University of Porto
Faculty of Sport
Research Center in Physical Activity, Health and Leisure

Physical activity, lifestyle-related factors and psychological determinants among patients with schizophrenia

Academic dissertation was submitted in order to achieve the PhD degree included in the doctoral course of Physical Activity and Health designed by the Research Center in Physical Activity, Health and Leisure, Faculty of Sport, University of Porto, according to the Law 74/2006 from March 24th.

The present academic dissertation was also submitted in order to obtaining the European Doctorate Title, approved by the Confederation of the Councils of European Rectors. Approved by Deliberation n.º 1289/2004, of 11 October 2004. Last amended by the order GR.08/01/2014, of 30 January 2014.

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Porto, 2017

Costa, R. (2017). Physical activity, lifestyle-related factors and psychological determinants among patients with schizophrenia. Doctoral dissertation presented in order to achieve the PhD degree in Physical Activity and Health, Faculty of Sport, University of Porto, and to obtaining the European Doctorate Title.

KEYWORDS: PHYSICAL ACTIVITY, SLEEP QUALITY, DIETARY PATTERNS, MOTIVATION, QUALITY OF LIFE, SCHIZOPHRENIA

Success appears when give up is not an option,

when goals are so strong that obstacles failure and when loss only act as motivation.

Dedicated to the most important persons

that have consistently walked alongside me during this journey.

Acknowledgments

The conclusion of my dissertation and subsequent PhD has been a long and challenging journey. Was four years of hard work, commitment, dedication, determination and also capability and strength to overcome barriers. In this work I leave part of me. Fortunately, there have been many people who have walked alongside me during this journey. They have placed opportunities and challenges but also supported, encouraged and guided me. Therefore, many people have to be acknowledged for their invaluable help through this ward journey.

First, my supervisors Professor **Rui Corredeira** and Professor **Tânia Bastos** for them unconditional assistance, advise, help, enthusiasm and support throughout my PhD. In addition, thank you very much for your friendship, for challenged me, believed in my abilities and opened the doors of your department. I will be eternally grateful for all the opportunities that you both provided me in APA field since my graduation. I hope to be always capable to correspond to the expectations and trust that you both deposited on me. My gratitude is also extended to my supervisor Professor **Michel Probst**, I have no words to thank you for your willingness to be part of my doctoral committee. Thank you very much for your insightful and knowledgeable comments as well as your guidance throughout this journey. To meet you in person was a special concretization. It was amazing to realize that behind such a big name was an incredibly humble person. For me, and for all researchers in mental health field, you are an inspiration and a truly example of competence, dedication and kindness. Thank you for provided me the opportunity to do an internship in Leuven, and for the unforgettable experience in the University Psychiatric Center of Kortenberg. The time spent in Leuven provided me much more than just research skills, definitively influence (as you know) my personal values.

I would also like to show my gratitude to others professors and researchers for their collaboration and invaluable help through this journey. To Professor **André Seabra** thank you for your help, support, dedication and promptness in all moments of this work (even when you were almost without time to breath). To Professor **Estela Vilhena** thank you for your help and professional view, but also, thank you for your kindness and friendly words. To **Sandra Abreu**, thank you for your scientific guidance, support and growing friendship. I am grateful for all your contributions of time and ideas, definitively were crucial in this work. To my Australian professors and friends, thank you Professor **Philip B. Ward** for your excellent professional expertise and scientific guidance. You opened the doors of the School of Psychiatry – Faculty of Medicine, University of New South

Wales, allowing me to expand my knowledge and professional experience. Your competence, modesty and integrity are really inspiring for me. I would also like to show my gratitude to **Simon Rosenbaum**, your critical spirit, vast scientific knowledge and work capacity were encouraging me. Thank you for hosting me in Black Dog Institute, I enjoyed every moment that I spent there. I express my warm gratitude to **Scott Teasdale**, I really appreciate your enthusiasm and availability to help me and to share your knowledge. Thank you for your important contribution for this thesis. To you three I am eternally thankful for your friendship and for what you have done for me and for this work. I hope that someday I can return to you three the precious help that you provided me. Finally, thank you to all professors of CIAFEL, especially to Professor **José Oliveira** and Professor **Jorge Mota**, for all support and positive reinforcements during the PhD course.

A word of gratitude for all the collaborating psychiatrists, therapists, nurses and physical activity teachers who generously contributed to this research, and without them the development of this dissertation would not have been possible. I wish to express my gratitude to the following participating centres: (1) **Associação Nova Aurora de Reabilitação Psicossocial (ANARP)**, Porto, Portugal; (2) **Psychiatric Department of Hospital São João**, Porto, Portugal; (3) **Casa de Saúde São José**, Barcelos, Portugal; (4) **Casa de Saúde São João de Deus**, Barcelos, Portugal; (5) **Casa de Saúde do Bom Jesus**, Braga, Portugal; (6) **Clinica do Outeiro**, Vila do Conde, Portugal; (7) **Associação dos Familiares, Utentes e Amigos do Hospital Magalhães Lemos**, Matosinhos, Portugal.

A special thanks to the participants of the studies, for contributing not only for my academic and professional career but also for my personal values. Thank you for allow me learn with you, and for transform me in a better person. I am sincerely grateful to have worked with you.

I would also like to show my gratitude to the master students who collaborated and helped me in data collection, **João Cordeiro**, **Ângela Vieira**, **Cristiana Branco**, **Jessica Cabral** e **Gabrielle Engleitner**. A special thanks to **Sandra Roque**, **Paulo Lourenço** and **Sara Carvalho**, I am grateful for your friendship, conversations, long trips and your promptness in providing any support.

Thank you to all my friends and colleagues (inside and outside the university, and also inside and outside Portugal), for your support and friendship during this journey. A special word to **Ana Sousa** for your kindness and confidence. Thank you for the opportunities that you provided me beyond the borders of my doctorate. It is extremely

pleasant and enjoyable work with you. A special acknowledgement to my dear friend **Eluana Gomes**, a partner for all occasions, regardless the distance. You have really helped me push forward, also with the encouragement needed through the hard times. Thank you so much, and I am looking forward to continue work with you in mental health field.

And finally, to my family…

Um caloroso e enorme obrigada à minha família e ao Bernardo, aos quais dedico todo este percurso. Uma grande dívida de gratidão deve ser paga a eles, os meus maiores apoiantes. Pessoas a quem, independentemente do meu humor e da minha ausência nunca pararam, por um segundo, de me apoiar e de demonstrar o quanto gostam e se preocupam comigo. Pessoas sem as quais jamais concluiria este percurso.

Aos meus **Pais**, a quem devo tudo o que sou e tudo o que consegui. Obrigada pelo vosso apoio e amor incondicional. Obrigada pelas palavras de encorajamento, por estarem sempre ao meu lado e por apoiarem as minhas decisões. Obrigada pelos valores que me incutiram, e que representam aquilo que vocês são e que eu sou. Vocês são os pilares do meu sucesso pessoal, académico e profissional.

Ao meu irmão **Ricardo**, à **Ana** e aos meus maravilhosos sobrinhos **Matilde** e **Guilherme**, obrigada por terem percorrido comigo mais uma etapa tão importante da minha vida. Obrigada por terem contribuído com união, amizade, carinho e alegria.

À **Cândida**, **Bernardo Manuel** e **Catarina**, obrigada pelo vosso apoio, preocupação e encorajamento. Obrigada sobretudo pelo amizade e carinho, e por me acolherem tão bem na vossa família.

Ao **Bernardo**, meu amigo, meu companheiro e confidente, a quem devo igualmente o meu sucesso. Esta tese é também tua, obrigada por todo o amor, carinho, amizade, compreensão, paciência e incentivos constantes. Obrigada por percorreres este longo e difícil caminho ao meu lado, sem nunca me deixares cair nem desistir. Desculpa por todos os momentos em que não pude estar presente, e obrigada pela imensa dedicação a mim, a nós e ao nosso futuro.

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Abstract

Approximately 75% of all deaths in patients with schizophrenia are caused by physical illness. Cardiovascular disease is the commonest cause of death. Unhealthy lifestyle choices, such as lack of physical activity (PA), poor sleep quality, unhealthy diets and tobacco smoking as well as psychological determinants (i.e., low autonomous motivation and self-esteem) contribute to this excessive morbidity and mortality. In addition, the overlapping of lifestyle-related factors and psychological determinants and with additional factors (e.g., psychiatric medication), affects the quality of life (QoL) of this population. In the last decade, the relevance of healthy lifestyle behaviours in patients with schizophrenia has been reported. However there are still several research gaps that need to be clarified. Specifically, in the Portuguese reality, research focusing in this population is almost non-existent. Therefore, the main purpose of this doctoral thesis was to explore lifestyle-related factors and psychological determinants, and to analyse the impact of these in QoL in patients with schizophrenia. This doctoral thesis included six studies that aimed to: i) examine the construct validity of the Portuguese version of the Behavioural Regulation in Exercise Questionnaire – 2 (BREQ-2) as well as the Portuguese version of the BREQ–3; ii) investigate among a number of barriers what predicts the most on PA; iii) assess the associations between PA levels and sleep quality; iv) compare the sleep quality and QoL between regular physical active and the non-physical active patients with schizophrenia; v) assess the dietary intake and adherence to Mediterranean Diet, specifically analysing the difference between treatment setting (i.e., inpatients and outpatients); and vi) explore the association between lifestyle-related factors, psychological determinants and QoL. In order to accomplish these aims, 118 patients with schizophrenia (25% women and 50% inpatients) were included. Standardized assessment tools (i.e., questionnaires and field test) were applied to evaluate lifestyle-related factors, psychological determinants and QoL. Results of the studies showed that: i) the Portuguese version of the BREQ–3 revealed to be an appropriate measure to assess controlled and autonomous motivation towards PA; ii) autonomous motivation and global domain of QoL was found to be the most significant predictors of PA; iii) sleep quality was positively associated with time of moderate and total PA per week; iv) patients of regular physical active group have better sleep quality and QoL; v) patients reported a high consumption of caffeine, while deficits were evident for fibre and folate intakes. Outpatients showed a significant higher consumption of meat and meat products, and fruits and nuts, compared with inpatients; and vi) PA behaviours and self-esteem predicted better QoL across all domains of QoL. This doctoral thesis provided new and relevant evidence regarding lifestyle-related factors and psychological

determinants in patients with schizophrenia. Several practical considerations could be highlighted in order to influence interventions integrated in patient's treatment.

KEYWORDS: PHYSICAL ACTIVITY, SLEEP QUALITY, DIETARY PATTERNS, MOTIVATION, QUALITY OF LIFE, SCHIZOPHRENIA

Resumo

Em pacientes com esquizofrenia, 75% da mortalidade é causada por comborbidades físicas. A doença cardiovascular é a causa de morte mais comum. Estilos de vida não saudáveis, como a falta de atividade física (AF), má qualidade de sono, hábitos alimentares inadequados, hábitos tabágicos bem como determinantes psicológicas (i.e., baixa motivação autónoma e autoestima), contribuem para este excesso de comorbidades e mortalidade. Em acréscimo, a sobreposição de estilos de vida e determinantes psicológicas, bem como com fatores adicionais (e.g., medicação psiquiátrica), afetam a qualidade de vida (QV) desta população. Na última década, tem sido reportada a importância da adoção de estilo de vida saudável em pacientes com esquizofrenia. Contudo existem ainda diversas lacunas na investigação que necessitam ser esclarecidas. Especificamente na realidade Portuguesa, investigação focada nesta população é praticamente inexistente. Neste sentido, o objetivo geral da presente dissertação foi explorar os fatores de estilos de vida e determinantes psicológicas, bem como analisar o impacto destes fatores na QV de pacientes com esquizofrenia. A presente dissertação inclui seis estudos originais que pretenderam: i) examinar a validade de constructo da versão Portuguesa do Behavioural Regulation in Exercise Questionnaire – 2 (BREQ-2), bem como da versão Portuguesa do BREQ–3; ii) identificar os fatores que são reconhecidos como barreiras para a AF; iii) avaliar a associação entre níveis de AF e qualidade de sono; iv) comparar a qualidade de sono e a QV entre pacientes fisicamente ativos e pacientes não fisicamente ativos; v) avaliar o consumo alimentar e a adesão à Dieta Mediterrânica, especificamente analisando as diferenças entre situação de tratamento (i.e., pacientes em situação de internamento versus pacientes residentes na comunidade); e vi) explorar a associação entre estilos de vida, determinantes psicológicas e QV. De forma a corresponder aos objetivos propostos, 118 pacientes com esquizofrenia (25% sexo feminino e 50% pacientes em situação de internamento) foram incluídos. Instrumentos de avaliação (i.e., questionários e teste de terreno) foram aplicados para avaliar os estilos de vida, determinantes psicológicas e a QV. Os resultados dos estudos demonstraram que: i) a versão Portuguesa do BREQ–3 demonstra ser uma medida apropriada para avaliar a motivação controlada e autónoma para a AF; ii) motivação autónoma e domínio global da QV foram identificados como os preditores mais significantes da AF; iii) qualidade de sono está positivamente associada com o tempo de AF moderada e AF total por semana; iv) pacientes que praticam AF regular revelam melhor qualidade de sono e QV comparativamente com pacientes que não praticam AF regularmente; v) pacientes reportaram elevado consumo cafeina, e apresentaram défices no consumo de fibra e folato. Pacientes residentes na

comunidade reportaram maior consumo de carne e produtos derivados, bem como de frutas e frutos secos, comparativamente com pacientes em situação de internamento; e vi) AF e autoestima são preditores de melhor QV em todos os domínios da QV. A presente dissertação demonstra nova e relevante evidência acerca dos estilos de vida e determinantes psicológicas em pacientes com esquizofrenia. Diversas implicações práticas podem ser evidenciadas no sentido de influenciar as intervenções integradas no tratamento de cada paciente.

PALAVRAS-CHAVE: ATIVIDADE FÍSICA, QUALIDADE DE SONO, HÁBITOS ALIMENTARES, MOTIVAÇÃO, QUALIDADE DE VIDA, ESQUIZOFRENIA

List of abbreviations

AI	Adequate intake
AP	Antipsychotic
BMR	Basal metabolic rate
BMI	Body mass index
BREQ	Behavioural Regulation in Exercise Questionnaire
CEFADE	Ethical committee Faculty of Sport
CFA	Confirmatory factor analysis
CFI	Comparative fit index
CI	Confidence interval
CIAFEL	Research Centre on Physical Activity Health and Leisure
DSM	Diagnostic and Statistical Manual of Mental Disorders
EER	Estimated energy requirement
EEI	Estimated energy intake
EFA	Exploratory factor analysis
e.g.	For example
EI	Energy intake
EQS	Structural Equation Modelling Software
FFQ	Food frequency questionnaire
kg/m^2	Kilograms divided by the square of the height in meters
ICC	Intraclass correlation coefficient
i.e	Meaning
IPAQ-SF	International Physical Activity Questionnaire – Short form
M	Mean
MDS	Mediterranean diet score

mg	Milligram
mg/day	Milligram per day
min	Minutes
min/ day	Minutes per day
min/ week	Minutes per week
MLE	Maximum likelihood estimation
MVPA	Moderate to vigorous physical activity
N	Number of subjects
PA	Physical activity
PSQI	Pittsburgh Sleep Quality Index
QoL	Quality of life
RI	Reference intake
RMSEA	Root mean square error of approximation
SBχ^2	Satorra-Bentler scaled statistic
SD	Standard deviation
SDT	Self-determination theory
SPSS	Statistical Package for the Social Sciences
SRMR	Standardized root mean square residual
WHOQOL-BREF	World Health Organization Quality of Life Scale – Brief version
6MWT	Six-minute walk test
α	Cronbach's alpha
h^2	Communality
η^2	Eta-squared
♀	Women

General introduction

General introduction

Schizophrenia: the clinical expression of the disorder

Schizophrenia is a severe mental disorder, which affects a person's global functioning and causes changes in almost all mental functions. It is characterized by a wide spectrum of signs and symptoms, which include delusions and hallucinations, distortions of thinking and perception, cognitive impairments, psychomotor abnormalities, difficulties in communication, restricted affective expression and loss of motivation and initiative (American Psychiatric Association, 2013; Carpenter & Tandon, 2013; Kahn et al., 2015; Tandon, Nasrallah, & Keshavan, 2009).

Symptoms of schizophrenia are generally classified into positive, negative, cognitive, mood and psychomotor symptom dimensions, with psychopathology differentially expressed across patients and through the course of the disorder (Kahn et al., 2015; Tandon et al., 2009). Positive symptoms consist of psychotic symptoms, involve impaired reality testing and include hallucinations, delusions, disorganized speech and behaviour (Kahn et al., 2015; Tandon et al., 2013; Tandon et al., 2009). Negative symptoms are associated with disruptions to normal emotions and behaviours. These include impairments in affective experience and expression, poverty of speech, reduced social drive, lack of motivation, initiative and interest (Heiden, Leber, & Hafner, 2016; Kahn et al., 2015; Tandon et al., 2013; Tandon et al., 2009). Cognitive symptoms comprise deficits in working memory, processing speed, attention and in executive functions (i.e., ability to organize and abstract) (Carpenter & Tandon, 2013; Tandon et al., 2013). Mood symptoms are characterized by depression and mania that occur in different stages of the disorder (Carpenter & Tandon, 2013; Tandon et al., 2013). Finally, psychomotor symptoms are frequently manifest in patients with schizophrenia. For one hand, slowing of psychomotor activity is associated with negative and depressive symptom clusters,

and portends a poor outcome (Bervoets et al., 2014; Morrens, Hulstijn, & Sabbe, 2007). For another hand, excessive motor activity is more often associated with exacerbations of positive symptoms. Disturbances of psychomotor activity can range from complex motion patterns such as catatonic states (Bervoets et al., 2014; Carpenter & Tandon, 2013), to simple isolated movements in posture, mannerisms and stereotypes (Morrens, Hulstijn, Lewi, De Hert, & Sabbe, 2006).

