45.00 (27.78)
Surprise	18.82 (21.69)	18.57 (21.50)	19.75 (23.89)
PA, percentage of total PA			
Sedentary behavior	78.71 (9.92)	78.66 (10.78)	84.18 (1.83)
Light intensity physical activity	12.42 (8.51)	13.23 (9.26)	8.96 (2.50)
Moderate to vigorous physical activity	7.88 (3.55)	8.11 (3.76)	6.86 (2.60)

Note. Mean (SD) unless otherwise noted. N.o.s. = not otherwise specified. MID = mild intellectual disability. ERT = emotion recognition task. PA = physical activity.

Figure 3 shows the overall prevalence (77%) of MID indications for the current sample. Additionally, Figure 4 displays the prevalence of MID indications in combination with SZP and 'other'-diagnoses. No significant differences were found between patients with SZP and patients with other diagnoses for MID prevalence, χ^2 (1, N=48) = 0.57, p=.702.

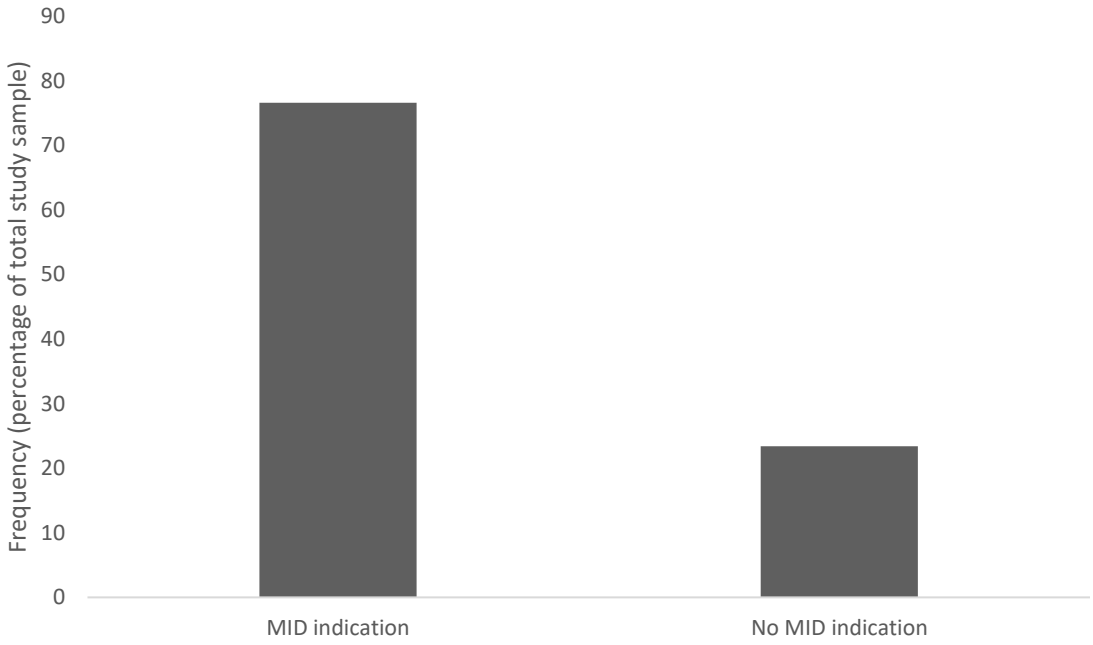

Figure 3. Prevalence of mild intellectual disability (MID) indications amongst all severe mental illness (SMI) in the current study sample.

