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Abstract

Even though it is well-known that certain antipsychotic medication such as olanzapine and clozapine can cause weight gain, metabolic disturbances, and other physical and mental complications in people with a psychotic disorder, the relationship between antipsychotic medication and exercise remains not clear. The main goal of this study is to investigate whether there is an association between using a certain type of antipsychotic medication and the amount of exercising in people with a psychotic disorder. First, this study examines whether people with a psychotic disorder that use atypical antipsychotic medication exercise less compared to those that use typical antipsychotic medication. Second, whether people with a psychotic disorder that use clozapine and olanzapine exercise less compared to those that use another type of antipsychotic medication. The data used originates from a longitudinal cohort study named GROUP, a total of 523 people with a psychotic disorder who participated are used in this study. From these 523 participants, a number of 69 used typical antipsychotic medication and 454 participants used atypical antipsychotic medication. In addition, a total of 241 participants from these 523 participants used clozapine or olanzapine, and 282 participants used other antipsychotics. Further, t-tests are used in the analysis to answer the research questions. The results show there is no significant difference in both groups with regards to the two hypotheses. This implies there is no association between using a certain type of antipsychotic medication and the amount of exercising in people with a psychotic disorder.

Keywords: exercise, antipsychotic medication, people with psychotic disorders, weight gain, and metabolic disturbances

Introduction

Based on a study from medical journal The Lancet in 2017, the World Health Organization (2019) reported twenty million cases of people with psychotic disorders worldwide. People with psychotic disorders have a lower life expectancy due to various causes. One of these possible causes is medication use, this is mainly for the reason that antipsychotic medication can be the cause of weight gain, metabolic disturbances and type 2 diabetes resulting in increased mortality and risk of cardiovascular morbidity (Larsen et al., 2017). Antipsychotic medication is used to treat people with schizophrenia and other psychotic disorders, bipolar disorders, and major depressive disorders with psychotic characteristics. Antipsychotic medication can be divided into two groups: typical and atypical antipsychotics. Typical antipsychotics are first generation antipsychotic medication and atypical antipsychotics are second generation antipsychotic medication (Vasan, & Abdijadid, 2018; Leucht et al., 2013).

The side effects profiles of antipsychotics

Treating symptoms of people with a psychotic disorder with antipsychotic medication remains the most common form of treatment. However, health-related side effects caused by these medicines have attracted increasing attention with poor drug compliance in result. As previously mentioned, both typical (first generation) and atypical (second generation) antipsychotics can cause a number of motor, metabolic, cardiovascular dysfunctions, diabetes, obesity, stroke, sedation and inability to concentrate (Leucht et al., 2012; Stanton, & Happell, 2014; Joukamaa et al., 2006; De Hert et al.,2012; Fusar-Poli et al., 2013; Young et al., 2014).

According to Navari and Dazzan (2009) treating people with a psychotic disorder with antipsychotics can contribute to structural changes in the brain. This study also shows that antipsychotics execute more regionally in the brain rather than globally and that antipsychotics have specific effects in different brain areas. For example, people that use antipsychotic medication exhibit a reduced grey matter volume in certain brain structures such as in the frontal lobe and temporal lobe. This reduction of grey matter volume in these brain areas within people with a psychotic disorder can be understood as a positive effect. Furthermore, using typical antipsychotics leads to an increased volume in the basal ganglia and increased grey matter volume in the cingulate cortex. The use of atypical antipsychotics causes a decrease of volume in the basal ganglia and an often-seen increase of volume in the hypothalamus (Navari and Dazzan, 2009). Konopaske et al. (2008) report that chronically administering haloperidol (typical antipsychotic medication) or olanzapine (atypical antipsychotic medication) is associated with a reduced grey matter volume which raises ethical question on antipsychotic use.

Quetiapine, risperidone, and olanzapine are the most frequently prescribed antipsychotic medications in 16 countries including the Netherlands (Hálfdánarson et al.