In schizophrenia, the severity of different symptom clusters varies across patients and through the course of the disorder (Kahn et al., 2015; Tandon et al., 2009). The disorder is characterized by a sequential trajectory that involves different phases. A *premorbid phase* where patients exhibit a range of developmental behavioural, emotional and cognitive problems (e.g., delays in motor development, attentional dysfunction, deficits in receptive language and emotional detachment), accompanied by premorbid impairments in academic and social function (Schenkel & Silverstein, 2004). A *prodromal phase* characterized by attenuated positive symptoms or basic symptoms and declining function (Schultze-Lutter, 2009). This phase could last from months to years, with a mean of approximately five years (Klosterkotter, Schultze-Lutter, & Ruhrmann, 2008). The development of psychotic symptoms marks the formal onset of the *first psychotic episode* of schizophrenia. This onset typically occurs between 20 and 24 years of age (Kirkbride et al., 2006), specifically between 18-25 years for men and 25 and the mid-30s for women (American Psychiatric Association, 2000). Approximately, one third of individuals develop this disorder before the age of 18 years (Madaan, Dvir, & Wilson, 2008). The initial decade of disorder is marked by repeated episodes of psychosis with partial and variable degrees and duration of inter-episode remission with accrual of disability with each episode of disorder (McGlashan & Fenton, 1993). Episodes of psychosis can be triggered by stress, non-adherence to treatment or substance abuse (Tandon et al., 2009). Finally, a *stable phase*, when psychotic symptoms are less prominent and

negative symptoms and the stable cognitive deficits increasingly predominant (Tandon et al., 2009).

Schizophrenia is considered one of the most debilitating psychiatric disorders (Rossler, Salize, van Os, & Riecher-Rossler, 2005), estimated to affect more than 21 million people worldwide (World Health Organization, 2016). Due to its seriousness, it is one of the mental disorders which leads to most disability, and is amongst the top 20 health causes of serious disability worldwide, both in developed and developing nations (World Health Organization, 2008). Schizophrenia is more common among males (12 million), than females (9 million) (World Health Organization, 2016).

In Portugal, the prevalence of schizophrenia is estimated between 0.5% and 1% of the population and it is one of the most disabling disorders for productive activities (Direção-Geral da Saúde, 2013; Silva, Negreiro, Silva, & Vicente, 2013). The disorder is also more common in males (65.1%) and in the 35-64 age group (60.3%) (Silva et al., 2013). The psychiatric census of 2001 showed that schizophrenia was the most frequent pathology with 3917 patients (26.43%). This disorder was also the main cause for care (36,5%) at health care institutions, divided into hospitalization (66.9%), consultations (30.5%) and emergency episodes (2.7%) (Silva et al., 2013). The study of Simões do Couto et al. (2011), in 478 Portuguese patients with schizophrenia revealed the following characteristics, an average age of 43 years, single (73.5%), living in a family environment (i.e., outpatients) (70%), and unemployed (85%). In addition, 22.5% of the patients lived permanently in psychiatric hospitals (i.e., inpatients). Regarding clinical characteristics, the most frequent diagnosis was paranoid schizophrenia (54%), of moderate severity (39.7%) and with a duration of more than 5 years.

In schizophrenia, comprehensive treatment entails a multi-modal approach, including pharmacological treatment and psychosocial interventions. The broad aims of treatment are to reduce the mortality and morbidity of the disorder by decreasing the frequency

and severity of psychotic episodes and improving the functional capacity and quality of life of the patients (Tandon, Nasrallah, & Keshavan, 2010). Regarding antipsychotic medications, is essential for the pharmacological treatment of schizophrenia. It is recognized that medication is effective in reducing overall symptoms and risk of relapse with primary efficacy mainly against positive and disorganization symptom domains (Leucht, Arbter, Engel, Kissling, & Davis, 2009). Over 60 antipsychotic medications have been developed and are classified into the first- and second-generation agents. The first-generation antipsychotics (e.g., chlorpromazine, fluphenazine, haloperidol) were developed in the 1950s. These medications has been hindered by intolerability, particularly extrapyramidal symptoms (e.g., akathisia, Parkinsonism, dystonia, dyskinesia), which are risk factors for reduced adherence and persistence to medications (Pierre, 2005; Warikoo, Chakrabarti, & Grover, 2014). In addition, first-generation antipsychotics medications showed to be minimally effective against negative and cognitive symptom domains which contribute to the disorder related disability (Tandon et al., 2009).

The second-generation antipsychotics (e.g., amisulpride, aripiprazole, asenapine, iloperidone, lurasidone, olanzapine, quetiapine, risperidone, ziprasidone) emerged in the 1980s. These medications are associated with a lower risk of extrapyramidal side-effects but also a higher risk of metabolic adverse effects (e.g., weight gain, diabetes, dyslipidaemia and cardiovascular problems) (American Diabetes, American Psychiatric, American Association of Clinical, & North American Association for the Study of, 2004; Crossley, Constante, McGuire, & Power, 2010; Miyamoto, Duncan, Marx, & Lieberman, 2005). In Portugal, a study revealed that first-generation antipsychotics are applied in 48% of the patients with schizophrenia, and second-generation antipsychotics in 51% (Simões do Couto et al., 2011).

Both types of antipsychotic medications cause a range of neurological, metabolic, cardiovascular, gastrointestinal, hematological, genito-urinary, musculoskeletal, endocrine, and other side effects. In contrast to its broadly similar efficacy, antipsychotic

agents clearly differ in their propensity to cause these adverse effects (De Hert et al., 2009; Ozbilen & Adams, 2009). Antipsychotic treatment responsiveness varies as a function of disorder stage, with first-episode patients responding faster and at a higher rate than those at later stages of the disorder (Salimi, Jarskog, & Lieberman, 2009). Since non-adherence to medication during treatment of schizophrenia is common, long-acting injectable antipsychotic regimens have been found to be variably advantageous over oral antipsychotic treatment approaches in reducing rates of relapse (Adams, Fenton, Quraishi, & David, 2001; Nasrallah, 2007).

In view of the limitations of antipsychotic medication in many symptom domains of schizophrenia, several other psychotherapeutic medications have been utilized in its treatment (Tandon et al., 2010). These include various anticonvulsants – to targeting aggression and impulsivity; antidepressants – to targeting depressive and anxiety symptoms; and benzodiazepines – to targeting anxiety, agitation, and insomnia (Thomas et al., 2009; Tiihonen, Wahlbeck, & Kiviniemi, 2009). In Portugal, benzodiazepines were the most common psychotropic medication prescribed as co-therapy (68.7%), followed by antidepressants (29.5%) (Simões do Couto et al., 2011).

Although pharmacological treatment represents the first-line treatment of choice in schizophrenia, the extent to which such treatment improves lifespan and psychosocial function in these patients is less clear (Lehman et al., 2004). In fact, according to Tandon et al. (2010) pharmacological treatment alone produces only limited improvement in negative symptoms, cognitive function, social functioning and quality of life (QoL).

This underlines the need for multi-modal care including psychosocial therapies as adjuncts to antipsychotic medications (Glynn, 2001; Kern, Glynn, Horan, & Marder, 2009) to help at symptom relief, the enhancement of self-confidence and the improvement of QoL (Probst, 2017). Specifically, psychosocial interventions are recognized to promote a reduction on psychotic symptoms and relapse, as well as improving patients' long-term outcomes (e.g., recovery, remission and disorder progression) (Kern et al., 2009;

Patterson & Leeuwenkamp, 2008). Therapies for patients with schizophrenia focus on the patient, as well as on family caregivers (Fallahi Khoshknab, Sheikhona, Rahgouy, Rahgozar, & Sodagari, 2014) and include case management, supported employment, cognitive remediation, psychoeducation, and cognitive-behavioural therapies (e.g., Social Skills Training, Cognitive Therapy) (Morin & Franck, 2017). These psychosocial approaches have proven their effectiveness in reducing the impact of cognitive impairment, negative symptoms, relapses, and the intensity of distress related to positive symptoms. In addition, the psychosocial approaches also try to promote the recovery process by encouraging self-determination and active empowerment (Morin & Franck, 2017).

However, patients with schizophrenia have poor access to health care (Mitchell, Malone, & Doebbeling, 2009). Specifically in Portugal, only 38% of the patients were involved in psychosocial approaches (18% occupational therapy, 12% psychotherapy, 8% rehabilitation and 8% community support) (Simões do Couto et al., 2011). Despite the benefits of multi-modal care for patients with schizophrenia, clinical and functional outcomes among patients participating in such services are still suboptimal. Among such patients, psychiatric hospitalizations can occur, substance use (especially tobacco) is high (Brown, Birtwistle, Roe, & Thompson, 1999; Kalman, Morissette, & George, 2005; Lasser et al., 2000; McCreadie, 2002), poor physical health outcomes are the norm (Cimo, Stergiopoulos, Cheng, Bonato, & Dewa, 2012; Correll et al., 2017; Crump, Winkleby, Sundquist, & Sundquist, 2013), and rates of participation in competitive employment remain lower than their age-matched peers without psychotic-spectrum disorders (Rosenheck et al., 2006).

The literature demonstrated that patients with schizophrenia have an excess premature mortality, being two or three times as high as that in the general population (Laursen, Nordentoft, & Mortensen, 2014; McGrath, Saha, Chant, & Welham, 2008; Tiihonen, Lonnqvist, et al., 2009). These patients have 11 to 20 years shorter lifespan compared

to general population (Laursen et al., 2013). Decreased life expectancy may be caused by suicide or somatic illnesses (e.g., cardiovascular diseases) (Brown, Inskip, & Barraclough, 2000; Osby, Westman, Hallgren, & Gissler, 2016). However, a recent study (Westman et al., 2017) revealed that cardiovascular diseases were the main reason for premature death in patients with schizophrenia, accounting for more excess deaths than suicide. Patients with schizophrenia are more likely to have more than one major risk factor for cardiovascular diseases, namely, overweight, smoking habits, high blood pressure and metabolic syndrome (Deuschle et al., 2013; Gardner-Sood et al., 2015; Gutierrez-Rojas et al., 2016; Olsson et al., 2015). In addition, they also are less likely to receive preventive care for these risk factors (Docherty, Stubbs, & Gaughran, 2016). Antipsychotic medications, particularly second-generation antipsychotics, may cause major adverse cardiovascular events (Khasawneh & Shankar, 2014). In Portugal, 28.4% of patients with schizophrenia suffer from somatic disorders, and the majority (26.5%) presented risks factors for cardiovascular diseases (i.e., hypertension, diabetes and high values of glycerides and cholesterol) (Simões do Couto et al., 2011).

Smoking, obesity, low physical activity, raised glucose levels, high cholesterol level and hypertension are considered as modifiable lifestyle and health associated mortality risk factors (World Health Organization, 2009). Due to the high prevalence of these factors in patients with schizophrenia (Cimo et al., 2012; Correll et al., 2017; Kalman et al., 2005; Lasser et al., 2000; Manu et al., 2015; Stubbs, Firth, et al., 2016; Stubbs, Williams, Gaughran, & Craig, 2016) preventive and rehabilitative strategies, such as lifestyle programs are highly needed.

Lifestyle-related factors: the impact on the disorder

Unhealthy lifestyle choices is one of the most cited modifiable determinants in patients with schizophrenia. Therefore, delivering lifestyle and life skills interventions, including

dietary education, physical activity (PA) and smoking cessation, to reduce cardiometabolic risk factors is a priority (Teasdale, Samaras, Wade, Jarman, & Ward, 2017).

Regarding lack of sufficient PA and a sedentary lifestyle, it is recognized that patients with schizophrenia are more sedentary than the general population (Faulkner, Cohn, & Remington, 2006; Stubbs, Firth, et al., 2016; Stubbs, Williams, et al., 2016; Vancampfort et al., 2010). Total energy expenditure of patients with schizophrenia is more than 20% lower than the minimum recommendations of the World Health Organisation (Sharpe, Stedman, Byrne, Wishart, & Hills, 2006). Additionally, only a minority (about 25%) of patients with schizophrenia follow the guidelines of public health recommendation of 150 minutes of PA per week (Beebe & Harris, 2013; Faulkner et al., 2006; Lindamer et al., 2008).

In schizophrenia, physical inactivity is identified as one of the most important modifiable factors strongly associated with cardiovascular disease-related mortality (Kilbourne et al., 2009). Patients with schizophrenia spend less time during the week performing strenuous activities than the general population, while during leisure time a greater proportion are not involved in sport activities (Roick et al., 2007; Stubbs, Firth, et al., 2016). In addition, an association between sedentary behaviour (i.e., time spent laying or sitting) and increased incidence of metabolic syndrome (Ford, Kohl, Mokdad, & Ajani, 2005), as well as neuro-cognitive deficits (Leutwyler, Hubbard, Jeste, Miller, & Vinogradov, 2014) was reported.

The benefits of PA and exercise in the population with schizophrenia are well established in the literature. When performed regularly, PA and exercise are associated with improved psychological well-being (Dauwan, Begemann, Heringa, & Sommer, 2016), QoL (Holley, Crone, Tyson, & Lovell, 2011), and physical health (Gorczynski & Faulkner, 2010). This is why PA has been recommended to be routinely integrated into psychiatric

services as an adjunct treatment for patients with schizophrenia (Richardson et al., 2005; Vancampfort, De Hert, et al., 2012).

Additionally, patients with schizophrenia also experience poor sleep quality compared to general population (Wulff, Dijk, Middleton, Foster, & Joyce, 2012). Around 30 to 80% of these patients suffer from some form of disturbed sleep (Cohrs, 2008). In this population, frequently sleep disturbances are reported such as initiating or maintaining sleep (Cohrs, 2008), advanced sleep phase syndrome and hypersomnia with short naps (Wirz-Justice, Haug, & Cajochen, 2001). To deal with sleep disturbances often sleep-inducing medication is prescribed or antipsychotics are chosen because of their enhanced sedative properties (Wilson & Argyropoulos, 2012). However, even clinically stable, medicated patients maintain sleep disturbances (Afonso, Brissos, Canas, Bobes, & Bernardo-Fernandez, 2014). Sleep disturbances are positively associated with difficulties in daytime activities (Waters, Faulkner, Naik, & Rock, 2012), greater positive symptoms (Afonso, Brissos, Figueira, & Paiva, 2011), impaired cognitive functions (Bromundt et al., 2011) and poor QoL (Brissos et al., 2013; Hofstetter, Lysaker, & Mayeda, 2005; Ritsner, Kurs, Ponizovsky, & Hadjez, 2004). Moreover, sleep disturbances are a contributor to obesity and cardiovascular disease (Czeisler, 2011) which are highly prevalent in patients with schizophrenia (Mitchell et al., 2013; Ringen, Engh, Birkenaes, Dieset, & Andreassen, 2014).

Unhealthy dietary habits are also frequent in patients with schizophrenia (Brown et al., 1999; Dipasquale et al., 2013; McCreadie, 2003; Stokes & Peet, 2004), and are characterized by a high intake of saturated fat (Amani, 2007; Brown et al., 1999; Henderson et al., 2010; Strassnig, Brar, & Ganguli, 2005), sugar (Stokes & Peet, 2004) and low intake of fibre, fruit and vegetables (Brown et al., 1999; Gupta & Craig, 2009; Henderson et al., 2006; McCreadie, 2003). In addition, a significantly increased intake of calories (Strassnig, Brar, & Ganguli, 2003) and a low consumption of both

monounsaturated and polyunsaturated fatty acids (Henderson et al., 2006) were also reported. This behaviour partly explains the higher incidence of metabolic abnormalities (Dipasquale et al., 2013; Stokes & Peet, 2004), and these nutritional factors seem to have a key role in the development of diabetes, osteoporosis and on the disorder aggravation (Kishimoto, De Hert, Carlson, Manu, & Correll, 2012; Peet, 2004).

Patients under antipsychotic medication seem to develop disordered dietary behaviours in response to altered appetite sensations and increased susceptibility to hunger, a factor which may influence the extent of body weight gain (Blouin et al., 2008). Additionally, adverse eating styles including disordered eating habits (e.g. only eating one main meal daily), fast-eating syndrome, and increased consumption of junk food and low food literacy were also observed (Blouin et al., 2008; Treuer et al., 2009). It is important to highlight that, in this population, discrimination, lower education and low socio-economic status may limit opportunities for access to healthier food (Thornicroft, Brohan, Rose, Sartorius, & Leese, 2009).

Due to the importance of an adequate diet on some comorbidities in patients with schizophrenia (e.g., obesity, insulin resistance, dyslipidaemia and hypertension) (Bonfioli, Berti, Goss, Muraro, & Burti, 2012; Bruins et al., 2014; Wu, Wang, Bai, Huang, & Lee, 2007), traditional dietary patterns with proven benefits on health was been recommended (Teasdale et al., 2017).

In a state-wide population survey of all patients with a mental disorder within a public mental health system, Morris et al. (2006) found that males were more likely to smoke tobacco than females, and that patients with a diagnosis of schizophrenia or bipolar disorder, were more likely to smoke tobacco than patients with other diagnoses. In fact, most patients with schizophrenia have tobacco smoking addiction (Kalman et al., 2005; McCreadie, 2002). Usually, these patients smoke tobacco 3-4 times more than the average of the general population (Lasser et al., 2000). Patients with schizophrenia who smoke are irrespective of age and gender more likely to suffer a cardiovascular event in

10 year when compared with subjects of the same spectrum disorder who do not smoke tobacco (Bobes, Arango, Garcia-Garcia, & Rejas, 2010). In addition, patients with schizophrenia who smoke are more likely to be physically inactive (Bobes et al., 2010), greater neuro-cognitive deficits and social, juridical and medical problems may occur (Bahorik, Newhill, & Eack, 2014). For this population, smoking feeling could alleviate schizophrenia symptomatology, particularly negative symptoms, by improving the sensory gating and cognitive deficits (Kumari & Postma, 2005; Winterer, 2010).

Psychological determinants: as a process to improve health

The adoption of a healthy lifestyle is a process that also involves motivation to plan a change, but also physical, psychological and material resources to adhere to the plan. Due to the disorder characteristics (i.e., cognition, perception, affect and volition) patients with schizophrenia could present difficulties in each step of this process (Hasnain, Victor, & Vieweg, 2011).