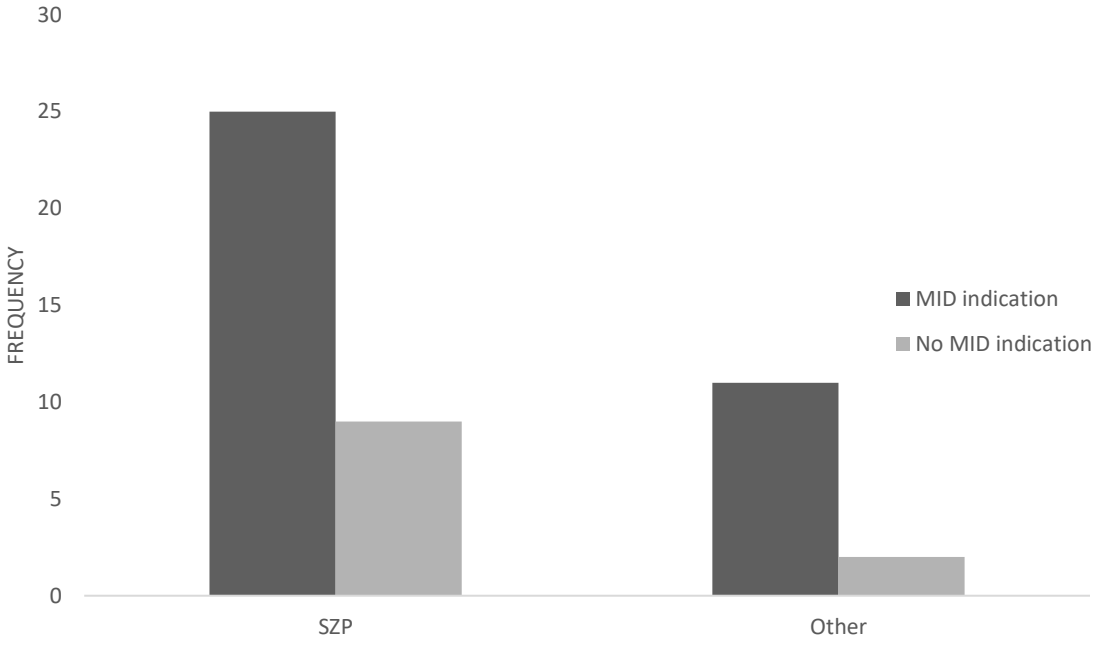

Figure 4. Distribution of mild intellectual disability (MID) indications specified per severe mental illness (SMI) diagnosis. SZP = Schizophrenia. MID = mild intellectual disability.

Corrected for age, education level and gender, patients with an indication for MID showed lower scores on the total recognition of emotions and specifically anger, disgust, happiness and sadness. However, only for recognizing disgust, patients indicated with MID

scored significantly lower compared to patients that were indicated to have no MID (B = -26.53, p = .018). In contrast with the non-significant findings for MID indication in association with overall performance on emotion recognition, a significant association was found for emotion recognition and total score on the SCIL indicating that a higher score on the SCIL (interpreted as less indicative for an MID) is associated with a higher total percentile score on emotion recognition (B = 0.99, p = .005) as well as with a higher percentile score for the emotion of disgust (B = 1.45, p = .022). Bootstrapped regression coefficients and significance values are displayed for MID indication (Table 2) and total score on SCIL (Table 3).

Table 2

Bootstrapped multiple regression, corrected for gender, age and education, for the association between indicated mild intellectual disability and outcomes for total emotion recognition score and the six basic emotions (N=38).

Variable	**B**	**[95% CI]**	***p*-value for MID indication**
Total ERT	-7.84	[-16.78, 0.32]	.090
Anger	-19.59	[-46.69, 2.60]	.131
Disgust	-26.53	[-45.05, -12.07]	.018*
Fear	8.84	[-5.39, 24.27]	.224
Happiness	-21.89	[-43.35, -3.68]	.074
Sadness	-6.85	[-31.43, 11.54]	.491
Surprise	5.97	[-9.39, 23.02]	.517

Note. Bootstrap is performed bias corrected and accelerated with 1000 samples. Models were corrected for gender, age and education level as potential confounders. CI = confidence interval. ERT = emotion recognition task.

* significant for p<.05

Table 3

Bootstrapped multiple regression, corrected for gender, age and education, for the association between total score on SCIL and outcomes for total emotion recognition score and the six basic emotions (N=38).