2017). Skonieczna-Żydecka and colleagues (2019) examine the use of quetiapine, risperidone, and olanzapine in a meta-analysis finding that antipsychotic treatment-related microbiome alterations result into body weight gain and metabolic disturbance. In addition, inflammation resting metabolic rate suppression appears to play a major role in the development of metabolic disorders. Furthermore, clozapine and olanzapine are considered the most effective antipsychotic medication to treat the symptoms of people with a psychotic disorder. Unfortunately, these two antipsychotic medications cause significant more weight gain and a larger increase in the risk of metabolic disturbances compared to all alternative antipsychotic medication (Henderson et al., 2015; Allison et al., 1999; Leucht et al., 2014; Rado, 2013; Kane et al., 1988; Correll et al., 2011; Merk et al., 2021).

The benefits of exercise

Several studies show that physical activity has a positive effect on promoting brain health and cognitive functions in people with psychotic disorders and encourages neurogenesis, cell proliferation and slows cell apoptosis (Wolf et al., 2011; Koehl et al., 2008; Avula et al., 2001). Exercise plays a crucial role in enhancing neurotrophic factor, synaptic plasticity, learning and essential elements in the brain (Hariri et al., 2003). Other studies show that exercise is important in reducing inflammation and limiting the positive effects of brain-derived neurotrophic factor (BDNF) on synaptic plasticity (Nichol, 2006; Cotman et al., 2007). Furthermore, exercise provides a positive effect on brain areas that are disrupted in psychotic disorders, such as the prefrontal cortex (PFC), caudate, hippocampus, nucleus accumbens, parietal cortex, and anterior cingulate cortex. These areas are associated with memory processing, motor behaviour, cognitive control, and reward (Erickson et al., 2011; Colcombe et al., 2006; Erickson et al., 2014). Pajonk et al. (2010) show that exercise increases the hippocampal volume in people with a psychotic disorder and healthy controls. Physical activity is beneficial for mental and physical health as it reduces the risk of cardiometabolic diseases and reduces psychotic and depressive symptoms (Shahar & Hamdy, 2015; Vina et al, 2012).

The consequences of decreasing exercise

Deenik et al. (2018) argue that an unhealthy lifestyle can lead to cardiovascular diseases, diabetes, and COPD (Deenik et al., 2018). Vancampfort and his colleagues (2017) show in a meta-analysis that approximately 50 percent of people with a severe mental disorder such as schizophrenia and other related psychotic disorders, bipolar disorder and major depressive disorder do not exercise the recommended physical activity per week. This can cause Metabolic Syndrome (MetS) which is a combination of central obesity, high blood pressure, low high-density lipoprotein (HDL) cholesterol, elevated triglycerides and hyperglycaemia (Vancampfort et al., 2017). It is well known that physical activity improves overall health and has a positive impact on the body and mind. Ross and Thomas (2010) for

instance argue that exercising is beneficial for emotional and physical health. Physical activity can be defined as any bodily movement produced by skeleton muscles, which results in the expanding of energy. As such any planned, structured, aimed, and repetitive physical activity that improves or maintains physical fitness is defined as exercise (Caspersen et al., 1985).

People with psychotic disorders often take antipsychotic medication, and there is discussion on whether the use of this medication can be associated with the amount of physical exercise in people with psychotic disorders (Sylvia et al., 2013; Deenik et al., 2018). Sylvia et al. (2013) suggests in their study that there is an association between exercise, quality of life, and mood symptoms by comparing exercising and the use of an antipsychotic (quetiapine) and mood stabilizer (lithium) in people with a psychotic disorder.

The relationship of antipsychotic medication and exercise

Cotman et al. (2007) find that exercise activates molecular and cellular cascades, which supports and maintains the brain plasticity. Based on these findings, Gorczynski, & Faulkner (2010) suggest that exercise can be useful to control the complications of antipsychotic medications in people with schizophrenia and advise to use the correct dosage of exercise (combined with antipsychotic medication) for an effective treatment. For example, in an animal study with Wistar rats it is found that exercise improved akinesia from chronic treatment with haloperidol (Baptista et al., 2013). Antipsychotic medication is used to reduce the symptoms in schizophrenic patients; however, several studies show that health-related side-effects of the medications are an increasing problem for patients (Young et al., 2014). Currently, the focus in healthcare is more on using exercise as an add on treatment to treat symptoms and the side effects of antipsychotic medication. As previously discussed, antipsychotic medication has several side effects, and certain types of antipsychotic medication might influence physical exercise. For example, atypical antipsychotic medication such as clozapine and olanzapine can cause people to be less motivated and may lead to less exercise with metabolic complications and gain weight in result compared to other antipsychotic medication (Simon, van Winkel, & De Hert, 2009; Deenik et al., 2018).