Motivation is described as a multidimensional construct (Tremeau, Goldman, Antonius, & Javitt, 2013) that generally means to be moved to do something. Without motivation, a person is passive, apathetic and unresponsive (Medalia & Brekke, 2010). In patients with schizophrenia, amotivation (i.e., lack of motivation) is considered a barrier to achieve a positive functional outcome (Blanchard, Mueser, & Bellack, 1998). For example, patients with schizophrenia often demonstrate decreased motivation to participate in treatment and in learning activities (Blanchard et al., 1998), which consequently affects the treatment outcomes (Strauss, Waltz, & Gold, 2014). Similarly, patients with schizophrenia often exhibit limited motivation to engage in physical activities and maintain an active lifestyle (Soundy, Stubbs, Probst, Hemmings, & Vancampfort, 2014; Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013).

The self-determination theory (SDT) (Deci & Ryan, 1985, 2000) is a theoretical framework for the research of motivation in exercise. This theory has generated particular interest due to its multidimensional conceptualization of intrinsic and extrinsic motivation (Markland & Tobin, 2004). SDT explains why individuals pursue specific goals and behaviours, such as PA. Broadly, SDT emphasizes that individuals set goals and engage in behaviours to meet intrinsic psychological needs (i.e., intrinsic motivation) or to move towards external rewards or away from punishment (i.e., extrinsic motivation) (Deci & Ryan, 2000). SDT consists of a continuum ranging from amotivation to intrinsic motivation. At the lowest end of the continuum is amotivation, when the person is in a state of not intending to act or lacks the motivation to act. The person is intrinsically motivated when adopting a behaviour for his/her inherent enjoyment, which represents the most self-determined form of regulation. Between amotivation and intrinsic motivation, four types of extrinsic motivation are found, namely external, introjected, identified and integrated regulation, and are placed on a continuum that is based on the extent to which the regulation is self-determined (Deci & Ryan, 1985, 2000). External and introjected regulation are often grouped and refer to controlled forms of motivation (i.e., less self-determination), while identified regulation, integrated regulation, and intrinsic motivation are often referred to as autonomous motivation (i.e., more self-determination).

In healthcare and rehabilitation settings, self-determined motivation has been linked to positive behavioural health outcomes (Fortier, Sweet, O'Sullivan, & Williams, 2007; Moran, Russinova, Yim, & Sprague, 2014; Williams et al., 2006; Williams, McGregor, Zeldman, Freedman, & Deci, 2004). Specifically, in patients with schizophrenia, higher levels of autonomous motivation, self-efficacy and readiness for PA are positively related to an increase of PA (Lindamer et al., 2008; Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013; Vancampfort, Vansteenkiste, De Hert, et al., 2014). Therefore, autonomous motivation can add value to the adoption and maintenance of health-promoting behaviours in patients with schizophrenia (Vancampfort, De Hert, et

al., 2013; Vancampfort, Vansteenkiste, De Hert, et al., 2014). For example, mental health professionals have repeatedly reported that motivation is a problem when trying to engage psychiatric patients in PA (Sorensen, 2006). Therefore, it is important to identify the motivation process, namely the self-determined types of motivation to PA in this population.

Self-esteem refers to an individual's sense of value or worth, or the extent to which a person appreciates, or likes himself (Blascovich & Tomaka, 1991). In general population, self-esteem is associated with mental health, with low self-esteem linked to depression and anxiety (Sowislo & Orth, 2013) and also with adverse reactions such as anger and irritability, aggressiveness and feelings of non-satisfaction from life (Campbell, Chew, & Scratchley, 1991). Low self-esteem is considered as a possible consequence and a possible cause of psychiatric symptoms (Blairy et al., 2004; Karatzias, Gumley, Power, & O'Grady, 2007). Previous studies indicated that lowered self-esteem frequently accompanies or became an etiological factor in many psychiatric conditions (Salsali & Silverstone, 2003; Silverstone & Salsali, 2003).

In patients with schizophrenia, Barrowclough et al. (2003a) reported significant correlations between negative self-evaluation and a wider variety of positive symptoms. Jones et al. (2010) found that a reduction in the severity of negative symptoms was significantly associated with improvement in self-esteem. Specifically, patients with high self-esteem exhibit better adaptation abilities, have confidence and are highly motivated. Contrarily, patients with low self-esteem have feelings of loneliness and underestimate their actual capabilities (Jones et al., 2010). Link et al. (2001) reported that 24% of the patients with schizophrenia scored below the mid-score (i.e., reflecting low score and low self-esteem). Silverstone and Salsali (2003), also found that these patients had intermediate levels of self-esteem. Patients with schizophrenia have significantly low self-esteem in comparison to other psychiatric conditions and they are expected to have

a compromised QoL and poor psychosocial functioning (Brekke, Kohrt, & Green, 2001; Gureje, Harvey, & Herrman, 2004).

Regarding its applications in PA behaviours, self-esteem processes are associated with motivated behaviour in PA settings in general population (Biddle & Mutrie, 2008). In patients with schizophrenia, detailed data on the relationship between self-esteem in PA behaviour is lacking. Faulkner and Biddle (1999) previously noted that in patients with schizophrenia, improvements in self-esteem are reported, albeit inconsistently, after exercise training. In accordance, Faulkner and Sparkes (1999) indicated that PA is instrumental in raising self-esteem in this population. Yoon et al., (2016) reported that an applied PA programme promoted psychological changes, namely improvements on self-esteem, competence and self-efficacy.

Quality of life: as a major outcome of treatment

Quality of life is a multidimensional concept that emphasizes the individual's satisfaction with all aspects of life and includes physical, social, environmental, and psychological well-being (Hays et al., 1995). In patients with severe mental disorders (e.g., schizophrenia and bipolar disorder) severe impairment in QoL was observed among 46% of patients (Hansson, 2006). In patients with schizophrenia, several factors are associated with poor QoL. The most important factors are sociodemographic factors (e.g., gender, ethnicity, financial situation and educational level) (Munikanan et al., 2017; Pinikahana, Happell, Hope, & Keks, 2002), pharmacotherapy (i.e., side effects of antipsychotic medication) (Loga-Zec & Loga, 2010) and severity of psychopathology (e.g., disorder duration, depressive and negative symptoms) (Browne et al., 1996; Pinikahana et al., 2002; Rocca et al., 2009). Also, physical health conditions (e.g., obesity, hypertension and metabolic syndrome) (Allison, Mackell, & McDonnell, 2003; Malhotra, Kulhara, Chakrabarti, & Grover, 2016) and lifestyle-related factors, such as

lack of PA (Acil, Dogan, & Dogan, 2008; Deenik et al., 2017; Gomes et al., 2014b; Vancampfort, Probst, et al., 2011) and poor sleep quality (Hofstetter et al., 2005; Ritsner et al., 2004) are related with low QoL in this population.

Finally, such psychosocial determinants as emotional distress, self-esteem, self-efficacy, and some coping styles with stressful situations, expressed emotion and social support have been found to play a significant role in satisfaction with QoL (Brekke et al., 2001; Gureje et al., 2004; Ritsner, Gibel, & Ratner, 2006; Ritsner, Lisker, & Grinshpoon, 2014; Ritsner et al., 2000). In patients with schizophrenia, QoL has been recognized as an important outcome of treatment (Faulkner, Cohn, Remington, & Irving, 2007; Maat, Fett, & Derks, 2012; Narvaez, Twamley, McKibbin, Heaton, & Patterson, 2008). Moreover, identifying determinants of schizophrenia specific QoL levels may improve the focus of health care treatment for this population.

Gaps in lifestyle-related factors and schizophrenia research

The poor physical health of patients with schizophrenia associated with unhealthy habits, attitudes and behaviours, has long been known. For that reason and due the interest of patients with schizophrenia in achieving lifestyle change (Archie et al., 2007), research into lifestyle-related factors in this population is increasing. According to Ward et al. (2017), targeted interventions have a major role to play in a holistic approach to addressing the major health inequalities in this vulnerable population. Ingrained inequality is one key reason why lifestyle interventions are an essential part of integrated best practice care. Adequate sleep, regular PA, and a healthy diet should be key contributors to well-being and a healthy life for everyone in society, but these are sadly absent for most patients with schizophrenia. In addition, this population often have poor self-management abilities and are frequently seen to have fewer health-promoting behaviours than non-psychiatric subjects or the general population (Chuang, Wu, Wang,

Liu, & Pan, 2016). In order to develop effective psychoeducational interventions to enhance and maintain health outcomes, it is important to understand the factors that influence the perseverance of health-promoting behaviours in schizophrenia.

Although the relevance of healthy lifestyle behaviours in patients with schizophrenia is reported, there are still several research gaps that need to be clarified, namely when analysing the Portuguese reality. Firstly, is important to considerer that motivation is important for the adoption of a healthy lifestyle. The increased autonomy towards PA may have a positive impact on research about PA adoption and adherence in patients with schizophrenia. Specifically, it is recognized when patients with schizophrenia who are more autonomously regulated towards PA are more likely to voluntarily exercise over longer periods of time and are therefore more likely to benefit from the multitude of health benefits conferred by an active lifestyle (Vancampfort, Vansteenkiste, Hert, et al., 2014). However, there is a lack of reliable and valid instruments to determine the motivation processes of patients with schizophrenia to practice PA. Therefore Study 1 was developed. The existence of valid and reliable instruments to assess the motivation to PA in patients with schizophrenia is an important issue for research and clinical practice in the field of mental health.

PA in patients with schizophrenia have been the focus of attention from researchers and clinicians in relation to the impact on psychopathology. Regarding the Portuguese context, few studies explore this theme. Gomes et al. (2014b) aimed to evaluate the effects of a 16-week group PA program on physical fitness and QoL in outpatients with schizophrenia. Results revealed that a PA program can be successfully implemented for outpatients with schizophrenia and can influence their QoL and PA levels. Other study (Gomes et al., 2014a) aimed to determine which type of PA (i.e., walking, dancing and small-sided games) is the most enjoyable and effective for patients with schizophrenia. The authors reported that outpatients with schizophrenia identified the walking sessions as the most effective (i.e., minimal target heart rate and PA levels), and the small-sided

games as the most enjoyable. However, to date, was not possible to identify any study exploring the barriers that Portuguese patients with schizophrenia could experience when try to adopt an active behaviour.

Several and distinct variables, such as side-effects of antipsychotic medication, psychiatric symptoms, lack of social support and biological and psychological correlates, has described in the literature for compromised the attempting of patients with schizophrenia to become more active (Carter-Morris & Faulkner, 2003; Firth et al., 2016; McDevitt, Snyder, Miller, & Wilbur, 2006; Vancampfort, Knapen, et al., 2012). Although, it was not possible to identify any study that simultaneous analized the association between several factors which are recognized as a barrier to PA in patients with schizophrenia. To overcome this limitation, Study 2 was carried out, to provide new evidence in the international literature, and specifically understand the factors that may influence participation and delusional beliefs about PA.

The poor sleep quality in patients with schizophrenia is well described in the literature. Problems affectting the components of sleep are commonly reported in this population. In general population, PA has been extensively recommended to improve sleep quality, due to the beneficial effects on sleep components (Chennaoui, Arnal, Sauvet, & Leger, 2015; Kredlow, Capozzoli, Hearon, Calkins, & Otto, 2015). However, there is lack of scientific evidence supporting the relevance of PA in mental health field. For that reason, Study 3 aimed to assess the associations between PA levels and sleep quality in patients with schizophrenia.

Recognized that poor sleep quality is associated with greater positive symptoms (Afonso et al., 2011), difficulties in daytime activities (Waters et al., 2012), and poor QoL (Brissos et al., 2013; Hofstetter et al., 2005; Ritsner et al., 2004) the Study 4 examined the differences in sleep quality and QoL between physical and non-physical active patients with schizophrenia.

Both, Study 3 and 4, highlight the importance of PA as an adjunctive treatment for sleep quality, and consequently in QoL in this population. PA should be considered as an option of non-pharmacological approach to deal with sleep disturbances. This situation will be in agreement with patient's preferences regarding the reduction of medication, and the interest in alternative non-pharmacological interventions to improve sleep quality (Peacey, Miller, Huthwaite, & Romans, 2012).

While the literature examining relationships between diet, lifestyle, and cardiovascular disease within the general population is broad, little has been assess among patients with schizophrenia. Specifically in the Portuguese context, there is a lack of research exploring the dietary habits in the population with mental disorders. Low socioeconomic status is recognized as an influent factor to the adherence to an adequate dietary intake (Roick et al., 2007; Samele et al., 2007). However, data on smoking status remain inconsistent (Dipasquale et al., 2013). Concerning that, Study 5 was carried out, to provide new evidence in the field of mental health. A better understanding of the characteristics of dietary patterns in patients with schizophrenia revealed great importance because diet are major and modifiable cause of cardiovascular disease (Dipasquale et al., 2013). Furthermore, interventions targeting dietary patterns in patients with schizophrenia could offer a greater benefit if synergetic effects can be detected in relation to metabolic syndrome-related conditions. Therefore, dietary intake, adherence to Mediterranean diet and the relationship with lifestyle-related factors (PA, tobacco smoking and sleep quality) were analysed.

Despite the high prevalence of inadequate lifestyles in patients with schizophrenia, and the potentially disabling consequences, there has been little research on the impact of lifestyle-related factors on various domains of a patient's life. Studies revealed that PA (Dauwan et al., 2016) and sleep quality (Brissos et al., 2013; Hofstetter et al., 2005; Ritsner et al., 2004), have a negative effect on QoL of this population. However, no

previous research has simultaneously analysed lifestyle-related factors (i.e., PA, sleep quality, smoking and dietary habits) and its impact on QoL. To overcome this limitation, Study 6 was carried out. In addition, psychological determinants such as self-esteem and motivation to PA were included in the analyses. The identification of the strongest predictors of QoL could be an added value for effective psychoeducational interventions related with lifestyles risks in patients with schizophrenia. The findings achieved could promote implications for lifestyle risk stratification in this population and work to develop and implement individualized physical health promotion interventions targeting modifiable lifestyle factors.

Aims of this body of work

Due to the lack of clarity in the literature related with lifestyle behaviours in patients with schizophrenia, the main purpose of this research was to develop strategies and tools related with lifestyle-related factors and psychological determinants, to improve the QoL in this population. A variety of study methods was used to address this goal, including a validation study and cross-sectional researches.

The specific aims were to:

i. Examine the construct validity of the Portuguese version of the Behavioural Regulation in Exercise Questionnaire – 2 (BREQ-2) as well as the Portuguese version of the Behavioural Regulation in Exercise Questionnaire – 3 (BREQ-3) in people with schizophrenia (Study 1).

ii. Identify the factors, which are recognized as a barrier to PA in patients with schizophrenia (Study 2).

iii. Assess the associations between PA levels and sleep quality in patients with schizophrenia (Study 3).

iv. Compare the sleep quality and QoL between the physical active and the non-physical active patients with schizophrenia (Study 4).

v. Assess the dietary intake and adherence to Mediterranean Diet, specifically analysing the difference between treatment setting (i.e., inpatients and outpatients), and also explore the adherence to Mediterranean diet in relation with lifestyle-related factors (Study 5).

vi. Explore the association between lifestyle-related factors, psychological determinants and QoL in people with schizophrenia (Study 6).

Studies

Study 1

Behavioural Regulation in Exercise Questionnaire in people with schizophrenia: construct validity of the Portuguese versions.

Behavioural Regulation in Exercise Questionnaire in people with schizophrenia: construct validity of the Portuguese versions

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This study is published as:

Costa, R., Probst, M., Bastos, T., Vilhena, E., Seabra, A. & Corredeira, R. (2017). *Behavioural Regulation in Exercise Questionnaire in people with schizophrenia: construct validity of the Portuguese versions.* Disability and Rehabilitation. DOI: 10.1080/09638288.2017.1342277.

Abstract

People with schizophrenia have low physical activity levels that can be explained by the restriction in motivation. The Behavioural Regulation in Exercise Questionnaire-2 is a 19-item scale commonly used to assess five different motivational subtypes for physical activity. However, there are limited psychometric analyses of this version in the schizophrenia context. Moreover, there is a lack of information related to the psychometric properties of version 3 of this questionnaire, with 24 items and six different motivational subtypes. The aim of this study was to examine the construct validity of both Portuguese versions in people with schizophrenia. Methods: A total of 118 persons with schizophrenia were included (30 women). Cronbach's alpha was used for internal consistency, Pearson's correlation for the retained motivation-types, confirmatory factor analysis for the structural validity of version 2 and exploratory factor analysis for the factor structure of version 3. Results and conclusions: Analyses of version 2 provided an adequate fit index for the structure of the five factors. Exploratory analyses suggested retaining 2 factors of version 3. The results of this study suggest that version 3 was an appropriate measure to assess controlled and autonomous motivation for physical activity in people with schizophrenia and support its use in clinical practice and research.

Keywords: Behavioural Regulation in Exercise Questionnaire; construct validity; motivation to physical activity; schizophrenia

1. Introduction

The benefits of physical activity (PA) and exercise in the population with schizophrenia are well established in the literature. When performed regularly, PA and exercise are associated with improved psychological well-being (Dauwan, Begemann, Heringa, & Sommer, 2016a), quality of life (Holley et al., 2011), and physical health (Gorczynski & Faulkner, 2010). This is why the inclusion of PA is recommended as an adjunct treatment in psychiatric rehabilitation (Vancampfort, De Hert, et al., 2012). However, only 25% of people with schizophrenia meet the minimum public health recommendation of 150 minutes a week of at least moderately-intense activity (Faulkner et al., 2006). The minimal engagement in PA by people with schizophrenia can be explained, among others, by the restriction in motivation (Vancampfort, De Hert, et al., 2012; Vancampfort, De Hert, et al., 2013; Vancampfort, Stubbs, Venigalla, & Probst, 2015).