Variable	**B**	**[95% CI]**	***p*-value for total SCIL score**
Total ERT	0.99	[0.41, 1.50]	.005*
Anger	2.28	[0.17, 4.62]	.063
Disgust	1.45	[0.61, 3.00]	.022*
Fear	-5.51	[-1.91, 0.72]	.403
Happiness	1.62	[-0.42, 3.67]	.087
Sadness	1.03	[-0.72, 3.33]	.180
Surprise	0.34	[-0.82, 1.15]	.530

Note. Bootstrap is performed bias corrected and accelerated with 1000 samples. Models were corrected for gender, age and education level as potential confounders. CI = confidence interval. ERT = emotion recognition task.

* significant for $p<.05$

While correcting for age, no significant association was found between overall PA, sedentary behavior, light PA and moderate to vigorous PA with the presence of an MID indication nor with total SCIL score. Patients with an indication for MID showed higher overall PA rates and a higher percentage of light PA together with a lower percentage of sedentary behavior and moderate to vigorous PA, though not significant. The results of the regression analysis, corrected for age, are presented in Table 4 (association PA and MID indication) and Table 5 (association PA and total SCIL score).

Table 4

Bootstrapped multiple regression, corrected for age, for the association between indicated mild intellectual disability and outcomes for total physical activity (PA) and the three types of PA (N=21).

Variable	**B**	**[95% CI]**	***p*-value for MID indication**
Total PA	0.18	[-0.53, 1.16]	.614
Sedentary behavior	-2.16	[-10.85, 4.00]	.510
Light PA	2.40	[-1.18, 7.68]	.423
Moderate to vigorous PA	-0.24	[-3.46, 2.94]	.880

Note. Bootstrap is performed bias corrected and accelerated with 1000 samples. Models were corrected for age as a potential confounder. CI = confidence interval. ERT = emotion recognition task.

Table 5

Bootstrapped multiple regression, corrected for age, for the association between total SCIL score and outcomes for total physical activity (PA) and the three types of PA (N=21).

Variable	**B**	**[95% CI]**	***p*-value for MID indication**
Total PA	-0.01	[-0.09, 0.06]	.749
Sedentary behavior	-0.12	[-0.91, 0.37]	.688
Light PA	0.17	[-0.16, 1.03]	.511
Moderate to vigorous PA	-0.05	[-0.36, 0.18]	.732

Note. Bootstrap is performed bias corrected and accelerated with 1000 samples. Models were corrected for age as a potential confounder. CI = confidence interval. ERT = emotion recognition task.

Discussion

The aim of the current study was to identify the distribution of MID indications in the long term psychiatry for patients with an SMI. Furthermore, this study looked into the relationship of an SMI disorder and a co-occurring MID indication on emotion recognition and PA to create new insight in the combination of these disorders on social cognition and physical activity.

The findings of the current study indicate an overall prevalence of 77% of MID indications amongst inpatients with SMI disorders in long term psychiatry. This prevalence is in accordance with research by Morgan et al. (2008). Looking into the specific distribution of

MID indications amongst different SMI disorders, no significant difference was found in the prevalence of MID indications in patients with SZP compared to patients with other SMI disorders. This finding is in contrast with the hypothesis. Based on the neurodevelopmental hypothesis a higher prevalence was expected amongst SZP patients as SZP is considered to be a developmental disorder situated on the same continuum as MID (Owen et al., 2011; Owen, 2012). This contrasting finding could be caused by the small sample size of the patient group with 'other' disorders. Though 28% of the patients in the current study cohort were diagnosed with a disorder other than SZP, this group only consisted of 13 patients. Furthermore, this group was further divided into presence of MID indication which resulted in a specified group of only 2 patients. This is very small to be statistically relevant. Therefore, the statistical findings should be interpreted with caution. In conclusion, in the absence of studies with a bigger sample size, MID counselling and guidance within the treatment of long term psychiatry is advised for all SMI disorders. As the overall prevalence of MID indications in patients with SMI diagnoses is high, counselling and guidance on the level of understanding of MID could be beneficial for many patients with different SMI disorders. To provide the staff with the necessary knowledge and tools to do so, additional courses should be provided by their employers. Furthermore, new employees should get introduced to the patient group with (co-occurring) MID as higher education facilities only provide students with limited information on MID (Neijmeijer et al., 2010).