Fiedorowicz et al., (2012), & Maayan et al., (2010) demonstrate the limited effect in preventing antipsychotic-induced weight gain with additional behavioral treatment, pharmacologic treatments or switching to other antipsychotic medication. However, Maagensen et al., (2021) finds that Liraglutide, a glucagon-like peptide-1 receptor agonist (GLP-1 receptor agonist) which is used to increase the insulin release and decreases the excessive glucagon release, improved cardiometabolic disturbances, weight gain and glucose tolerance in people with a psychotic disorder that were treated with clozapine and olanzapine. Non-pharmacological interventions such as exercise programs, dietary counseling and cognitive and behavioral strategies appear to have a positive effect on weight loss (Deenik et al., 2018). Additional weight loss medication has the highest efficacy, still there seems to be

no clear evidence of benefit in routine prescription of these medications (Merk et al., 2021). However, there are few studies looking at the relationship between the use of typical (first generation) or atypical (second generation) antipsychotic medication and the amount of exercise in people with a psychotic disorder (Vancampfort et al., 2021). The essence of this study is to increase the understanding of the relationship between the use of antipsychotic medication and exercise. It is essential to identify the relationship between antipsychotic medication and exercise in people with a psychotic disorder, as this information provides the opportunity to give insight into which antipsychotic medication can be prescribed in combination with exercise to treat people with a psychotic disorder. Based on the previously mentioned findings and theories on the relationship between exercise and medication in people with a psychotic disorder, this raises the following questions: (1) Do people with psychotic disorders that use atypical antipsychotic medication exercise less compared to those that use typical antipsychotic medication? And (2) Do people with psychotic disorders that use olanzapine and clozapine exercise less compared to those that use other type of antipsychotic medication?

Following this research questions, two hypotheses are formulated. First, people with psychotic disorders that use atypical antipsychotic medication such as risperidone (Risperdal), olanzapine (Zyprexa), and clozapine (Leponex) exercise less compared to people with psychotic disorders that use typical antipsychotic medication such as flupentixol (Fluanxol), and haloperidol (Haldol). This hypothesis is based on the findings of the previously mentioned studies (Simon, van Winkel, & De Hert, 2009; Deenik et al., 2018; Vancampfort et al., 2021) who found that the use of atypical antipsychotic medication is associated with more weight gain compared to typical antipsychotic medication. This weight gain may lead to psychological complaints and physical disease such as cardiometabolic diseases, diabetes and COPD and might be the main reason of the decrease in exercise amongst people with a psychotic disorder that use atypical antipsychotic medication.

Second, people with psychotic disorders that use olanzapine and clozapine exercise less compared to people with psychotic disorders that use other type of antipsychotic medication (e.g., flupentixol, quetiapine, haloperidol etc.). This hypothesis is based on the findings of Henderson et al., (2015), and Allison et al., (1999); Simon et al., (2009); Deenik et al., (2018) who found that the use of clozapine and olanzapine increasingly results into body weight gain, metabolic disturbance and the development of metabolic disorders compared to other antipsychotic medication. The body weight gain, metabolic disturbance and development of metabolic disorders makes it more likely that people with a psychotic disorder that use clozapine and olanzapine exercise less compared to those that use other antipsychotic medication.