Motivation is described as a multidimensional construct (Tremeau et al., 2013) that generally means to be moved to do something. It is a goal-oriented process where tasks are instigated and sustained over time. Moreover, motivation is related with differences in the intensity of behaviour. For example, more intense behaviours are considered to be the result of higher levels of motivation (Petri, 1996). Overall, motivation requires motor or mental activity. The motor activity entails persistence and effort. While mental activity includes cognitive actions such as planning, rehearsing, organizing, monitoring, making decisions, solving problems, and assessing progress (Pintrich & Schunk, 1996). Without motivation, a person is passive, apathetic and unresponsive (A. Medalia & Brekke, 2010). In people with schizophrenia, amotivation is considered a barrier to achieving a positive functional outcome (Blanchard et al., 1998), with several studies (Foussias, Mann, Zakzanis, van Reekum, & Remington, 2009; Gard, Fisher, Garrett, Genevsky, & Vinogradov, 2009; Nakagami, Hoe, & Brekke, 2010) reporting the relationship between lower motivation and poorer neurocognition, functioning, and outcome in this population. For example, people with schizophrenia often demonstrate decreased motivation to participate in treatment and in learning activities (Blanchard et

al., 1998), which consequently affects the treatment outcomes (Strauss et al., 2014). Specifically, people with schizophrenia may miss sessions or forget medications or assignments (A. Medalia & Brekke, 2010).

Similarly, people with schizophrenia often exhibit limited motivation to engage in physical activities and maintain an active lifestyle (Soundy et al., 2014; Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013). Several factors influence the motivation for PA in this population, namely the presence of negative and depressive symptoms (Bassilios, Judd, & Pattison, 2014; Vancampfort, De Hert, et al., 2013; Vancampfort, Stubbs, et al., 2015), low self-efficacy and lack of confidence (Bassilios et al., 2014; Vancampfort, Probst, Sweers, et al., 2011a) and somatic co-morbidities associated with the disorder (e.g., metabolic syndrome and clinical pain) (Stubbs et al., 2014; Vancampfort, Sweers, et al., 2011). This is why multidimensional research on the motivation process in people with schizophrenia is crucial (Choi, Choi, Felice Reddy, & Fiszdon, 2014).

The self-determination theory (SDT) (Deci & Ryan, 1985, 2000) is a theoretical framework for the research of motivation in exercise. This theory has generated particular interest due to its multidimensional conceptualization of intrinsic and extrinsic motivation (Markland & Tobin, 2004). SDT explains why individuals pursue specific goals and behaviours, such as PA. Broadly, SDT emphasizes that individuals set goals and engage in behaviours to meet intrinsic psychological needs (i.e., intrinsic motivation) or to move towards external rewards or away from punishment (i.e., extrinsic motivation) (Deci & Ryan, 2000). SDT consists of a continuum ranging from amotivation to intrinsic motivation. At the lowest end of the continuum is amotivation, when the person is in a state of not intending to act or lacks the motivation to act. On the other hand, the person is intrinsically motivated when adopting a behaviour for their inherent enjoyment, which represents the most self-determined form of regulation. Between amotivation and intrinsic motivation, four types of extrinsic motivation are found, namely external, introjected, identified and integrated regulation, and are placed on a continuum that is

based on the extent to which the regulation is self-determined (Deci & Ryan, 1985, 2000). External and introjected regulation are often grouped and refer to controlled forms of motivation (i.e., less self-determination), while identified regulation, integrated regulation, and intrinsic motivation are often referred to as autonomous motivation (i.e., more self-determination).

In healthcare and rehabilitation settings, self-determined motivation has been linked to positive behavioural health outcomes (Fortier et al., 2007; Moran et al., 2014; Williams et al., 2006; Williams et al., 2004). Specifically, in people with schizophrenia, higher levels of autonomous motivation, self-efficacy and readiness for PA are positively related to an increase of PA (Leas & McCabe, 2007; Lindamer et al., 2008; Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013; Vancampfort, Vansteenkiste, De Hert, et al., 2014). Therefore, autonomous motivation can add value to the adoption and maintenance of health-promoting behaviours in people with schizophrenia (Vancampfort, De Hert, et al., 2013; Vancampfort, Vansteenkiste, De Hert, et al., 2014). For example, mental health professionals have repeatedly reported that motivation is a problem when trying to engage psychiatric patients in PA (Sorensen, 2006). Therefore, it is important to identify the motivation process, namely the self-determined types of motivation to PA in this population.

However, there is a lack of reliable and valid instruments to determine the processes that motivate people with schizophrenia to practice PA. To our knowledge, the Behavioural Regulation in Exercise Questionnaire – 2 (BREQ-2) (Markland & Tobin, 2004), which assesses participants' motivation for exercising, was the only instrument aiming to determine the continuum of motivation (i.e., a 19-item scale with 5 subscales: amotivation, external, introjected, identified and intrinsic regulations) applied to individuals with severe mental disorders, namely, affective disorders (i.e., major depressive disorder and bipolar disorder) (Vancampfort et al., 2016; Vancampfort, Stubbs, et al., 2015) and schizophrenia (Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013; Vancampfort, Stubbs, et al., 2015; Vancampfort,

Vansteenkiste, De Hert, et al., 2014). Moreover, only Vancampfort et al. (2013) explored the structure validity of the BREQ-2 in people with schizophrenia using exploratory factor analysis. The previously mentioned authors found sufficient convergence for the amotivation, external and introjected regulation subscales. In the same study, the identified and intrinsic regulation subscales were loaded on a single factor that the authors labelled "autonomous regulation". This study was conducted with Belgian patients. However, the factorial validity of the BREQ-2 using confirmatory factor analysis has not yet been performed in people with schizophrenia.

Due to the limited comprehensive psychometric analyses of the BREQ-2 in people with schizophrenia, specifically in the Portuguese context, the purpose of this study was to examine the construct validity of the Portuguese version of the BREQ-2 (Markland & Tobin, 2004; Palmeira, Teixeira, Silva, & Markland, 2007) (Study 1) as well as the Portuguese version of the Behavioural Regulation in Exercise Questionnaire – 3 (BREQ-3) (i.e., a 24-item scale with one additional subscale: integrated regulation) (Cid, Moutão, Monteiro, Teixeira, & Palmeira, in preparation) (Study 2) in this population.

2. Materials and Methods

2.1. Participants

One hundred and eighteen patients diagnosed with schizophrenia and recruited from 7 psychiatric centres situated in the north region of Portugal participated voluntarily in this study. All participants met the following criteria: i) more than 18 years old; ii) a diagnosis of schizophrenia according to the Diagnostic and Statistical Manual of Mental Disorders – 5 (DSM-5) (American Psychiatric Association, 2013) established by experienced psychiatrists responsible for the patients' treatment; and iii) psychiatrically stable on psychotropic medication (i.e., no medication changes within the last month). Exclusion criteria included an inability to provide informed consent or to speak Portuguese, an inability to concentrate for at least 20 minutes (as determined by the treating psychiatrist), neurological disorders, and substance abuse in the last six months or hospitalization in

the previous three months. This study was carried out following the Declaration of Helsinki guidelines for human research. The study procedure was approved by the Faculty Ethics Committee and by all 7 ethical committees. All participants gave their written informed consent.

2.2. Behavioural Regulation in Exercise Questionnaire (BREQ-2 and BREQ-3)

The BREQ-2 (Markland & Tobin, 2004) evaluates behavioural regulation in the PA context, assessing the following five dimensions: i) amotivation (four items, e.g., “I do not see the point in doing physical activities”); ii) external regulation (four items, e.g., “I do physical activities because other people say I should”); iii) introjected regulation (three items, e.g., “I feel ashamed when I miss my physical activities”); iv) identified regulation (four items, e.g., “It is important to me to do physical activities regularly”); and v) intrinsic regulation (four items, e.g., “I do physical activities, it is fun”). Responses were scored on a 5-point Likert scale ranging from 0 (“not true for me”) to 4 (“very true for me”). The mean of the 5 retrieved subscales is calculated on a five-point scale to score the extent of each motivation type separately. The BREQ-2 presents adequate psychometric properties when applied to the general population. The BREQ-2 is accepted worldwide and is translated into different languages.

The Portuguese version of the BREQ-2 was validated by Cid et al. (2012) and Palmeira et al. (2007). The BREQ-2 was applied in Portuguese samples of adolescents (Quaresma, Palmeira, Martins, Minderico, & Sardinha, 2014), adolescents with obesity (Fonseca, Palmeira, Martins, Falcato, & Quaresma, 2014), elderly people (Moutão, Rosário, Vitorino, Alves, & Cid, 2014) and a healthy population (Cid et al., 2012; A. R. Gomes & Capelão, 2012) but not in people with mental disorders.

An improvement of the BREQ-2 was suggested by Wilson et al. (2006) regarding the inclusion of the subscale “integrated regulation” (four items, e.g., “I consider PA a part of my identity”), specific to PA contexts and in line with SDT. The inclusion of the subscale did not compromise the instrument’s validity. The addition of this new regulation subscale

has been considered a third version of the questionnaire (BREQ-3). The BREQ-3 has been validated in Spain (Gonzalez-Cutre, Sicilia, & Fernandez, 2010; Sicilia, Saenz-Alvarez, Gonzalez-Cutre, & Ferriz, 2015), and preliminary assessments of the BREQ-3 have been developed in Portugal (Cid et al., in preparation).

The Portuguese version of the BREQ-3 (Cid et al., in preparation) consisted of 24 items, the 19 BREQ-2 items completed by four items proposed by Wilson et al. (2006) and one additional item ("I consider exercise consistent with my values") (Cid et al., in preparation; Markland, 2014). The BREQ-3 intended to assess the 6 subscales of SDT, and the mean of the subscales is calculated as the BREQ-2.

To include patients with literacy problems an interviewer-administered questionnaire was used. Two adaptations to the original questionnaire were made. First, the term "exercise" was replaced by the term "physical activity" (Vancampfort, De Hert, et al., 2013). Second, points 1 and 3 of the Likert scale were also labelled to improve the participants understanding of the scale (1 – "few times true for me"; 3 – "many times true for me"). This is because in the English and Portuguese original versions, only point 0 ("not true for me"), point 2 ("sometimes true for me"), and point 4 ("very true for me") were labelled.

2.3. Statistical analyses

To test how well the measured variables represent the factor structure of the BREQ-2, we used confirmatory factor analysis (CFA). Five continuous latent variables were regressed on 19 BREQ-2 items, as suggested by Markland and Tobin (Markland & Tobin, 2004).

Maximum likelihood estimation (MLE) is used to assess the fit of the model; however, this method assumes that the data must have a normal multivariate distribution (Kline, 2005), so the more robust chi-square statistic, the Satorra-Bentler scaled statistic ($SB\chi^2$) (Satorra & Bentler, 1994), was used. This test corrects for the non-normality of the data distribution and produces more accurate results (Bentler, 2007). The goodness of fit for each factor structure was evaluated using several descriptive criteria: the Comparative

Fit Index (CFI), which quantifies how much better the model fits compared to a baseline model in which the observed items are assumed to be uncorrelated, and the Standardized Root Mean Square, Residual (SRMR), and the Root Mean Square Error of Approximation (RMSEA), which quantifies the divergence between the data and the proposed model per degree of freedom, with a 90% confidence interval (RMSEA 90% CI).

As recommended by Brown (2006), the model was considered to have “adequate fit” if the RMSEA and SRMR were less than 0.08 and the CFI was greater than 0.9; “good fit” was indicated by an RMSEA and SRMR less than 0.05, a CFI greater than 0.95 and X^2/df values less than 3. For each variable, the magnitudes of factor loadings were considered. Variables with a factor loading of 0.3 or greater (T. A. Brown, 2006) were considered representative of the construct being measured in each domain. The confirmatory factor analysis was performed with the use of EQS 6.1 software (Bentler, 2002).

Exploratory factor analysis (EFA) was chosen to analyse the main components of BREQ-3 factor structure (Study 2) using varimax rotation and eigenvalues greater than 1 (Kaiser, 1960). An item with a factor loading higher than 0.40 on a factor was considered to load sufficiently high on the relevant factor. Cronbach's alpha was calculated to determine the internal consistency of the items of the retained factors. Subsequently, Pearson's correlations among the retained motivation-types were inspected. Descriptive statistics (mean and standard deviations) were calculated. The significance level was set at $p<0.05$.

3. Results

A total of 118 Portuguese persons with a DSM-5 (American Psychiatric Association, 2013) diagnosis of schizophrenia with an average age of 44.53 years (± 9.74) were included in the analysis. Thirty (25.4%) were women, fifty-eight (50.8%) were inpatients and ninety-three were single (78.8%). On average, the duration of education was 8.75

years (±3.58), the illness duration was 19.79 (± 9.21) years (data available for 53.4% of the sample), and the number of hospitalizations was 2.82 (± 2.76) (data available from 52.5% of the sample). Participants were treated with either a single first-generation (n=11; 9.3%), single second-generation (n=42, 35.6%); or a combination of first- and/or second-generation (n=60; 50.8%) antipsychotic medication. There were seventy-seven (65.3%) smokers in the sample who smoked an average of 15.8 (± 8.9) cigarettes per day. Seventy-seven (65.3%) participants were engaged in PA, and no significant differences were found between groups in the six subscales of motivation.

The results of the CFA on the Portuguese version of the BREQ-2 (Study 1) revealed that the 19-item, 5-factor model of the Portuguese BREQ-2 (latent variables: amotivation, external, introject, identified and intrinsic) provided an acceptable fit for the data from people with schizophrenia (see Figure 1). All items significantly loaded their hypothesized factors and acceptable fit indices, S-Bχ2=209.0; *df*=142; *p*<0.001; S-Bχ2/*df*=1.47; CFI=0.85; SRMR=0.09; RMSEA=0.06; 90% CI=[0.06, 0.08]. Standardized factor loadings greater than 0.3 were also observed for all items on the BREQ-2.

Figure 1. Factor loadings of confirmatory factor analysis for the Portuguese BREQ-2 (Standardized Parameters Estimates)

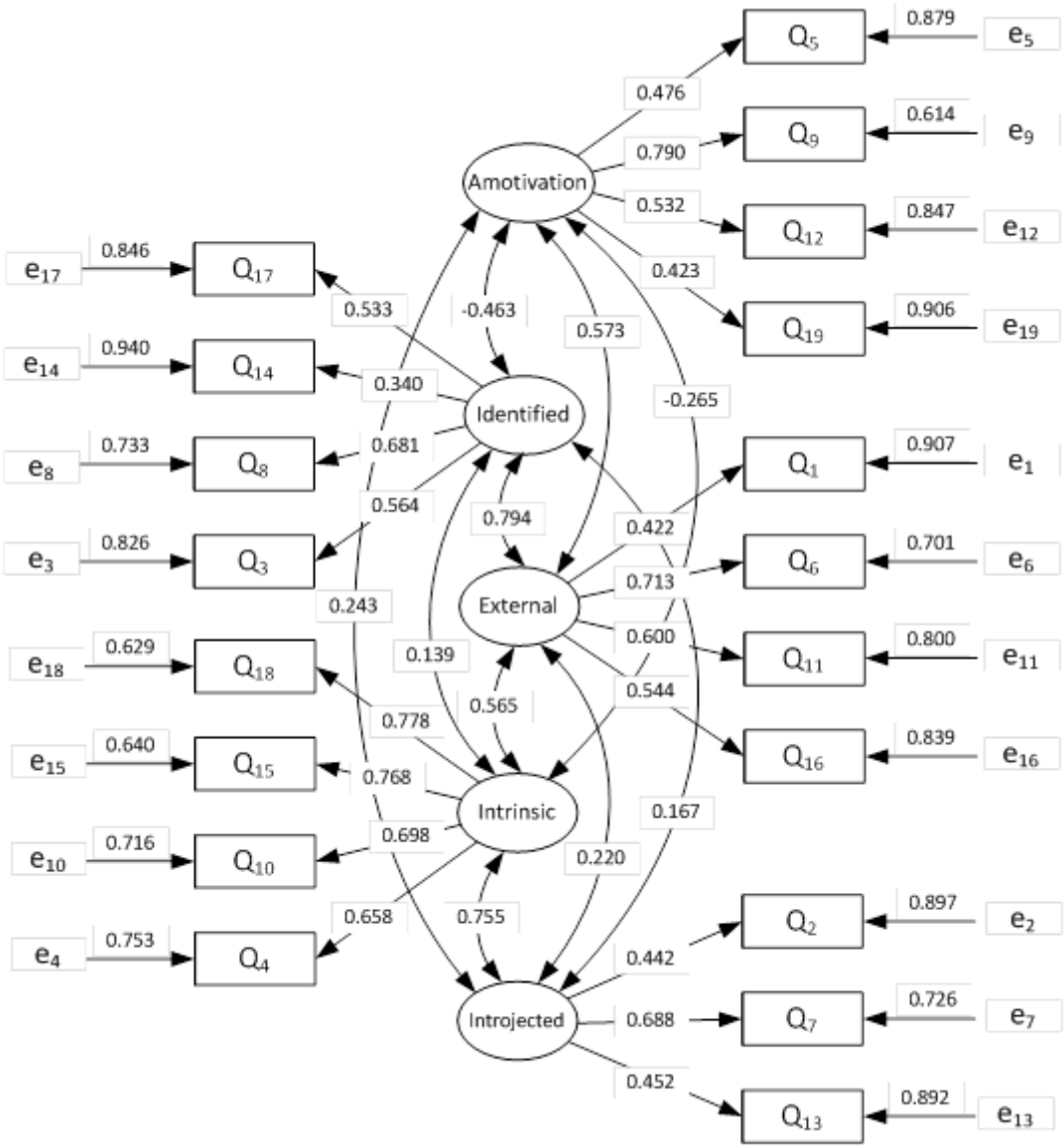

Table 1. Mean (standard deviations), internal consistency and intercorrelations of subscales of the Portuguese version of BREQ-2 in people with schizophrenia.

	M ± SD	Cronbach's Alpha	1.	2.	3.	4.
1. Amotivation	0.62 ± 0.76	α=.61				
2. External	1.29 ± 0.98	α=.65	0.38**			
3. Introjected	1.33 ± 1.04	α=.59	0.31	0.42**		
4. Identified	2.46 ± 0.85	α=.59	-0.32**	0.13	0.40**	
5. Intrinsic	2.98 ± 0.89	α=.81	-0.20*	0.11	0.17	0.53**

M ± SD = mean ± standard deviation; **p < 0.01; *p < 0.05.

An EFA of the BREQ-3 (Study 2) showed that six factors had an eigenvalue higher than one. Four factors were retained with an eigenvalue above 1 and with 61% of the total variance explained.