Secondly, in accordance with the hypothesis, no difference in emotion recognition ability was observed between patients with and without MID indications. This finding supports the neurodevelopmental and emotion specificity hypothesis (Memisevic et al., 2016; Owen et al., 2011; Owen, 2012). In context of the current findings, an emotion recognition deficit can therefore be considered a characteristic of neurodevelopmental disorders in general. Interestingly, when looking at the measure of MID indication on a continuum, a higher score was significantly related to a higher performance on emotion recognition. It can therefore be concluded that the higher the IQ score, the better their performance on emotion recognition. This is in accordance with findings from Anderson and Miller (1998) and more recently from Shenk, Putnam, and Noll (2013) who found a more impaired emotion recognition in people with lower IQ. Taking together these findings, a lower cut-off score (Nijman et al. (2018) suggests a different cut-off score for an IQ indication of <70) would have probably resulted in different outcomes when comparing the MID indication group with the non-indicative patients. Therefore, it is expected that the deficits in emotion recognition found when looking at the continuous variable, are related to an IQ score heading towards 70

instead of 85. This is supported by findings from Hetzroni and Oren (2002). For the implementation of these findings in current practice, it can be concluded that treatment focused on the improvement of social functioning should not be limited to MID patients. Given the overall emotion recognition deficits in different SMI disorders, many patients could benefit from improving their basic social skills.

When looking into the specifics of the six basic emotions, only the emotion of disgust was found to be recognized significantly worse in patients with an MID indication. A possible explanation for this finding is the difficulty of the emotion of disgust in general. This is in line with the study of Hetzroni and Oren (2002) in which they conclude disgust to be a complex emotion. Furthermore, the observations during the assessment also support this conclusion. Many patients reported very few disgust emotions overall and sometimes even asked what the emotion of disgust meant. Therefore, the poor recognition of disgust is likely to be caused by the difficulty of the emotion of disgust in general. Although not significant, the emotions of anger, happiness and sadness showed a similar association with MID indications like the emotion of disgust. Apart from happiness, these emotions are negatively laden. The impairment in emotion recognition in SZP and MID patients is mainly present in negative emotions (Cebula et al., 2017; Chambon et al., 2006; Memisevic et al., 2016; Ruiz et al., 2013; Schneider et al., 2006; Scholten et al., 2005). Albeit not significant, the directions of the relations in this study are in line with the literature.

With regard to the results on emotion recognition stated above, it is important to consider the overall distribution of the scores on the ERT. The total ERT percentile score in the present study ranged between 0 and 50, with 97.3% of the patients scoring between the 0 and 30th percentile. Hence, the ERT scores can be considered low and are not normally distributed. Scholten et al. (2005) assessed SZP patients with the ERT and in fact found normally distributed total scores. Although no specifications were found on the characteristics of their patient sample being inpatient or having possible co-occurring MID indications, the low overall scores found in the current study ask for a critical view on the appropriateness of the norms for this population and a validation of the task for patients with an intellectual disability.

Lastly, no significant differences were found for the amount of PA, and different types of PA behavior between patients with a co-occurring MID indication compared to non-indicative MID patients. The low PA that is commonly reported in this patient group (Koritsas & Iacono, 2016; Kruisdijk et al., 2017; Oviedo et al., 2017; Vancampfort et al., 2017), can therefore not be explained by a high prevalence of cognitive impairment alone. It is most

likely more affected by (an) other factor(s), such as type and dose of medication taken currently or in the past (Kruisdijk et al., 2016). The implication of this finding is that an intervention to increase PA in people with SMI should not have to be specified according to the possible co-occurrence of MID. Considering the reduced life expectancy in SMI patients mainly caused by cardiometabolic diseases, together with the improvement PA can give to cardiometabolic diseases (Firth et al., 2015; Laursen, 2011), it is highly important to gain more insight into other factors of influence on PA. An increase in rate of PA can improve their life expectancy which will contribute to a better daily functioning and therefore more independence in SMI patients.

The present study is the first study to successfully look into the distribution of MID in the current study population of GGz Centraal Zon & Schild. Because of the characteristics of SMI, assessing these inpatients with full intelligence test batteries was found not possible. By using the SCIL as a screener for MID, the staff is provided with additional knowledge on their patients which could benefit their daily living and treatment. Furthermore, social cognition and PA was measured using objective instruments. The data is therefore considered more accurate to determine the associations analyzed in the present study. Also given the fact that confounding variables based on prior literature were taken into account in assessing the associations.