Methods

Design

This study is part of the GROUP study: a longitudinal cohort study (the Genetic Risk and OUtcome of Psychosis (GROUP) study). The GROUP study is conducted by a committee of scientific leaders from schizophrenia research programmes in four different university departments of psychiatry in the Netherlands (Maastricht, Groningen, Amsterdam, and Utrecht). The aim of the GROUP study is to research the genetic and the non-genetic vulnerability and resilience factor in people with psychotic disorders, their family members and nonrelated controls. In the cohort study the following measurements have been performed: at baseline (T1) neuropsychological assessments and collection of urine samples to check for drug abuse. Further, two follow-ups were scheduled: the first one three years (T2) after the baseline measurement, and the second follow-up six years (T3) after the baseline (Simsons et al., 2018; Korver et al., 2012). In this study the variables ‘Medication’ and ‘Exercise’ will be used. The variable 'medication' consists of data from measurement moment 2 (T2) of people who use antipsychotic medication and will be used as the dependent variable. Further, for the variable ‘Exercise’, data of Social Functioning Scale (SFS) at measurement moment 2 (T2) will be used. The variable ‘exercise’ is the dependent variable. The variable 'exercise' data will consist of 4 items from the SFS that measure physical activity. These four items are 'playing indoor sports', 'playing outdoor sports', 'swimming', and 'walking'.

Participants

The inclusion criteria of the study are: 1) an age between 16 to 50 years 2) participants had to be diagnosed with a non-affective psychotic disorder, according to the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (DSM-IV) criteria and needed to have their first mental health care contact for psychotic symptoms no longer than ten years ago 3) participants disposed a fluency in understanding and speaking the Dutch language. The history and current use of prescribed antipsychotic medication were all registered (Korver et al., 2012).

The participants in this study are people with a psychotic disorder. The data has been collected from patients in 36 mental health care institutions measured in four academic medical centres: Utrecht, Maastricht, Amsterdam, and Groningen. The participants used a variety of medication: antipsychotic medication, mood stabilizers, antidepressants, anti-Parkinson, anti-epilepsy, benzodiazepines, and other medications. The focus of this study is mainly on antipsychotic medication. In GROUP study 3171 people with psychotic disorders from different regions in the Netherlands and Belgium participated. From these 3171 participants, 1686 used antipsychotic medication.

Measures

For this study, people with a psychotic disorder are divided into two groups based on what type of antipsychotic medication is used, namely: typical antipsychotic medication (group 1) and atypical antipsychotic medication (group 2). The typical antipsychotics used in are haloperidol (Haldol), flupentixol (Fluanxol), penfluridol (Semap), pimozide (Orap), zuclopentixol (Cisordinol), amisulpride, broomperidol, perfenazine, and sulpiride. The atypical antipsychotics are risperidone (Risperdal), olanzapine (Zyprexa), quetiapine (Seroquel), clozapine (Leponex), aripiprazol (Abilify), and paliperidon. For the second hypothesis the data is divided into two groups, namely clozapine and olanzapine (group 1), and all the other antipsychotic medication (group 2).

The Social Functioning Scale (SFS) is a self-rating scale used to measure social functioning, the SFS contains seven subscales: social engagement/withdrawal, interpersonal behaviour, independence-competence, independence-performance, recreation, pro-social behaviour and employment. As early mentioned, the variable 'exercise' will be computed using the physical activities' playing indoor sports', 'playing outdoor sports', 'swimming', and 'walking' from the measured SFS. A four-point Likert-type scale is used to rate the social functioning compliance with a range of 'never' to 'often', 'never' will be expressed with the number '1' and 'often' with number' 4'. The average score of the four variables will be the outcome measure, a higher outcome indicates more physical exercise.

Procedure

Informed consent is given prior to the assessments and self-report questionnaires are checked for data missing (Korver et al., 2012). In this study a total of 523 people of the 1686 participants are used for the reason that they have been assessed at measurement moment 2 (T2) and filled in the Social Functioning Scale (SFS) at T2. Neuropsychological test battery was first performed on the participants to ensure they were entirely concentrated and focused. Order-effects are not ruled out. In addition, to maximize the participants' chances to perform in their best condition, it was necessary to start with the neuropsychological test battery. Only trained researchers administered the neuropsychological test battery. Further, urine screening was performed to exclude the influence of recreative drug use and an assessment for the PANSS interview was performed. In the second assessment meeting, it is essential to administer the diagnostic tool primary, followed by other questionnaires and finished with the physical examinations. There are overlapping items in some questionnaires and have for that reason been consecutively administered to avoid repetition (Korver et al., 2012).