The results of the four- and three-factor analyses did not fit with the theoretical framework. Amotivation and external regulation loaded on a single factor; integrated regulation and intrinsic regulation loaded on a single factor; identified regulation loaded on different factors; and two items (4 and 10) showed cross-loadings of 0.35 and 0.52, respectively, with other factors. A new exploratory factor analysis was made with the amotivation subscale deleted from the model, as previously suggested by Cid et al. (2012) in the Portuguese version of the BREQ-2.

Descriptive statistics, internal consistency and intercorrelations of the subscale were analysed. For controlled motivation, the results showed a mean of 1.33 ± 0.8 and a Cronbach's alpha of .73. For autonomous motivation, a mean of 2.67 ± 0.81 and a Cronbach's alpha of .87 was found. The correlation between subscales showed a low negative value (r = -0.343; p < 0.01).

Table 2 presents the results of the exploratory factor analysis. Two factors were retained with an eigenvalue above 1 and with 59% of the total variance explained. External regulation and introjected regulation loaded in a single factor representing controlled motivation. Identified, integrated and intrinsic regulation loaded in another single factor

representing autonomous motivation. Two items (21 and 16) showed cross-loadings of 0.47 and 0.19, respectively, with other factors.

Table 2. Results of exploratory factor analysis of the Portuguese version of BREQ-3, based on two factors, in people with schizophrenia (n= 118).

Factor	1	2	h^2
I External regulation			
2. I do physical activities because other people say I should.		0.42	0.24
8. I do physical activities because my friends/family/partner say I should.		0.68	0.49
14. I do physical activities because others will not be pleased with me if I don't.		0.70	0.39
20. I feel under pressure from my friends/family to do physical activities.		0.60	0.31
II Introjected regulation			
3. I feel guilty when I don't do physical activities.		0.53	0.42
9. I feel ashamed when I miss my physical activities.		0.67	0.41
15. I feel like a failure when I haven't done physical activities in a while.		0.46	0.48
21. I get restless if I don’t do physical activity regularly.	0.47	0.45	0.59
III Identified regulation			
4. I value the benefits of physical activity.	0.54		0.24
10. It’s important to me to do physical activities regularly.	0.72		0.52
16. I think it is important to make the effort to do physical activities regularly.	0.32	0.19	0.25
22. I would feel bad about myself if I was not making time to do physical activity.	0.47		0.51
IV Integrated regulation			
5. I do physical activities because it is consistent with my life goals.	0.72		0.57
11. I consider physical activity part of my identity.	0.78		0.66
17. I consider physical activity a fundamental part of who I am.	0.64		0.56
23. I consider physical activity consistent with my values.	0.71		0.56
V Intrinsic regulation			
6. I do physical activities because it’s fun.	0.63		0.50
12. I enjoy my physical activity sessions.	0.69		0.50
18. I find physical activity a pleasurable activity.	0.71		0.55
24. I get pleasure and satisfaction from participating in physical activity.	0.74		0.60
Eigenvalue	5.94	2.56	-
Factor variance	29.70	42.49	-
Total variance	29.70	12.79	-

h^2 (communality) = the sum of the squared factor loadings; it represents the amount of variance in that variable accounted for by all the factors.

4. Discussion

The first part of this study examines the construct validity of the Portuguese version of the BREQ-2 in people with schizophrenia. The BREQ-2 motivational continuum is suited

to examine motivational changes across a period of behavioural change, such as PA adoption. This increased autonomy towards PA may have a positive impact on research about PA adoption and adherence in people with schizophrenia. The BREQ-2 is a widely used measure among motivation researchers in the PA setting and has been shown to have good psychometric features (Markland & Tobin, 2004; P. M. Wilson, Rodgers, & Fraser, 2002). The BREQ-2 has been applied successfully in different populations (Cid et al., 2012; Fonseca et al., 2014; A. R. Gomes & Capelão, 2012; Markland & Tobin, 2004; Vancampfort et al., 2016; Vancampfort, Stubbs, et al., 2015; Vancampfort, Vansteenkiste, De Hert, et al., 2014) and cultures, providing evidence for the factorial validity of the questionnaire (Chung & Liu, 2012; Cid et al., 2012; Murcia, Gimeno, & Camacho, 2007).

In the present study, CFA demonstrated that the BREQ-2 provided an acceptable fit for the data from people with schizophrenia. The 5-factor model of the Portuguese BREQ-2 (latent variables: amotivation, external, introject, identified and intrinsic) met the criteria for adequate fit for RMSEA but was borderline for SRMR (T. A. Brown, 2006). The incremental indices values, which provide a better estimate of model fit than the null model, were lower than expected, probably due to the small sample.

In general, the results of the mean and standard deviation in all subscales were similar to validation studies by Markland and Tobin (2004) and Cid et al. (2012). The subscale's internal consistency applied acceptable borders (α=.59 - .81) (Table 1). Vallerand (1989) suggested appropriate values of internal consistency ranging between .70 and .85. However, Loewenthal (2001) indicated that an alpha of .60 is also acceptable for subscales containing four items. In general, the results of the present work are in line with previous studies. Markland and Tobin (2004) reported internal consistency ranging between .73 - .86 and Cid et al. (2012) values ranged between .45 - .80. Palmeira et al.'s (2007) internal consistency ranged between .63 - .79. In the same clinical group, Vancampfort et al. (2013) found higher internal consistency, with values ranging between .73 - .90.

With regard to the intercorrelation between the different subscales, very low to moderate correlations were found in the present study. As expected, the different subscales measured different types of motivation. These results agreed with previous studies (Cid et al., 2012; Markland & Tobin, 2004; Palmeira et al., 2007; Vancampfort, De Hert, et al., 2013) where the correlations between the subscales exhibited an organized pattern of relationships, such that types of motivation closer along the motivational continuum are strongly and positively correlated. However, the types of motivation that are further apart are correlated more weakly or are negatively correlated (Ryan & Deci, 2007).

The second part of this study examines the construct validity of the Portuguese version of the BREQ-3 in people with schizophrenia. EFA with 2-factors demonstrated a good fit for the data from people with schizophrenia. Moreover, the new additional item ("I consider exercise consistent with my values") (Cid et al., in preparation; Markland, 2014) seems adequate to include in the integrated subscale, with a factor loading of 0.71. In the present study, internal consistency and correlation values were similar to Cid et al. (2012), who performed CFA for the Portuguese version of the BREQ-2. Cid et al. (2012) tested different hierarchical models and found appropriate measures for controlled and autonomous motivation. Therefore, the Portuguese BREQ-3 in people with schizophrenia provides an acceptable measure of controlled motivation and autonomous motivation that is consistent with the motivational continuum of SDT (Deci & Ryan, 1985, 2000). In the same way, different studies in the fields of education (Zhou, Ma, & Deci, 2009), health (Ingledew & Ferguson, 2007; Pavey & Sparks, 2008), sports (Ntoumanis & Standage, 2009), and exercise (Ingledew & Markland, 2008) developed an integrated approach with the different types of regulation forming a global index for autonomous and controlled motivation.

Controlled motivation is described as an index incorporating the factors of external and introjected regulation. In SDT, external regulation is related to controlled and external behaviours mediated by the presence of contingencies. When contingencies are withdrawn, the behaviours are poorly maintained (Ryan & Deci, 2007). Introjected

regulation involves the internalization of external controls, which are then applied through self-imposed pressures to avoid guilt or to maintain self-esteem (Markland & Tobin, 2004). Globally, in controlled motivation, one's behaviour is a function of external contingencies of reward or punishment, pressuring the person to be more active. When people with schizophrenia are controlled, they experience pressure to think, feel, or behave in particular ways (e.g., “should,” guilt, or seeking social approval), which in turn is associated with less PA participation (Vancampfort, De Hert, et al., 2013).

Autonomous motivation is presented as an index incorporating the factors of identified, integrated and intrinsic regulations. In SDT, identified regulation consists of an acceptance of the behaviour as being important in order to achieve personally valued outcomes (Markland & Tobin, 2004). Integrated regulation comprises the assimilation of identified regulation so that engaging in the behaviour is fully congruent with one’s sense of self (Markland & Tobin, 2004). Intrinsic regulation involves participating in an activity for the enjoyment and satisfaction inherent in engaging in the behaviour itself (Markland & Tobin, 2004). Globally, in autonomous motivation, people are identified with the goals and value of PA and, consequently, volitionally adopt PA as a lifestyle. When people with schizophrenia are autonomously motivated, they exhibit an open curiosity and interest about PA that is related with long-term and successful participation in PA.

However, some inconsistencies were identified in the BREQ-3 structure analyses that may make it difficult to make a clear distinction between the different subscales along of the continuum of motivation. In the present study, cross-loadings between controlled and autonomous motivation were reported. A similar situation has also been reported in the general population (Verloigne et al., 2011), as well as in people with schizophrenia (Vancampfort, De Hert, et al., 2013). Likely, the difference between the controlled and autonomous types of motivation is related to gradual and continuum motivational changes (i.e., from external and inner pressures to personal convictions and volition). Specifically, inconsistencies in introjected regulation (i.e., controlled motivation) and identified regulation (i.e., autonomous motivation) may be due to the differences in the

PA lifestyle of the sample. The present study comprised people with schizophrenia who are physically active (i.e., participants in a structured PA program) and others who are not (i.e., do not have any participation in PA). Patients who are not physically active may be unable to identify the value of the beneficial outcomes associated with PA (Bassilios et al., 2014; Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013) and possibly never experience negative feelings (e.g., frustration, shame, and restlessness) associated with PA.

The existence of cross-validation items could also be due to the relatively small sample size to analyse the factor structure of the questionnaire. However, the Portuguese version of the BREQ-3 is being developed, and this version has been used for the first time in people with schizophrenia. Therefore, more validation studies are needed to determine if the questionnaire is able to distinguish the different types of motivation, if the rating scale is accurate, if the items are properly phrased and, consequently, if specific items should be excluded from the Portuguese version on the BREQ-3.

Finally, our findings need to be interpreted with caution due to some methodological issues. This is the first study with the BREQ-2 and BREQ-3 in a Portuguese clinical population of people with schizophrenia. The sample size is limited due to the specificity of the group. Further empirical studies are needed to confirm the psychometric robustness of the Portuguese version of the BREQ-3 in people with schizophrenia. Additionally, further research should examine the impact of different variables, such as age, gender, anthropometric characteristics, PA levels, treatment setting, disorder stage and psychopathological symptoms that can influence the motivation for PA in patients with schizophrenia.

5. Conclusion

The present study demonstrates that the 19-item 5-factor model of the Portuguese BREQ-2 has acceptable construct validity and is adequate to be used in clinical and research settings.

After the preliminary analysis of the construct validity of the Portuguese version of the BREQ-3, it is possible to conclude that the BREQ-3 is an appropriate measure to assess controlled and autonomous motivation for PA in people with schizophrenia. The existence of valid and reliable instruments to assess the motivation to PA in people with schizophrenia is an important issue for research and clinical practice in the field of mental health. It allows mental health professionals to identify and follow the motivational processes related to PA in people with schizophrenia, and consequently, to promote interventions that are experienced as pleasant and enjoyable so that patients are engaged for intrinsic reasons.

Further research is necessary to establish cross-cultural psychometric properties and more deeply analyse the Portuguese version of the BREQ-3 in people with schizophrenia. This would be an important step to ultimately validate the instrument.

Acknowledgements

The authors would like to thank all of the participants, the collaborating psychiatrists', physiotherapists, nurses and physical activity teachers. We also would like to thank the following participating centres: (1) Associação Nova Aurora de Reabilitação Psicossocial (ANARP), Porto, Portugal; (2) Psychiatric Department of Hospital São João, Porto, Portugal; (3) Casa de Saúde São José, Barcelos, Portugal; (4) Casa de Saúde São João de Deus, Barcelos, Portugal; (5) Casa de Saúde do Bom Jesus, Braga, Portugal; (6) Clinica do Outeiro, Vila do Conde, Portugal; (7) Associação dos Familiares, Utentes e Amigos do Hospital Magalhães Lemos, Matosinhos, Portugal.

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Study 2

Autonomous motivation and quality of life as predictors of physical activity in patients with schizophrenia

Autonomous motivation and quality of life as predictors of physical activity in patients with schizophrenia

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This study is published as:

Costa, R., Bastos, T., Probst, M., Seabra, A., Vilhena, E. & Corredeira, R. *Autonomous motivation and quality of life as a predictors of physical activity in patients with schizophrenia*. International Journal of Psychiatry in Clinical Practice. DOI: 10.1080/13651501.2018.1435821

Abstract

Being physically active is a complex behaviour in patients with schizophrenia. Several factors were identified as barriers to achieving active behaviours in this population, therefore, the purpose of this study was to investigate among a number of barriers what predicts the most on physical activity (PA) in patients with schizophrenia. Methods: A total of 114 patients (28♀) with schizophrenia were included. Body mass index (BMI) was calculated. Autonomous and controlled motivation (Behavioural Regulation in Exercise Questionnaire – 3), self-esteem (Rosenberg Self-esteem scale), quality of life (World Health Organization Quality of Life Scale – Brief version) and functional exercise capacity (6-minute walk test – 6MWT) were evaluated. Multiple Regression Analysis was applied to assess the effect of these variables on Total PA per week (International Physical Activity Questionnaire – short version). Results: Autonomous motivation and domains of quality of life were positively correlated with Total PA per week. Stepwise multiple regression analyses showed that of all the candidate factors to predict PA, autonomous motivation and global domain of quality of life were found as significant predictors. Conclusions: Our findings help to understand the importance of autonomous motivation and quality of life for PA in patients with schizophrenia. Knowledge about these predictors may provide guidance to improve PA behaviour in this population.

Keywords: physical activity; autonomous motivation; quality of life; schizophrenia.

1. Introduction

There is a clear scientific evidence that proves the physical and psychological health benefits of physical activity (PA) in patients with schizophrenia (Dauwan, Begemann, Heringa, & Sommer, 2016; Gorczynski & Faulkner, 2010). As such, PA has been strongly recommended as an adjunct treatment in psychiatric rehabilitation (Beebe et al., 2005; Richardson et al., 2005). However, patients with schizophrenia are more likely to be less physically active than the general population (Faulkner, Cohn, & Remington, 2006; Lindamer et al., 2008; Stubbs, Firth, et al., 2016; Stubbs, Williams, Gaughran, & Craig, 2016) and are consequently at a high risk for chronic medical conditions associated with physical inactivity (Vancampfort et al., 2010; Vancampfort, Probst, et al., 2013). Therefore, only a minority (about 25%) of patients with schizophrenia meet the minimum public health recommendation of 150 minutes a week of at least moderate-intensity PA (Faulkner et al., 2006).

Distinct variables undermine the attempt of patients with schizophrenia to become more active. Studies revealed that side-effects of antipsychotic medication (Carter-Morris & Faulkner, 2003; McDevitt, Snyder, Miller, & Wilbur, 2006), psychiatric symptoms (Carter-Morris & Faulkner, 2003; McDevitt et al., 2006) and lack of social support (Carter-Morris & Faulkner, 2003; Firth et al., 2016) are the most often reported barriers to PA. The study of Vancampfort et al. (2012) revealed that other determinants, such as demographic, biological and psychological determinants, were also associated with PA. In regards to demographic determinants, the authors found that less-educated patients, lower socio-economic status and longer illness duration demonstrated lower PA participation. Due to the prevalence of overweight characteristics and lower PA levels in low educational levels groups, patients with schizophrenia with lower education could be considered as a vulnerable subgroup (Vancampfort et al., 2012). Regarding biological determinants, cardio-metabolic comorbidity was the most consistent (Vancampfort et al., 2012). Patients with a better physical fitness and functional exercise capacity were more physically active. According to Vancampfort et al. (2011a) functional exercise capacity is

reduced in patients with schizophrenia compared to healthy controls. Finally, regarding psychological determinants, Vancampfort et al. (2012) demonstrated that increased self-efficacy, physical self-perception and quality of life were related with higher PA participation. Contrarily, data on body weight–related self-esteem or self-image were inconsistent. Several studies demonstrated that higher PA partcipation is positively associated with better quality of life in patients with schizophrenia (Acil, Dogan, & Dogan, 2008; Gomes et al., 2014; Vancampfort, Probst, Scheewe, et al., 2011). Patients with schizophrenia and higher self-esteem exhibit better adaptation abilities, are confident and highly motivated (Vancampfort, Probst, et al., 2011a). Contrarily, patients with lower self-esteem have feelings of loneliness and underestimate their actual capabilities (Jones, Hansen, Moskvina, Kingdon, & Turkingto, 2010).

Soundy et al. (2014) explored the perceptions of physical therapists who work within mental health services regarding barriers of PA among patients with schizophrenia. Results revealed that the most frequently cited barriers were patients' lack of motivation. Motivational deficits in patients with schizophrenia were described as a crucial feature of this mental illness since early definitions (Bleuler, 1911; Kraepelin, 1919). Recently, there has been an increased interest in the impact of motivation on the lifestyle of patients with schizophrenia (Barch, 2008; Gard et al., 2014; Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013; Vancampfort et al., 2014). Several studies reported that lower motivation is associated with poorer neurocognition and functioning (Gard, Fisher, Garrett, Genevsky, & Vinogradov, 2009; Nakagami, Xie, Hoe, & Brekke, 2008), as well as lower rates in treatment adherence and in learning activities (Choi & Medalia, 2010; Medalia & Freilich, 2008).

Self-determination theory (SDT) (Deci & Ryan, 1985, 2000) is used as a theoretical framework to evaluate key elements of the treatment in psychiatric rehabilitation (Fitzgerald et al., 2015). This theory examines the diverse effects of different types of motivation that can determine behaviour and can explain why patients adopt and maintain certain health behaviours. Particularly, SDT distinguishes between controlled

(i.e., external and introjected regulation) and autonomous (i.e., identified, integrated and intrinsic regulation) motivation based on the underlying attitudes and goals that give rise to action (Deci & Ryan, 1985, 2000). With autonomous motivation, the patients behave with a full sense of volition and choice. On the other hand, with controlled motivation, patients engage in an activity out of internal and/or external pressures (Deci & Ryan, 2008). The theory predicts that autonomous motivation will facilitate and sustain changes, whereas controlled motivation will interfere negatively with changes. Controlled and autonomous motivation has also been investigated in the field of PA and exercise. Studies revealed that in patients with schizophrenia, higher levels of autonomous motivation were correlated to the maintenance of frequent participation in PA over a longer period (Vancampfort et al., 2014) and with higher PA participation (Vancampfort, De Hert, et al., 2013).