However, a few limitations of the current study should be noted. First of all, the length of the assessment. Difficulties with attention are known characteristics of many SMI disorders (Sadock, Sadock, & Ruiz, 2015). The data collection of the current study was part of a bigger assessment battery consisting of multiple questionnaires and tasks, in total taking up to 45 minutes to fully administer. Though the aim was to start with the tasks requiring the most attention (being the SCIL and the ERT), this was not always possible due to material availability. As a consequence, for some patients the ERT was the final task of the assessment. This could have influenced the accuracy of the data since the lack of attention and focus could have interfered with the adequate effort necessary for the task. Secondly, outcome scores of the SCIL were used as a discriminating measurement for patients with or without MID. However, the SCIL is a tool to screen for an MID indication and cannot be used independently for diagnostic purposes. For a valid MID diagnosis, a full intelligence test battery should be administered together with assessment of adaptive functioning (Nijman et al., 2018). Yet, the cognitive impairments known in patients with SMI, especially in the domain of attention (Sadock et al., 2015), resulted in the choice for the use of the SCIL as a criterion tool in the current study. Nonetheless, conclusions made based on the current study

should be interpreted as appropriate for MID indicative patients, not MID diagnosed patients. Lastly, due to the small sample size, the statistical power of the analyses is reduced. Therefore, in further research larger patient samples should provide further evidence for the (lack of) difference between SMI patients with or without MID indications in their social cognition and physical activity.

Conclusion

Based on the current study, no differences can be identified between SMI patients with and without co-occurring MID indications in social cognition and PA, apart from the recognition of the emotion of disgust. However, a higher IQ indication is associated with a better performance on emotion recognition. Considering the high prevalence of indications of MID for the study sample (77%), it is of importance that the treatments for improvement of social and daily functioning are tailored to the level of understanding of MID. To effectively do so, staff should get additional education on the treatment and guidance of MID patients.

To gain additional knowledge on variables impacting the social an daily functioning of these patients, future research should focus on the higher order levels of social cognition such as mentalizing and moral reasoning. These findings could contribute to better structure treatments to enhance reintegration by looking into further possible differences between patient with and without MID. Furthermore, additional research into factors contributing to the increase of PA, impact of drug intake and the implementation of PA interventions in long term psychiatry is necessary to create a supplementary way of enhancing daily functioning in this patient group. Moreover, additional studies with larger samples are necessary to rule out the presence or lack of significant findings due to the small sample size of the current study. For example, comparing large groups with different SMI disorders and a co-morbid MID diagnoses, could give insight in the possible need for differentiation in treatments and approach based on the type of SMI disorder. With more knowledge on the factors of influence in the daily life of SMI patients, the shift towards reintegration and creating more independence in this patient group could be enhanced.