Ethics

The Ethical Review Board has approved the protocol of the GROUP study of the University Medical Centre Utrecht. It has been subsequently approved by the local review committees of the participating institutions and is conducted according to the 1975 Helsinki Declaration (revised in 2008). After obtaining all the oral and written information about the study, the written informed consent of all participants has been obtained before starting the assessments. For participants aged 16-17, a written informed consent filled in by their parents or guardians was also obtained. A unique research identification (ID) is used for each participant to maintain the data confidentially. To protect the privacy of the participants and to remain anonymous, the ID numbers did not contain any information regarding the name of the participants or information that could lead to the identification of the participants. Each local centre securely stores the personal data associated with the ID (Korver et al., 2012).

Statistical analyses

IBM SPSS Statistics 25 is used to perform the statistical analyses. To compare exercise levels between people with psychotic disorders using either typical or atypical antipsychotic medication, a t-test is performed. 'Exercise' is used as a continuous outcome measure, and typical and atypical antipsychotic medications are used as comparison groups. Prior to the analysis, two assumptions are used to check for the scale of measurement (e.g., nominal, or ordinal scale) and simple random sample. For the analysis in SPSS, three assumptions are used to check for normal distribution, large sample size, and variance homogeneity. Furthermore, the exact same analysis is performed to examine whether exercise level differs significantly between people with psychotic disorders using clozapine or olanzapine and those using any other antipsychotic medication. In this analysis, only the comparison groups were changed, where group 1 consisted clozapine and olanzapine and group 2 consisted of the other antipsychotic medication used in the current study. The two hypotheses are significant if the p-values are below 0.05.

Results

For the first hypothesis, 523 participants are divided into two groups based on the type of antipsychotic medication used. Group 1 consists of 69 participants using typical antipsychotic medication. Group 2 consists of 454 participants using atypical antipsychotic medication. For the second hypothesis, group 1 consisted of 241 participants using clozapine or olanzapine and group 2 consisted of 282 participants that use other antipsychotics. From the 523 people with a psychotic disorder, 403 of the participants are male (77.1%), and 120 are female (22.9%), with a mean age of 30.75 (range= 18-56).

The results of the analysis of the first hypothesis (table 1) show an insignificant difference between the two groups implying that people with psychotic disorders using typical antipsychotics do not exercise more compared to people with psychotic disorders using atypical antipsychotics. The Levene's Test for Equality of Variances shows that equal variances are not assumed (F=1.055, p=0.305). The result of the independent samples t-test indicate that scores are not significantly higher for the group using typical antipsychotics (table 1). As such, the hypothesis that people with psychotic disorders using atypical antipsychotic medication exercise less compared to people with psychotic disorders using typical antipsychotic medication is rejected (H1).

Table 1: Descriptives and *t*-test results comparing the use of atypical (group 1) and typical antipsychotic medication (group 2) on the amount of exercise

	Typical antipsychotics (n = 69)	**Atypical antipsychotics (n = 454)**	**Test statistic**	**p-value**	**Effect size**
Exercise M (SD)	1.086 (0.709)	1.065 (0.668)	t(df) = 0.232 (521)	0.808	d= 0.030
Age M (SD)	30.75 (7.119)	30.75 (7.119)			
Sex			χ^2 (df) = 4.852	0.023	
n males	46	357	(1)		
n females	23	97			

The second hypothesis is performed to see if people with psychotic disorders using clozapine and olanzapine (group 1) exercise less compared to people with psychotic disorders using other type of antipsychotic medication (group 2). The results of the second hypotheses (table 2) show an insignificant difference between the two groups which means that people with a psychotic disorder using clozapine and olanzapine do not exercise more compared to people with a psychotic disorder using other types of antipsychotics. The Levene's Test for Equality of Variances display that equal variance are not assumed (F=0.004, *p*=0.951), so the degrees of freedom were not adjusted. The independent samples t-test indicates that scores are significantly lower for the group using other types of antipsychotics. These results suggest that there is no relationship between the use of a certain type of antipsychotic medication and the amount of exercise that people with a psychotic disorder perform. Thus, the hypothesis that people with a psychotic disorder that use clozapine and olanzapine exercise less compared to people with a psychotic disorder that use other type of antipsychotic medication is rejected (H2).