Considering the health benefits associated to PA and the low levels of PA participation in the majority of patients with schizophrenia, understanding the predictors of PA levels and consequently improving the PA participation of these patients represents a clinical challenge. Therefore, the present study aimed to investigate among a number of barriers (i.e., BMI, autonomous and controlled motivation, self-esteem, quality of life domains and functional exercise capacity) what predicts the most on physical activity in patients with schizophrenia.

2. Material and methods

2.1. Participants and procedures

A cross-sectional design was used incorporating 7 health centres that treat persons with schizophrenia (see acknowledgements). The centres were located in the north region of Portugal. All participants of the study met the following criteria: over the age of 18, without substance dependence and with a stable medication regimen (i.e., no medication changes within the last month). Psychiatric diagnosis of the participants was based on Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric

Association, 2013) criteria and was established by experienced psychiatrists responsible for the patients' treatment. This study was carried out following the Declaration of Helsinki guidelines for human research. The study procedure was approved by the Faculty Ethics Committee and by all the 7 centres' ethical committees. All participants gave their written informed consent.

2.2. Demographic and anthropometric variables

Demographic variables included gender, age, years of study and anthropometric measures. Weight was measured using a Tanita scale (BC-418MA, Tanita Corporation, Tokyo, Japan). Patients wore light clothing with shoes removed. Height was measured with shoes removed using a portable stadiometer (Siber Hegner). Body mass index (BMI) (kg/m^2) was calculated.

In addition, dichotomous variables were constructed for employment situation (with versus without employment) and treatment setting (in- versus out- patients).

2.3. Medication use

Current antipsychotic medication use was recorded for each patient and converted into a daily equivalent dosage of chlorpromazine (Gardner, Murphy, O'Donnell, Centorrino, & Baldessarini, 2010).

2.4. Short-Form International Physical Activity Questionnaire (IPAQ-SF)

Physical activity levels were assessed using the Portuguese version of the Short-Form International Physical Activity Questionnaire (IPAQ-SF) (Craig et al., 2003). IPAQ-SF comprises seven items and provides information on the time spent on PA (Craig et al., 2003). Participants were asked to recall the number of days they performed each activity (frequency) and the length of time (duration) they were involved daily in each activity during the last 7 days. Data from the IPAQ-SF were summed up within each item (i.e., vigorous intensity, moderate intensity, and walking) to estimate the total amount of time

spent on PA per day. Previous research in patients with schizophrenia (Faulkner et al., 2006) shows that the IPAQ is a reliable and valid tool to assess PA levels in this population.

2.5. Behavioural Regulation in Exercise Questionnaire-3 (BREQ-3)

The Portuguese version of the BREQ-3 (Cid, Moutão, Monteiro, Teixeira, & Palmeira, in preparation) was used as an interviewer-administered questionnaire in order to ensure the participation of all patients regardless of their level of literacy. The BREQ-3 comprises 24 items and evaluates behavioural regulation in the PA context, assessing the following six dimensions: (i) amotivation (four items, e.g., “I don't see why I should have to do physical activities”); (ii) external regulation (four items, e.g., “I do physical activities because others will not be pleased with me if I don't”); (iii) introjected regulation (four items, e.g., “I feel guilty when I don't do physical activities.”); (iv) identified regulation (four items, e.g., “I value the benefits of physical activity.”); (v) integrated regulation (four items, e.g., “I do physical activities because it is consistent with my life goals.”) and; (vi) intrinsic regulation (four items, e.g., “I do physical activities, it is fun”). Each item is measured on a five-point Likert-scale, from 0 (“Not true for me”) to 4 (“Very true for me”). The mean of the six retrieved subscales is calculated on a five-point scale to score the extent of each motivation type separately. For the purpose of the present study, amotivation dimension was not included in the data analysis.

We adapted the BREQ-3 by replacing the term “exercise” with the term “physical activity” (Vancampfort, De Hert, et al., 2013). Secondly, we added a designation for option 1 and 3 (i.e., “few times true for me” and “many times true for me”, respectively), to make the answer option more clear to the participants (Costa et al., 2017).

In the present study, motivation for PA was investigated according to controlled (i.e., external and introjected regulation) and autonomous (i.e., identified, integrated and intrinsic regulation) motivation. This because previous research (Costa et al., 2017) demonstrated that the Portuguese BREQ-3 provides an acceptable measure of

controlled motivation and autonomous motivation in patients with schizophrenia that is consistent with the motivational continuum of SDT.

2.6. Rosenberg Self-Esteem Scale

Self-esteem was assessed using the Portuguese version of the Rosenberg Self-Esteem Scale (Vasconcelos-Raposo, Fernandes, Teixeira, & Bertelli, 2012). The scale consists of 10 items (five positively e.g., “I feel that I have a number of good qualities”; and five negatively e.g., “I feel I do not have much to be proud of”) measured on a 4-point Likert-scale, from 1 (“strongly disagree”) to 4 (“strongly agree”). Negatively worded items were reversed before any subsequent analysis, allowing for the calculation of a global score with possible values range between 10 and 40, where higher values represent higher levels of self-esteem.

Although the Rosenberg Self-Esteem Scale is widely used in a mental illness context (Carter & Kelly, 2015; Kahng & Mowbray, 2005; Kumar & Mohanty, 2016; Lysaker, Ringer, Maxwell, McGuire, & Lecomte, 2010), little is known about its psychometric properties in this population (Torrey, Mueser, McHugo, & Drake, 2000). Reliability assessed in previous studies with patients with severe mental illness found internal consistency exceeding 0.80 and test – retest reliability of 0.87 (Torrey et al., 2000). Specifically in patients with schizophrenia, the Rosenberg Self-Esteem Scale is applied at the national (Salgado, Rocha, & Marques, 2008) and international level (Kumar & Mohanty, 2016; Lysaker et al., 2010; Wykes, Reeder, Corner, Williamson, & Everitt, 1993). Data regarding psychometric properties in patients with schizophrenia is non-existent, studies suggests that these patients can also reliably complete the questionnaire (Lysaker et al., 2010; Wykes et al., 1993).

2.7. World Health Organization Quality of Life Scale – Brief version (WHOQOL-BREF)

Quality of life was assessed using the Portuguese version of the World Health Organization Quality of Life Scale – Brief version (WHOQOL-BREF) (Vaz-Serra et al., 2006). The WHOQOL-BREF includes 26 items categorised into four domains: i) physical (e.g., mobility, pain, fatigue and energy); ii) psychological (e.g., positive and negative feelings, memory and concentration); iii) social relationships (e.g., personal relationships and social support); and iv) environment (e.g., physical safety, health and leisure activities) and two questions related to global perception of quality of life and health. Each domain consists of three to eight items and each item is assigned a score on a five-point Likert scale. The domain scores of the WHOQOL-BREF were calculated according to the instructors' manual. Higher scores mean better quality of life. The Portuguese version of the WHOQOL-BREF was found to be a valid and reliable instrument, with an intra-class correlation coefficient (R) of 0.65 and a Cronbach's alpha of .92 (Vaz-Serra et al., 2006).

2.8. Functional exercise capacity

The 6-minute walk test (6MWT) was used to quantify functional exercise capacity. This test assimilates responses of the pulmonary and cardiovascular systems. The changes of functional exercise capacity are measured according to the number of meters walked (American Thoracic Society, 2002). Participants were asked to walk in an indoor corridor at their own preferred pace for 6 minutes. Walks were timed with a stopwatch for 6 minutes and measured to the nearest foot.

Analyses of reproducibility of the 6MWT for individuals with schizophrenia demonstrated that the 6MWT is both reproducible and reliable (intra-class correlation coefficient was equivalent to 0.94 [95% IC = 0.90 - 0.97] (Gomes et al., 2016) and 0.96 [95% IC = 0.94 - 0.98] (Vancampfort, Probst, et al., 2011b), indicating that it can be used to quantify the functional exercise capacity in this population.

2.9. Statistical analysis

Characteristics of the sample were expressed either as means and standard deviations or proportions. Cronbach's alpha was calculated to determine the internal consistency of the items of Rosenberg Self-esteem scale and of each BREQ-3 subscale. Pearson correlations were calculated in order to examine the bivariate relation between measured variables.

Multiple regression analysis, with the stepwise method, was used to explore the years of study, BMI, equivalent dosage of chlorpromazine, autonomous and controlled motivation, self-esteem, domains of quality of life and functional exercise capacity as significant predictors of Total PA per week. Regression assumptions were evaluated and a significance level of 0.05 was used. All analyses were carried out using the Statistical Package for Social Sciences (SPSS), version 24.0.

3. Results

A total of 114 Portuguese patients with a DSM-5 diagnosis of schizophrenia (American Psychiatric Association, 2013) with an average age of 44.25 (± 9.72) years were included in the study. Twenty eight (24%) were women, fifty-seven (50%) were inpatients and thirty (26%) were employed. Descriptive statistics, Cronbach's alpha, and Pearson correlations coefficient between the measured variables are presented in Table 1. Significant low to moderate linear correlations were found between autonomous and controlled motivation, self-esteem, domains of quality of life and total PA per week (Table 1).

Table 1. Mean (standard deviations), internal consistency and intercorrelations between variables measured.

Variable	Mean ± SD	α	1	2	3	4	5	6	7	8	9	10	11	12
1. Years of study	8.89 ± 4.06	-												
2. BMI (Kg/m^2)	28.61 ± 5.64	-	.12											
3. Chlorpromazine (mg/day)	550.22 ± 528.39	-	.70	-.009										
4. Autonomous motivation	2.65 ± 0.79	.90	.09	.13	.13									
5. Controlled motivation	1.33 ± 0.83	.82	-.16	.14	-.08	.37**								
6. Self esteem	29.63 ± 4.26	.63	.13	.05	.01	.16	-.16							
7. WHOQOL-BREF Global	65.23 ± 21.24	-	-.02	-.01	-.002	.18*	.05	.23*						
8. WHOQOL-BREF Physical	68.37 ± 13.29	-	-.03	-.10	.04	.26**	-.01	.48**	.60**					
9. WHOQOL-BREF Psychological	65.92 ± 16.39	-	.15	-.19*	.02	.26**	-.11	.47**	.62**	.56**				
10. WHOQOL-BREF Social	61.20 ± 20.00	-	-.10	-.18*	.12	.16	.04	.14	.37**	.40**	.36**			
11. WHOQOL-BREF Environmental	63.77 ± 14.77	-	-.08	-.04	.02	.25**	.10	.35**	.57**	.49**	.56**	.47**		
12. Functional exercise capacity	467.43 ± 76.88	-	-.02	-.30**	.01	.13	.06	.01	.09	.21*	.17	.09	.15	
13. Total PA per week	77.02 ± 67.33	-	-.05	.16	-.008	.25**	-.05	.15	.33**	.29**	.25**	.12	.25**	.00

SD = standard deviation; α = Cronbach's alpha; BMI = body mass index; WHOQOL-BREF = World Health Organization Quality of Life Scale – Brief version; PA = physical activity.

* $p<0.05$

** $p<0.01$

The stepwise linear regression model indicated that autonomous motivation and global domain of quality of life were significantly associated with Total PA per week (see Table 2). More autonomous motivation (B = 16.73, *p* = 0.045) and a better global domain of quality of life (B = 0.94, *p* = 0.003) were associated with higher Total PA per week.

Table 2. Results of multiple regression analyses with total minutes PA per week as the dependent variable and years of study, BMI, chlorpromazine, psychological measures and functional exercise capacity as independent variables.

Predictors	**B (95% CI)**	**SE**	**β**	**t**	***p***
Years of study			-0.06	-0.65	0.516
BMI (Kg/m^2)			0.14	1.45	0.150
Chlorpromazine (mg/day)			-0.03	-0.35	0.729
Autonomous motivation	16.73 (0.41 to 33.06)	8.22	0.20	2.04	**0.045**
Controlled motivation			-0.17	-1.61	0.111
Self-esteem			0.06	0.59	0.556
WHOQOL-BREF Global	0.94 (0.33 to 1.55)	0.31	0.30	3.04	**0.003**
WHOQOL-BREF Physical			0.09	0.75	0.458
WHOQOL-BREF Psychological			0.02	0.15	0.882
WHOQOL-BREF Social			0.02	-0.21	0.831
WHOQOL-BREF Environmental			0.05	0.42	0.67
Functional exercise capacity			-0.06	-0.56	0.575

B = unstandardised regression coefficient; CI = confidence interval; SE = standard error; β = standardized coefficients beta; BMI = body mass index; WHOQOL-BREF = World Health Organization Quality of Life Scale – Brief version;

4. Discussion

The promotion of active lifestyles is an increasing health priority in patients with schizophrenia. Investigating the factors that correlate with PA is important to understand, support and apply therapeutic rehabilitation strategies. To our knowledge, this is the first

study to analyse the association between several factors recognized as barriers to PA in patients with schizophrenia. The goal of this study was to investigate among a number of barriers what predicts the most on physical activity in patients with schizophrenia. Among the different factors identified as determinants for PA in patients in schizophrenia (Vancampfort et al., 2012), results showed that autonomous motivation and global domain of quality of life are the strongest predictors of PA in this population. There were no other significant associations between the measured factors (i.e., years of education, BMI, psychiatric medication, self-esteem or functional exercise capacity) and PA.

The present results are consistent with previous studies that examined relationships between autonomous motivation and PA in patients with schizophrenia (Vancampfort, De Hert, et al., 2013) and with other severe mental illnesses (Vancampfort, Stubbs, Venigalla, & Probst, 2015). The importance of autonomous motivation towards PA on active behaviour in patients with schizophrenia could be justified because in autonomous motivation, people are identified with the goals and value of PA and, consequently, volitionally adopt PA as a lifestyle. When patients with schizophrenia are autonomously motivated, they exhibit an open curiosity and interest about PA that promote successful participation in PA. Based on SDT, autonomous motivation is facilitated in environments that support three psychological constructs, namely need for autonomy (i.e., experiencing a sense of psychological freedom when engaging in PA), competence (i.e., ability to attain desired outcomes) and relatedness (i.e., being socially connected) (Deci & Ryan, 1985, 2000). Consequently, if the patients are physically active in an environment that is perceived as need supportive, they are more likely to be autonomously motivated and experience increased levels of well-being.

In patients with schizophrenia, quality of life is a complex construct influenced by several factors (e.g., sociodemographic, severity of psychopathology and physical health conditions) (Malhotra, Kulhara, Chakrabarti, & Grover, 2016; Munikanan et al., 2017; Pinikahana, Happell, Hope, & Keks, 2002). The results of the present study support that quality of life influences PA. Reciprocally, previous studies (Acil et al., 2008; Deenik et

al., 2017; Gomes et al., 2014; Vancampfort, Probst, Scheewe, et al., 2011) showed that higher PA can contribute to better quality of life in patients with schizophrenia. Positive interactions between PA and quality of life suggest a reciprocal relationship, where PA could represent an important modifiable factor to improve quality of life in this population. Our results demonstrated that, with the exception of the social domain, all other domains of quality of life correlated with Total PA per week. Pesek, Mihoci, Medved, and Solinc (2011) found that higher PA scores were associated with better quality of life, but only in the physical domain. In the regression analysis, the global domain was found as a significant predictor of PA. Further empirical studies are needed to confirm the relationship between PA behaviours and the domains of quality of life.

Moreover, practical implications of the present findings are that PA interventions ideally should consider and target changes in anthropometric, physical and psychological factors so as to achieve adequate active behaviours in patients with schizophrenia. A major focus in clinical practice should be considered to guide this population to be physically active and to help them to overcome potential barriers. Therefore, clinical practice guidelines should highlight the importance of autonomous motivation in order to improve PA behaviour in patients with schizophrenia. However, how to motivate patients with schizophrenia to adopt and maintain an active lifestyle is one of the greatest challenges facing researchers and clinicians (Sorensen, 2006). To increase autonomous motivation of this population, clinicians should minimize pressure and rewards; adopt supportive language and positive feedback; promote pleasant and enjoyable activities in a positive environment (Farholm & Sorensen, 2016; Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013). Adopting active behaviours and consequently a clearer perception about the benefits of PA could improve the quality of life of patients with schizophrenia.

4.1. Limitations and future research

The current findings should be interpreted with some caution due to some methodological considerations. This is a cross-sectional study, consequently the directionality of the relationships observed cannot be deduced with certainty. In this sense, longitudinal studies about how motivation towards PA might contribute to the identification of the causal pathways between the variables and about the relationships between PA behaviours and the domains of quality of life are needed. Second, the use of self-reported measures could be considered as a limitation. Namely in the IPAQ-SF, patients with schizophrenia might experience difficulties to properly identify the frequency, duration and intensity of PA. Moreover, although all participants were informed that data were analysed anonymously, we cannot rule out a bias in the sense of social desirability when self-reported measures are applied. Third, psychopathology symptoms were not formally assessed. Despite the current limitations, the present results could help to understand the importance of autonomous motivation and global domain of quality of life in adequate PA behaviours in patients with schizophrenia.

Acknowledgements

The authors would like to thank all of the participants, the collaborating psychiatrists', physiotherapists, nurses and physical activity teachers. We also would like to thank the following participating centres: (1) Associação Nova Aurora de Reabilitação Psicossocial (ANARP), Porto, Portugal; (2) Psychiatric Department of Hospital São João, Porto, Portugal; (3) Casa de Saúde São José, Barcelos, Portugal; (4) Casa de Saúde São João de Deus, Barcelos, Portugal; (5) Casa de Saúde do Bom Jesus, Braga, Portugal; (6) Clinica do Outeiro, Vila do Conde, Portugal; (7) Associação dos Familiares, Utentes e Amigos do Hospital Magalhães Lemos, Matosinhos, Portugal. The Research Centre on Physical Activity Health and Leisure (CIAFEL) is supported by UID/DTP/00617/2013.