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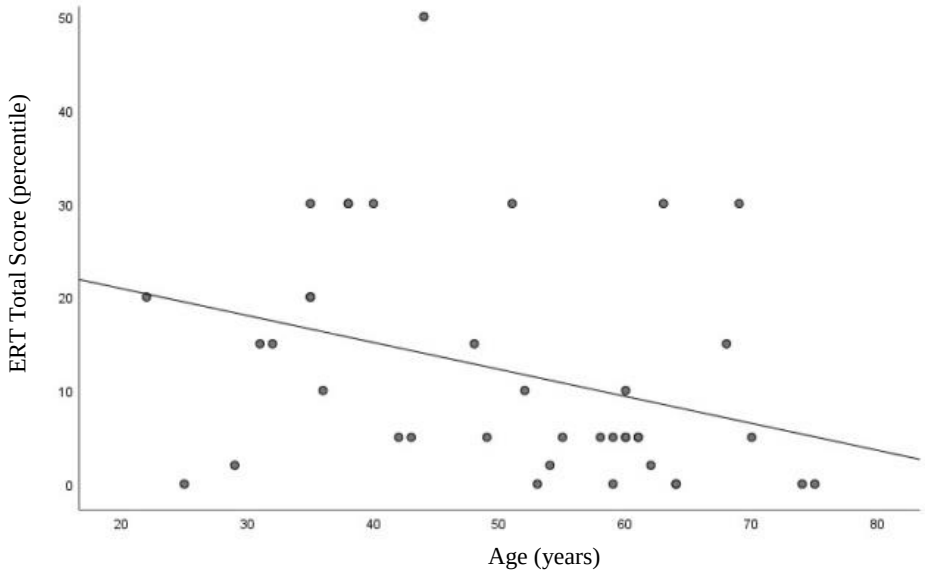
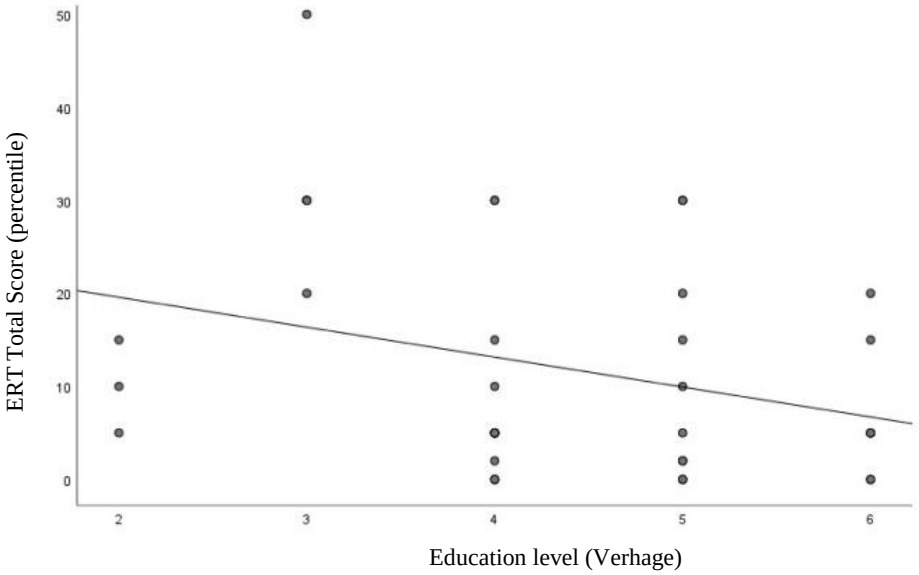
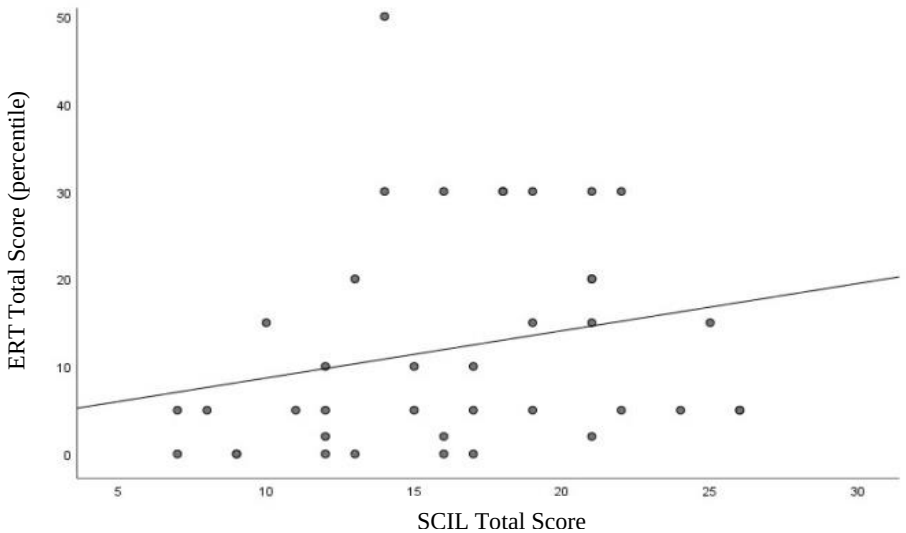
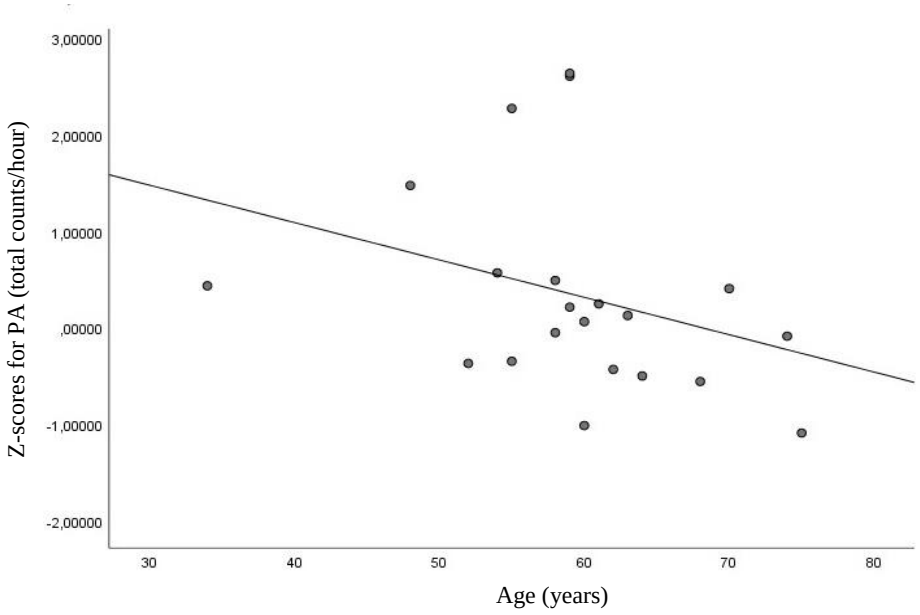
Appendix