Table 2: Descriptives and t-test results comparing the use of clozapine and olanzapine (group 1) to other type of antipsychotic medication (group 2) on the amount of exercise

	Clozapine and olanzapine (n = 241)	**Other antipsychotic medication (n = 282)**	**Test statistic**	**p-value**	**Effect size**
Exercise M (SD)	1.075 (0.676)	1.061 (0.672)	t(df) = 0.239 (521)	p = 0.811	d= 0.021
Age					
M (SD)	30.75 (7.119)	30.75 (7.119)			
Sex			χ^2 (df) =	p = 0.260	
n males	200	203	1.268 (1)		
n females	41	79			

Discussion

The relationship between exercise and antipsychotic medication in people with a psychotic disorder has been investigated. The aim was to increase the understanding of the association between the amount of exercise and the use of certain antipsychotic medication in people with a psychotic disorder. The research objectives of this study have been to examine whether people with a psychotic disorder that use atypical antipsychotic medication such as risperidone, olanzapine, and clozapine exercise less compared to people with a psychotic disorder that use typical antipsychotic medication such as flupentixol, and haloperidol and to examine whether people with a psychotic disorder that use clozapine and olanzapine exercise less compared to people with psychotic disorders that use other type of antipsychotic medication. The results of this study show that there are no significant differences in exercise between typical and atypical antipsychotic medication users, nor between clozapine/olanzapine users and other psychotic medication users.

No association is found between the use of antipsychotic medication and the amount of exercise in people with a psychotic disorder. First, no difference is found in exercise in people with a psychotic disorder who use typical antipsychotic medication compared to the people with a psychotic disorder who use atypical antipsychotic medication. This is not in line with the literature of Deenik et al., (2018) which looked in their study at lifestyle enhancement in people with a severe mental illness (SMI) by studying medication use, including antipsychotic medication (typical and atypical antipsychotic medication), and exercising and suggested that there is an association between antipsychotic medication use and exercising. Their study compared medication use in people with SMI between multidisciplinary lifestyle enhancing treatment (MULTI) where the focus was increasing physical activity and treatment as usual (TAU) which the focus was on pharmacological treatment. They found a significant reduction in the dose of atypical antipsychotic medication in both MULTI and TAU, and a decrease in the dose of typical antipsychotic medication in MULTI, in contrast to TAU. In addition, studies from Simon, van Winkel, & De Hert (2009); Vancampfort et al. (2021) show that the use of atypical antipsychotic medication is associated with more weight gain compared to typical antipsychotic medication. This weight gain may lead to psychological complaints and physical disease such as cardiometabolic diseases, diabetes, and COPD and might be the main reason of the decrease in exercise amongst people with a psychotic disorder that use atypical antipsychotic medication (Simon, van Winkel, & De Hert, 2009; Deenik et al., 2018; Vancampfort et al., 2021). Taken together, these findings are inconsistent with the findings of this study. The reason this study deviates from the findings of other studies might possibly be caused by the difference in study method employed. For example, Deenik and colleagues (2018) categorize antipsychotic medication into three groups: typical antipsychotics, atypical antipsychotics, and lithium. In addition,

they use two compare groups: a group where the focus was physical activity (MULTI) as treatment and the other groups focus was pharmacological treatment (TAU). Contrary to the current study, where antipsychotic medication is categorized into two groups: typical antipsychotics, and atypical antipsychotics. For the measure exercise a measurement outcome of physical activity is used to compare the two groups. However, it could simply be the case that there is no relation between antipsychotic medication (typical and atypical antipsychotic medication) and exercise in people with psychotic disorder.