Disclosure of Interest

The authors report no conflicts of interest.

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Study 3

Sleep quality in patients with schizophrenia: the relevance of physical activity

Sleep quality in patients with schizophrenia: the relevance of physical activity

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This study is accepted as:

Costa, R., Bastos, T., Probst, M., Seabra, A., Vilhena, E. & Corredeira, R. *Sleep quality in patients with schizophrenia: the relevance of physical activity*. Mental Health and Physical Activity (Accepted for publication).

Abstract

Patients with schizophrenia experience poor sleep quality that affects their physical and mental health. In the general population, physical activity (PA) is considered as a beneficial non-pharmacological intervention for sleep quality. However, there is a lack of research concerning its implications in the sleep quality of patients with schizophrenia. Therefore, the purpose of this study was to assess the associations between PA levels and sleep quality. One hundred and thirteen patients (28 women and 56 inpatients) with schizophrenia participated in the study. PA levels and sleep quality were assessed via standardized questionnaires, Short-Form International Physical Activity Questionnaire (IPAQ-SF) and Pittsburgh Sleep Quality Index (PSQI) respectively. Multiple linear regression models were conducted. Results demonstrated that sleep quality was positively associated with time of moderate and total PA per week. No associations were found between PA levels and anxiolytics and antipsychotic medication. Pearson's correlations showed that some of IPAQ-SF measures are negatively correlated with some PSQI components. More research is needed to explore the potential interaction between sleep quality and PA levels in patients with schizophrenia.

Keywords: physical activity levels, sleep quality, schizophrenia

1. Introduction

The lower levels of physical health in patients with schizophrenia is a major concern (De Hert, Schreurs, Vancampfort, & Winkel, 2009) specifically considering the alarming disparity compared with the general population (Hoang, Goldacre, & Stewart, 2013; Nielsen, Uggerby, Jensen, & McGrath, 2013). Patients with schizophrenia exhibit unhealthy lifestyle choices such as physical inactivity (G. Faulkner, Cohn, & Remington, 2006; Lindamer et al., 2008; Vancampfort et al., 2010), poor diet (Strassnig, Brar, & Ganguli, 2003) and high rates of cigarette smoking (Bobes, Arango, Garcia-Garcia, & Rejas, 2010). This unhealthy lifestyle causes poor physical health conditions such as cardiovascular disease, obesity, metabolic syndrome and diabetes (Cimo, Stergiopoulos, Cheng, Bonato, & Dewa, 2012; Crump, Winkleby, Sundquist, & Sundquist, 2013).

Additionally, these patients also experience poor sleep quality compared to the general population (Wulff, Dijk, Middleton, Foster, & Joyce, 2012). The term ‘‘sleep quality’’ encompasses perceived and/or objective measures of sleep aspects (e.g., onset) and effects (e.g., tiredness during the day) (Krystal & Edinger, 2008). Around 30 to 80% of patients with schizophrenia suffer from some form of disturbed sleep (Cohrs, 2008). In early course of schizophrenia, sleep disturbance occurs before the presence of psychotic symptoms (Davies, Haddock, Yung, Mulligan, & Kyle, 2017) and often persists after other symptoms have been treated (Baandrup, Jennum, Lublin, & Glenthoj, 2013). In patients with schizophrenia, frequent sleep disturbances include difficulties in initiating or maintaining sleep (Cohrs, 2008), advanced sleep phase syndrome (i.e., early evening bedtimes and early morning awakenings) and hypersomnia with short naps (Wirz-Justice, Haug, & Cajochen, 2001). Reduced sleep efficiency and total sleep time, increased sleep latency, decreased slow wave sleep and rapid eye movement (REM) latency were also observed in most patients with schizophrenia (Keshavan et al., 1998; Tandon et al., 1992; Wirz-Justice et al., 2001; Wulff et al., 2012). In these patients, positive symptoms (e.g., hallucinations, disorganized speech and behaviour) have been

reported to be correlated with short REM latency, reduced sleep efficiency (i.e., proportion of hours slept to hours spent in bed) and increased sleep latency (i.e., prolonged sleep onset time) (Poulin, Daoust, Forest, Stip, & Godbout, 2003; Tandon et al., 1992). On the other hand, negative symptoms (i.e., impairments in affective experience and expression) have been associated with short REM latency and slow-wave sleep deficits (Goder et al., 2004; Tandon et al., 1992).

Both inpatients (Ritsner, Kurs, Ponizovsky, & Hadjez, 2004; Waters, Faulkner, Naik, & Rock, 2012) and outpatients (Afonso, Figueira, & Paiva, 2014; Freeman, Pugh, Vorontsova, & Southgate, 2009; Palmese et al., 2011) with schizophrenia are affected by sleep disturbances. In first-episode patients, individuals with sleep disturbance reported low economic status, low educational level and higher depressive and anxiety symptoms (Ma, Song, Xu, Tian, & Chang, 2016). To deal with sleep disturbances sleep-inducing medication is often prescribed or antipsychotics are chosen because of their enhanced sedative properties (Wilson & Argyropoulos, 2012). However, even clinically stable, medicated patients maintain sleep disturbances (Afonso, Brissos, Canas, Bobes, & Bernardo-Fernandez, 2014). Sleep disturbances are positively associated with difficulties in daytime activities (Waters et al., 2012), greater positive symptoms (Afonso, Brissos, Figueira, & Paiva, 2011), impaired cognitive functions (Bromundt et al., 2011) and worse quality of life (Brissos et al., 2013; Hofstetter, Lysaker, & Mayeda, 2005; Ritsner et al., 2004). Moreover, sleep disturbances are a major contributor to obesity and cardiovascular illness (Czeisler, 2011) which are highly prevalent in patients with schizophrenia (Mitchell et al., 2013; Ringen, Engh, Birkenaes, Dieset, & Andreassen, 2014).

Faulkner and Bee (2017) indicated that management of sleep disturbance is neglected in clinical guidance of psychotic illnesses (including schizophrenia) when compared to other mental illnesses. According to the previously mentioned authors, psychological approaches (e.g., Cognitive Behavioural Therapy for Insomnia) for treatment of sleep disturbances in the general population has recently been applied to populations with

serious mental illness. In the general population, physical activity (PA) has been extensively recommended for the improvement of sleep quality (Chennaoui, Arnal, Sauvet, & Leger, 2015; Kredlow, Capozzoli, Hearon, Calkins, & Otto, 2015). However, it is still difficult to understand exactly how PA impacts on sleep and vice versa. In fact, sleep and PA influence each other through complex and reciprocal interactions involving multiple physiological and psychological pathways (Chennaoui et al., 2015). Hypotheses such as thermoregulation (i.e., the increase in body temperature facilitates the sleep induction) and energy conservation (i.e., the increase of calorie output promoted during sleep because exercise increases the need for sleep) provide a positive energetic balance, establishing a condition for the sleeping cycle (Chennaoui et al., 2015). The effects of PA on sleep are modulated by several factors such as individual (e.g., age, sex, and fitness level) and PA characteristics (e.g., exercise type, intensity duration and adherence) (Chennaoui et al., 2015; Kredlow et al., 2015). Regarding components of sleep, it is recognized that regular PA has beneficial effects on total sleep time, sleep efficiency, sleep onset latency, and sleep quality (Kredlow et al., 2015). Additionally, these authors suggested that regular PA leads to greater subjective and objective sleep benefits over time, with subjective benefits being comparable to those produced by behaviour therapy or pharmacotherapy for insomnia.

Although a significant body of research has investigated the effects of PA on sleep quality in the general population, there is lack of scientific evidence in the field of mental illness (Chien, Chung, Yeh, & Lee, 2015; Stanton, Donohue, Garnon, & Happell, 2016). Specifically, in schizophrenia, only one study was found regarding PA and sleep interactions. Lalande et al. (2016) reported that an 8-week PA programme (i.e., strength-training and cardiovascular fitness) improved sleep quality in outpatients. The authors suggested that sleep quality was associated with more energy and self-esteem and less depression, suggesting that PA could potentially act as an alternative to medication. However, limited information was provided regarding the different sleep components. In addition, it was not possible to identify the impact of the PA programme on good and

poor sleepers. Therefore, further research is needed to confirm this preliminary evidence and provide detail analyses regarding PA and sleep interactions in both inpatients and outpatients. This knowledge could be important for future PA approaches, helping to improve clinical outcomes and the efficiency and effectiveness of service provision to patients with schizophrenia. Thus, the purpose of this study was to assess the associations between PA levels and sleep quality.

2. Method

2.1. Participants and procedure

One hundred and thirteen patients diagnosed as schizophrenia and recruited from seven psychiatric centres, located in the north region of Portugal participated in this study. All participants of the study met the following criteria: more than 18 years old, without substance dependence and with a stable medication regimen (i.e., no medication changes within the last month). Psychiatric diagnosis of the participants was based on Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013) criteria and was established by experienced psychiatrists responsible for the patients' treatment. The study was approved by the Faculty Ethics Committee and by all the seven ethical committees. All participants gave their written informed consent.

2.2. Demographic and anthropometric variables

Demographic variables included gender, age and anthropometric measures. Weight was measured to the nearest 0.1 kg using a Tanita scale (BC-418MA, Tanita Corporation, Tokyo, Japan). Height was measured to the nearest 0.1 cm using a portable stadiometer (Siber Hegner). Body mass index (BMI) (kg/m2) was calculated. Patients wore light clothing with shoes removed.

In addition, dichotomous variables were constructed for employment (with and without employment), treatment setting (in- versus out- patients) and educational level (lower: basic education [i.e., grade 1 to grade 9] versus higher: secondary education or university).

2.3. Short-Form International Physical Activity Questionnaire (IPAQ-SF)

PA levels were assessed using the Portuguese version of the Short-Form International Physical Activity Questionnaire (IPAQ-SF) (Craig et al., 2003). IPAQ-SF comprises seven items and provides information on the time spent on PA (Craig et al., 2003). Participants were asked to recall the number of days they performed each activity (frequency) and the length of time (duration) they were involved daily in each activity during the last 7 days. Data from the IPAQ-SF were summed up within each item (i.e., vigorous intensity, moderate intensity, and walking) to estimate the total amount of time spent on PA per day. Previous research in patients with schizophrenia (G. Faulkner et al., 2006) shows that the IPAQ-SF is a reliable and valid tool to assess PA levels in this population.

2.4. Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) is a frequently used international questionnaire on sleep quality research in the general population (Afonso, Figueira, et al., 2014; João, Becker, Jesus, & Martins, 2017; Zhang et al., 2017) and in patients with schizophrenia (Afonso, Brissos, et al., 2014; Afonso, Figueira, et al., 2014; Brissos et al., 2013; Ma et al., 2016). PSQI comprises 18 self-rated questions designed to measure sleep quality during the previous month and evaluates 7 components of sleep: subjective quality, latency, duration, usual efficiency, sleep disturbances, medication use, and daytime dysfunction. These components consisted of the four-grade system (i.e. 0, 1, 2, 3) (Buysse et al., 1989). Subjective sleep quality was assessed 0–3 points (0 – very good sleep quality; 1 – fairly good sleep

quality; 2 – fairly bad sleep quality; 3 – very bad sleep quality). Sleep latency was assessed 0–3 points (minutes required to go to sleep each night and frequency of getting to sleep within 30 minutes). Sleep duration was assessed 0–3 points (0 – sleep duration >7 hours; 1 – 6 to 7 hours; 2 – 5 to 6 hours; 3 – <5 hours). Habitual sleep efficiency was assessed 0–3 points (proportion of hours slept to hours spent in bed, 0 – ≥85%; 1 – 75 to 84%; 2 – 65 to 74%; 3 – <65%). Sleep disturbance was assessed 0–3 points (having trouble sleeping because of some reasons and the frequency of those). Use of sleep medication was assessed 0–3 points (0 – not use during the past month; 1 – less than once a week; 2 – once or twice a week; 3 – three or more times a week). Daytime dysfunction was assessed 0–3 points (frequency of having trouble staying awake while eating meals, or engaging in social activity and frequency of having trouble keeping up enough enthusiasm to get things done). All component scores are summed up to produce a total score (range 0–21). The higher the score, the lower the sleep quality. The total score < 5 discriminates between good and poor sleepers.

PSQI is a valid, reliable and standardised measure of sleep quality to be used in psychiatric patients (Buysse et al., 1989). It discriminates good and poor sleepers and allows for an easy administration during clinical practice (Buysse et al., 1989). This questionnaire has favourable psychometric properties, with internal consistency reliability of .83 and test-retest reliability of .85 (Buysse et al., 1989).

In this study, the reliability of the total score was assessed using a test-retest procedure (two-week interval) with a random sub-sample of 40 patients with schizophrenia. For the total score of PSQI, intra-class correlation coefficient (R) was R ≤ 0.85.

2.5. Medication use

Current antipsychotic medication use was recorded for each patient and converted into a daily equivalent dosage of chlorpromazine (Gardner, Murphy, O'Donnell, Centorrino, & Baldessarini, 2010). In addition current anxiolytics medication use was recorded for each patient, and the mean of milligram (mg) per day was calculated.

2.6. Statistical analysis

Descriptive statistics (means and standard deviations) were calculated. Multiple linear regression models, using the enter method, were constructed where the dependent variable were PA levels measured by IPAQ-SF. Independent variables included age, gender, educational level, employment, treatment condition, chlorpromazine, anxiolytics, and sleep quality. Pearson's correlation coefficients were calculated to investigate the association between IPAQ-SF and PSQI components. Significance level was set at 0.05 throughout the analyses. Statistical procedures were done using SPSS 24.0.

3. Results

One hundred and thirteen Portuguese patients with a DSM-5 diagnosis of schizophrenia (American Psychiatric Association, 2013), were included in the study. Patients were predominantly male (n= 85) and fifty-six were inpatients. Their demographic and clinical characteristics are presented in Table 1, which shows that a greater proportion of participants reported attaining a low level of educational achievement. Similarly, a greater proportion of participants reported attaining low PA levels, with only five patients achieving 150 minutes/ week of MVPA as recommended by ACSM (American College of Sports Medicine, 2016). Regarding sleep quality, no difficulties (i.e., scores around zero) were reported in the sleep duration (0.29) and habitual sleep efficiency (0.39) components. In contrast, the use of sleep medication (2.27) component revealed that patients take frequently sleep medication (i.e., scores around three that means use of sleep medication three or more times per week).

Table 1. Demographic and clinical characteristics of 113 patients with schizophrenia, and scores on the IPAQ-SF and PSQI.

Variables	M ± SD (range)
Age (years)	44.33 ± 9.84 (20 - 63)
Sex n(%) female	28 (24.8%)
Low education level n(%)	70 (61.9%)
With employment n(%)	28 (24.8%)
Treatment condition n(%) inpatients	56 (49.6%)
Chlorpromazine equivalent dose (mg/day)	567.81 ± 517.88 (0 – 3400.0)
Anxiolytics (mg/day)	9.83 ± 15.28 (0 – 80.0)
BMI	28.68 ± 5.37 (17.9 - 46.1)
IPAQ-SF	
Walking PA (min/ week)	31.48 ± 25.53 (0 - 120)
Moderate PA (min/ week)	32.14 ± 43.71 (0 - 300)
Vigorous PA (min/ week)	7.39 ± 22.85 (0 - 180)
Total score PA (min/ week)	71.01 ± 57.43 (0 - 375)
Sedentary time (min/ day)	343.93 ± 163.85 (30 - 675)
MVPA (min/ week)	39.53 ± 49.69 (0 - 300)
≥ 150 MVPA (min/ week) n(%)	5 (4.4%)
PSQI	
Subjective sleep quality	0.72 ± 0.60 (0 - 3)
Sleep latency	1.03 ± 1.59 (0 - 6)
Sleep duration	0.29 ± 0.47 (0 - 2)
Habitual sleep efficiency	0.39 ± 0.80 (0 - 3)
Sleep disturbances	1.05 ± 0.65 (0 - 3)
Use of sleep medication	2.27 ± 1.28 (0 - 3)
Daytime dysfunction	1.50 ± 1.54 (0 - 6)
Total score	7.25 ± 3.50 (1 - 18)
Poor sleepers n(%)	76 (67.3%)

M= mean; SD = standard deviation; mg/day = milligram per day; BMI = body mass index; IPAQ-SF = International Physical Activity Questionnaire – Short form; PA = physical activity; min/ week = minutes per week; min/ day = minutes per day; MVPA = moderate and vigorous physical activity; PSQI = Pittsburgh Sleep Quality Index

Adjusted coefficients and 95% CI with IPAQ-SF measures as the dependent variables in multiple regression analyses are presented in table 2. Education level was positively associated with sedentary time, employment was positively associated with total PA, treatment condition was positively associated with time of vigorous PA and sedentary time. Also, sleep quality was positively associated with time of moderate and total PA. No significant associations were observed between independent variables and the walking PA.

The results showed that 13% of the variability of moderate PA was explained by sleep quality, 11% of the variability of vigorous PA was explained by treatment condition, 14% of the variability of total PA was explained by employment and sleep quality and 17% of sedentary time was explained by education level and treatment condition.

Table 2. Results of multiple linear regression analyses with the IPAQ-SF measures as the dependent variables and age, gender, educational level, treatment condition, chlorpromazine, anxiolytics, and sleep quality as independent variables.