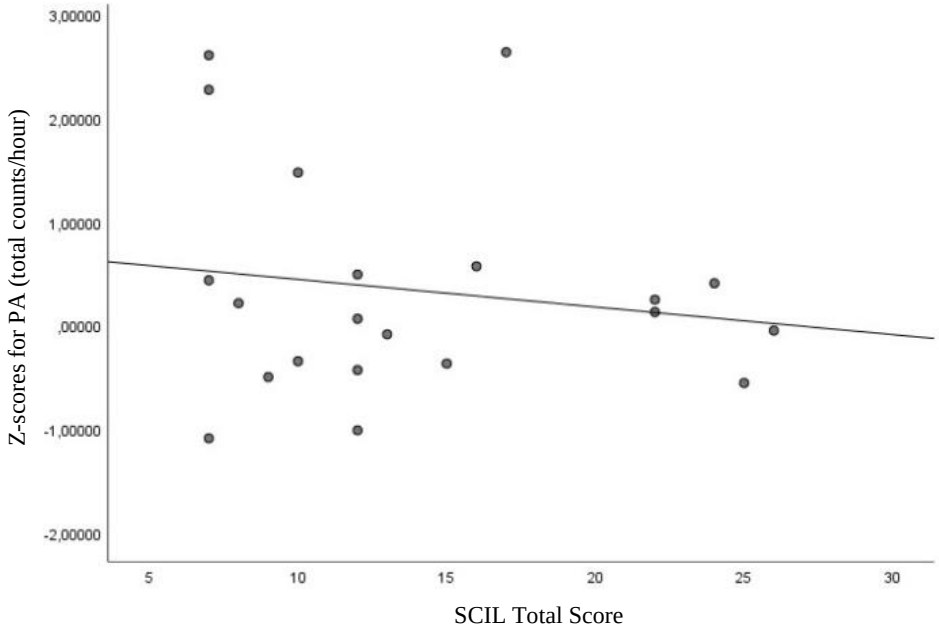
Scatterplots to test linearity assumption for multiple linear regression analyses








Z-scores for PA (total counts/hour)
3,00000
2,00000
1,00000
,00000
-1,00000
-2,00000
30
40
50
60
70
80
Age (years)


Z-scores for PA (total counts/hour)
3,00000
2,00000
1,00000
,00000
-1,00000
-2,00000
5
10
15
20
25
30
SCIL Total Score