Furthermore, no difference was found as well in exercise in people with a psychotic disorder that use olanzapine and clozapine compared to the people with a psychotic disorder that use other type of antipsychotic medication. This result is consistent with prior findings of Merk et al. (2021) that indicated that there is no evidence of an association between clozapine/olanzapine and exercising. Hypothetically, this result can be explained by the study of Fiedorowicz et al. (2012) & Maayan et al. (2010) that sbows that is a limited effect on preventing antipsychotic-induced weight gain with additional behavioral treatment such as exercising. This implies that the limited effect of preventing antipsychotic-induced weight gain by exercise can simply be explained by the claim that there is no relationship between these two variables. It might also be explained by the idea that the people with a psychotic disorder that use olanzapine, and clozapine in the current study, which already exercise, already treated their complaints about (cardio)metabolic disturbances and body weight gain with exercising. In addition, Maagensen et al. (2021) explain in their study that people with a psychotic disorder that were treated with clozapine and olanzapine improved in cardiometabolic disturbances, weight gain and glucose tolerance by using Liraglutide. Liraglutide is a glucagon-like peptide-1 receptor agonist (GLP-1 receptor agonist) which is used to increase the insulin release and decreases the excessive glucagon release. It might be the case that the people with a psychotic disorder in the current study were also treated with Liraglutide which was not measured nor controlled for. Furthermore, according to Hálfdánarson et al. (2017), olanzapine is one of the most prescribed antipsychotic medication in the Netherlands which is also the case in the data of the current study. Most people in this study were treated with olanzapine or clozapine (n=241). These findings support the findings of Skonieczna-Żydecka et al. (2019) that explain in their meta-analysis that clozapine and olanzapine are the most prescribed and effective antipsychotic medication to treat the symptoms of people with a psychotic disorder.

However, this study also contains some limitations. For instance, only one measurement instrument for exercise was available (SFS) and no International Physical Activity Questionnaire (IPAQ) was taken. IPAQ is a questionnaire that estimates the physical activity level of people. In addition, not every measurement moment had the SFS and therefore no measure was of exercise was available on the other measurement moments.

Furthermore, the use of activity tracker devices such as wearable activity trackers (WAT) (e.g., Fitbit, Xiaomi, Garmin, Samsung Gear Fit), pedometers, and wearable tracking applications (e.g., Apple ihealth app) could present more reliable results. These activity tracker devices measure physical activity and are electronic monitoring devices that enable users to track and monitor their health-related physical fitness metrics, including steps taken, activity level, walking distance, heart rate, and sleep patterns.

This research has shown that there is no association in certain antipsychotic medication use and physical exercise in people with a psychotic disorder. The results of this study demonstrate that people with a psychotic disorder that use atypical antipsychotic medication do not exercise less compared to people with a psychotic disorder that use typical antipsychotic medication. In addition, the results also show that people with a psychotic disorder that consume the antipsychotic medication olanzapine and clozapine do not differ in exercising compared to the people with a psychotic disorder that use other antipsychotic medication. These findings concern the relationship between exercising and the use of certain type of antipsychotic medication in people with a psychotic disorder. Larsen and colleagues (2017) show in their study that people with a psychotic disorder have a low life expectancy mainly due to antipsychotic medication use and probably due to their less amount of exercising. However, more research is needed to research the association of certain antipsychotic medication use and exercising in people with a psychotic disorder.

For future studies, a different method can be used to assess whether the findings remain equal. It would for example be possible to focus more on differences in the amount of exercising and the effects of antipsychotic medication in people with a psychotic disorder which would be a baseline study using exercise and a healthy lifestyle as treatment. Another possibility can be to use other measurement instruments for exercise, such as: IPAQ, WAT (e.g., Fitbit, Xiaomi, Garmin, Samsung Gear Fit), pedometers, and wearable tracking applications (e.g., Apple ihealth app) to directly measure the amount of exercise of participants, instead of using only a Social Functioning Scale (SFS). These instruments can possibly give more accurate and reliable measures of exercise. Finally, it would also be an interesting follow-up study on the early mentioned studies (Erickson et al., 2011; Colcombe et al., 2006; Erickson et al., 2014; Pajonk et al., 2010), which shows that exercise can improve the function of certain brain areas that are affected by a psychotic disorder such areas as the frontal cortex, the caudate nucleus accumbens, and the parietal cortex, to research the difference in brain volume between people with a psychotic disorder that exercise and those that do not that are treated with a certain antipsychotic medication. This future follow-up study can provide a good view on the effect of exercising and the use of antipsychotic medication on the brain volume in people with a psychotic disorder. These studies provide an opportunity to identify which antipsychotic medication is most appropriate to treat people

with a psychotic disorder and which additional interventions (e.g., exercise, and lifestyle) can be introduced to improve the treatment and quality of life of people with a psychotic disorder. Based on the findings of this research, it is recommended in clinical practices to offer an exercise program with the correct antipsychotic medication dosage as treatment to people with psychotic disorder.

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