	Walking PA		**Moderate PA**		**Vigorous PA**		**Total PA**		**Sedentary time**	
	$R^2 = 0.10$		$R^2 = 0.13$		$R^2 = 0.11$		$R^2 = 0.14$		$R^2 = 0.17$	
	B (95% CI)	***p***	**B (95% CI)**	***p***	**B (95% CI)**	***p***	**B (95% CI)**	***p***	**B (95% CI)**	***p***
Age	0.25 (-0.27 to 0.77)	0.34	-0.05 (-0.92 to 0.83)	0.92	-0.25 (-0.71 to 0.22)	0.43	-0.04 (-1.19 to 1.10)	0.94	1.64 (-1.57 to 4.85)	0.31
Gender	-6.44 (-18.13 to 5.25)	0.28	-5.71 (-25.35 to 13.93)	0.57	-4.14 (-14.52 to 6.24)	0.29	-16.29 (-41.92 to 9.33)	0.21	43.51 (-28.25 to 115.28)	0.23
Educational level	2.12 (-8.41 to 12.64)	0.69	-3.45 (-21.14 to 14.24)	0.70	-1.67 (-11.02 to 7.68)	0.72	-3.00 (-26.09 to 20.08)	0.80	67.29 (2.64 to 131.94)	**0.04**
Employment	8.83 (-2.65 to 20.30)	0.13	17.33 (-1.96 to 36.62)	0.08	5.79 (-4.41 to 15.98)	0.26	31.95 (6.78 to 57.12)	**0.01**	-33.67 (-104.15 to 36.82)	0.35
Treatment condition	-7.30 (-18.06 to 3.46)	0.18	-4.42 (-22.49 to 13.66)	0.63	12.07 (2.52 to 21.63)	**0.01**	0.35 (6.77 to 57.12)	0.98	83.02 (16.97 to 149.07)	**0.01**
Chlorpromazine (mg/day)	0.006 -0.004 to 0.02)	0.28	-0.007 (-0.02 to 0.01)	0.43	0.008 (-0.001 to 0.02)	0.08	0.007 (-0.02 to 0.03)	0.55	-0.007 (0.07 to 0.05)	0.82
Anxiolytics (mg/day)	-0.09 (-0.43 to 0.24)	0.58	0.07 (-0.50 to 0.63)	0.82	-0.02 (-0.32 to 0.28)	0.91	-0.04 (-0.78 to 0.70)	0.91	-0.29 (-2.36 to 1.79)	0.78
Sleep quality	3.23 (-6.89 to 13.35)	0.53	23.83 (6.82 to 40.83)	**0.006**	2.41 (-6.58 to 11.39)	0.60	29.46 (7.27 to 51.65)	**0.01**	-46.61 (108.75 to 15.54)	0.14

PA = physical activity; (Gender: female = 0, male = 1; Educational level: lower = 0, higher = 1; Employment: without = 0, with = 1; Treatment condition: inpatients = 0, outpatients = 1; Sleep quality: poor sleep = 0, good sleep = 1)

Table 3 shows Pearson correlation's between IPAQ-SF and PSQI components. The results indicated that walking PA was significantly correlated with sleep latency (r=-.20) and total score of PSQI (r=-.21); moderate PA was significantly correlated with total score of PSQI (r=-.20); total PA was significantly correlated with subjective sleep quality (r=-.20), with daytime dysfunction (r=-.20) and with total score of PSQI (r=-.26).

Table 3. Correlations between components of PSQI and PA levels of IPAQ-SF in patients with schizophrenia

		PA levels – IPAQ-SF				
		Walking PA (min/ week)	Moderate PA (min/ week)	Vigorous PA (min/ week)	Total PA (min/ week)	Sedentary time (min/ day)
PSQI components	Subjective sleep quality	- .04	-.19	-.10	-.20*	.06
	Sleep latency	- .20*	-.09	-.01	-.16	-.07
	Sleep duration	- .12	-.05	-.12	-.05	.13
	Habitual sleep efficiency	-.11	-.09	-.01	-.12	.02
	Sleep disturbances	-.06	-.12	-.05	-.10	.02
	Use of sleep medication	-.06	-.01	-.02	-.04	-.13
	Daytime dysfunction	-.10	-.16	-.09	-.20*	.06
	Total score	-.21*	-.20*	-.04	-.26**	-02

PA = physical activity; min/ week = minutes per week; min/ day = minutes per day

** p<0.01.

* p<0.05.

4. Discussion

4.1 Main findings

The purpose of the present study was to assess the associations between PA levels and sleep quality. This study demonstrated that sleep quality was positively associated with time of moderate and total PA per week. No associations were found between PA levels

and anxiolytics and antipsychotic medication. Comparative studies in patients with schizophrenia are lacking.

The majority of the participants reported lower educational level. According to Vancampfort et al. (2012) lower educated patients with schizophrenia are considered a vulnerable subgroup. The literature revealed that in the general population, individuals with lower educational level or economic status were more affected by sleep disturbances (Benbir et al., 2015; Xiang et al., 2008). In the present study, only 5 patients meet public health recommendations of 150 minutes of MVPA per week (American College of Sports Medicine, 2016). Therefore, more research is needed to determine the influence of active PA behaviours in sleep quality. Low adherence to PA recommendations is consistently reported in patients with schizophrenia (G. Faulkner et al., 2006; Vancampfort et al., 2012).

Regarding sleep quality, 67% of the patients reported a PSQI total score above 5, which is considered as poor sleep quality. A PSQI total score above 5 was also reported in previous studies in patients with schizophrenia (Afonso et al., 2011; Afonso, Figueira, et al., 2014; Ma et al., 2016; Ritsner et al., 2004; Waters et al., 2012). In addition, the PSQI total score reported in this study is higher than in patients with schizophrenia without sleep disturbances (Afonso, Brissos, et al., 2014) and in the general population (Afonso, Figueira, et al., 2014; Zhang et al., 2017).

Overall, the results of the present study showed a positive association between PA levels and sleep quality. These findings are in accordance with the Lalande et al. (2016) study in patients with schizophrenia, and also with different reviews in the general population (Chennaoui et al., 2015; Kredlow et al., 2015; Yang, Ho, Chen, & Chien, 2012), showing that potential intervention on PA levels could improve sleep quality. Specifically, the results found in the correlations analyses, demonstrated that PA levels were significantly and positively associated with some PSQI components. Although the correlation values were low, these results help to understand the importance of PA in sleep quality. Therefore, more research is needed to explore the potential interaction between sleep

quality and PA levels in patients with schizophrenia. Considering that similar evidence in the positive association between PA levels and sleep quality was reported between both schizophrenia and general population, it is possible to argue that patients with schizophrenia follow the same physiological mechanisms. For example, PA may improve sleep quality through increasing endorphin secretion, energy consumption, and body temperature (Chennaoui et al., 2015) in patients with schizophrenia. However, future research is needed to deeply understand the psychological and physiological effects of PA on sleep characteristics and its reciprocal relationship.

Treatment condition was positively associated with time of vigorous PA and sedentary time. Inpatients presented higher PA levels than outpatients, higher values of active minutes (with the exception of vigorous PA), and less sedentary time. These results are not in line with previous research (Kurebayashi & Otaki, 2017) where outpatients presented higher amounts of PA and less sedentary time in comparison with inpatients. In the present study, inpatients could present higher amounts of PA due to the activities available in psychiatry centres, such as PA sessions, walking activities, therapies and work activities. Additionally, the patients' adherence to the activities offered in the psychiatric centres is directly controlled by the practitioners. Similarly, it is important to highlight that the lower levels of PA reported for outpatients could be related with low confidence and motivation towards PA (Soundy, Stubbs, Probst, Hemmings, & Vancampfort, 2014; Vancampfort et al., 2013), as well as with lack of confidence, social support (Johnstone, Nicol, Donaghy, & Lawrie, 2009), finances, facilities and resources (Carter-Morris & Faulkner, 2003; McDevitt, Snyder, Miller, & Wilbur, 2006).

4.2 Practical implications

Sleep disturbances are frequently reported as a complaint by patients with schizophrenia. Therefore, the attention for sleep disturbances should be incorporated into standard clinical care for this population. Moreover, patients often indicate the

preference to take less medication (Peacey, Miller, Huthwaite, & Romans, 2012) and to be more interested in behavioural sleep interventions (Huthwaite, Miller, McCartney, & Romans, 2014). Therefore, non-pharmacological approaches are becoming increasingly important in daily clinical practice. Practitioners should highlight the importance of non-pharmacological interventions, and one of these interventions could be PA, which is low cost, widely available and has no side effects. In order to improve PA behaviour in patients with schizophrenia, practitioners could offer psycho-education sessions. Psychoeducation refers to the process of providing education and easy, understandable and valuable information, support and feedback regarding the benefits of PA to patients with schizophrenia (and their family members). With this insightful information, patients are often better able to address the challenges, and also experience more control and better well-being. It is considered as an essential component of the therapy programme. The combination between an active lifestyle and behaviour strategies for sleep quality (e.g., regular waking, sleep times and avoiding naps) may represent adequate and effective measures to improve sleep quality and quality of life, as well as reduce sleep medication.

4.3 Limitations and future research

The current findings should be interpreted with caution due to some methodological considerations. First, this study is a cross-sectional study and the directionality of the relationships observed cannot be deduced with certainty. Longitudinal and intervention studies should analyse the consequences of regular PA in the sleep quality in patients with schizophrenia. Second, the use of self-reported measures to asses PA and sleep quality can present a limitation in this population. For example, in the IPAQ-SF, patients with schizophrenia might experience difficulties in properly identifying the frequency, duration and intensity of PA. Although all participants were informed about the

anonymous analysis of the data, a bias in the sense of social desirability cannot be ruled out.

Despite the current limitations, the study provides preliminary data regarding PA levels and its relationship with sleep quality in patients with schizophrenia. Higher amounts of PA were associated with good sleep quality in patients with schizophrenia. The improvements in sleep quality may contribute to physical and mental health and consequently the quality of life in patients with schizophrenia.

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Study 4

The importance of physical activity on the sleep quality and quality of life in patients with schizophrenia

The importance of physical activity on the sleep quality and quality of life in patients with schizophrenia

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This study is submitted as:

Costa, R., Bastos, T., Probst, M., Seabra, A. & Corredeira, R. *The importance of physical activity on the sleep quality and quality of life in patients with schizophrenia.* Under review.

Abstract

Patients with schizophrenia present sleep disturbances affecting their quality of life (QoL). Physical activity (PA) is beneficial for QoL, however sleep quality has been understudied in this population. Objective: This study aims to compare the sleep quality and QoL between regular physical active and the non-physical active patients with schizophrenia. Methods: One hundred and eleven patients with schizophrenia (28 women and 54 inpatients) participated in the study. Sleep quality and QoL were assessed using Pittsburgh Sleep Quality Index and World Health Organization Quality of Life – brief version, respectively. International Questionnaire of Physical Activity – short form was applied to ensure the difference of PA behaviours between both groups. Results: Patients of regular physical active group presented significantly better sleep quality and less daytime dysfunction and use of sleep medication. Regarding QoL, patients of regular physical active group also showed better QoL across all domains, with statistical significance in global and physical domain. Conclusions: This study indicate that potentially intervening on regular PA could improve sleep quality and QoL in patients with schizophrenia.

Keywords: physical activity; sleep quality; quality of life; schizophrenia

1. Introduction

In schizophrenia, 30 to 80% of patients present some form of disturbed sleep (Cohrs, 2008). Increased sleep latency, reduced sleep efficiency and total sleep time are sleep disturbances frequently reported in this population (Tandon et al., 1992). Although sleep medication is frequently used in schizophrenia, it presents limited efficacy as a treatment for sleep disturbances (Waters, Faulkner, Naik, & Rock, 2012). Even clinically stable, medicated patients report sleep disturbances (Afonso, Brissos, Canas, Bobes, & Bernardo-Fernandez, 2014), that are positively associated with greater positive symptoms (Afonso, Brissos, Figueira, & Paiva, 2011), difficulties in daytime activities (Waters et al., 2012), and poor quality of life (QoL) (Brissos et al., 2013; Hofstetter, Lysaker, & Mayeda, 2005). In patients with schizophrenia, QoL is associated with emotional distress, low self-esteem and self-efficacy, lack of emotional and social support (Ritsner, Lisker, & Grinshpoon, 2014).

In general population, the importance of regular physical activity (PA) on sleep quality and QoL has been extensively documented (Kredlow, Capozzoli, Hearon, Calkins, & Otto, 2015; Yang, Ho, Chen, & Chien, 2012). In patients with schizophrenia, some studies associated PA with improved QoL (Gomes et al., 2014; Vancampfort et al., 2011) however there is a lack of studies exploring associations between PA and sleep quality. Only one study explored the relationship between PA and sleep quality in patients with schizophrenia. Lalande et al. (2016) found that an 8-week PA program (i.e., strength-training and cardiovascular fitness) improved sleep quality in outpatients. In addition, sleep quality was associated with more energy and self-esteem and less depression.

Considering the high prevalence of poor sleep quality and QoL in patients with schizophrenia, research regarding sleep components and the role of regular PA as an adjunctive approach to prevent its onset, is needed. The purpose of the present study is to compare the sleep quality and QoL between regular physical active and the non-physical active patients with schizophrenia.

2. Methods

2.1. Participants

One hundred and eleven patients diagnosed with schizophrenia recruited from seven Portuguese psychiatric centres participated in this study. All participants met the inclusion criteria: more than 18 years old, no substance dependence and a stable medication regimen within the last month. Psychiatric diagnosis was based on Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013) criteria established by experienced psychiatrists. The study was approved by the Faculty Ethics Committee and by the 7 ethical committees. All participants gave their written informed consent.

2.2. Instruments and procedure

Demographic variables and use of medication were collected. Current antipsychotic medication use was converted into a daily equivalent dosage of chlorpromazine (Gardner, Murphy, O'Donnell, Centorrino, & Baldessarini, 2010) and current anxiolytics medication use was calculated in milligram (mg) per day.

Regarding PA behaviours, patients were included in the regular physical active group if PA practice were offered as a part of the treatment (i.e., if they were at least 1 to 3 times per week involved in PA practice). The Portuguese version of the International Physical Activity Questionnaire short-form (IPAQ-SF) (Craig et al., 2003) was used to ensure the difference of total PA per week between groups. IPAQ-SF provides information on time spent walking, in vigorous- and moderate intensity activity. Data from the IPAQ-SF were summed within each item (i.e., vigorous intensity, moderate intensity, and walking) to estimate the total amount of time spent in PA per week. Validity and reliability data from 12 countries (including Portugal) showed that the IPAQ-SF is a valid and reliable measure of PA (Craig et al., 2003). Previous studies have used the IPAQ-SF to assess the PA levels of persons with schizophrenia (Faulkner, Cohn, & Remington, 2006; Vancampfort et al., 2013; Vancampfort et al., 2010).

The Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) is a reliable self-report questionnaire which rates sleep quality during the previous month, and evaluates 7 components of sleep: subjective quality, latency, duration, habitual efficiency, sleep disturbances, medication use, and daytime dysfunction. A score greater than five represents worse sleep quality. This questionnaire was included in Portuguese studies in patients with schizophrenia (Afonso, Brissos, et al., 2014; Afonso et al., 2011; Brissos et al., 2013).

The Portuguese version of the World Health Organization Quality of Life – Brief version (WHOQOL – BREF) (Vaz-Serra et al., 2006) comprises 26 items composed by physical, psychological, social and environmental domains of QoL. Higher scores mean better QoL. This Portuguese version is considered as valid and reliable (Vaz-Serra et al., 2006).

2.3. Statistical analysis

Descriptive statistics were calculated. Independent sample *t*-test and Chi-square were used to compare the variables between physical active group and non-physical active group. Pearson's correlation was used to investigate the association between sleep quality and QoL. Effect size was calculated using eta-squared (η^2) and interpreted as small (0.01), medium (0.06) or large (0.14) (Cohen, 1988). Significance level was set at 0.05 throughout the analyses. Statistical procedures were done using SPSS 24.0.

3. Results

Demographic, anthropometric and clinical characteristics of the sample are presented in Table 1. Significant statistical differences between physical active group and non-physical active group were found in anxiolytics medication and also in total minutes of PA per week. Both groups presented a score above 5 on the PSQI, which is considered as poor sleep quality (Table 2). Patients of physical active group have better sleep quality and components of sleep, with significant lower use of sleep medication and daytime

dysfunction. These patients, also reported better QoL in all domains, compared to patients of non-physical active group. Statistical differences were found in global and physical domain (Table 2). High effect-size was found for the PSQI total score and the WHOQOL – BREF domains.

Table 1. Comparison of the demographic, anthropometric and clinical characteristics between the physical active and non-physical active patients with schizophrenia.

Characteristics	**Total sample**	**Non-physical active group**	**Physical active group**	**Chi^2**
Gender	Men= 83 Women=28	Men= 29 Women=6	Men= 54 Women=22	0.183
Treatment condition	Inpatients= 54 Outpatients=57	Inpatients= 20 Outpatients=15	Inpatients= 34 Outpatients=42	0.224
		M ± SD	**M ± SD**	**p-value**
Age	44.25 ± 9.91	42.57 ± 9.90	45.03 ± 9.88	0.22[a]
Education (years)	8.92 ± 3.59	8.17 ± 3.20	9.27 ± 3.72	0.13[a]
BMI	28.75 ± 5.34	28.03 ± 4.65	29.08 ± 5.62	0.33[a]
Chlorpromazine (mg/day)	575.25 ± 519.38	629.44 ± 551.89	550.30 ± 505.53	0.45[a]
Anxiolytics (mg/day)	9.83 ± 15.39	15.97 ± 19.38	7.00 ± 12.30	**0.01[a]**
Total PA (min/week)	71.30 ± 57.90	52.29 ± 64.37	80.05 ± 52.84	**0.02[a]**

M = mean; SD = standard deviation; BMI = body mass index; mg/day = milligram per day; PA = physical activity; min/week = minutes per week

[a] Independent samples *t*-test.

Table 2. Comparison of sleep quality and quality of life between the physical active and non-physical active patients with schizophrenia.

Scales	Non-physical active group (n=35) M ± SD	Physical active group (n=76) M ± SD	t-test	p-value	η^2
PSQI:					
Subjective sleep quality	0.74 ± 0.56	0.68 ± 0.61	0.47	0.63	0.01
Sleep latency	1.06 ± 1.55	0.95 ± 1.54	0.34	0.72	0.01
Sleep duration	0.29 ± 0.45	0.30 ± 0.49	-0.17	0.86	0.004
Habitual sleep efficiency	0.49 ± 1.01	0.34 ± 0.70	0.76	0.45	0.04
Sleep disturbances	1.17 ± 0.61	0.99 ± 0.62	1.45	0.14	0.03
Use of sleep medication	2.66 ± 0.96	2.07 ± 1.38	2.58	**0.01**	0.05
Daytime dysfunction	2.03 ± 1.75	1.26 ± 1.38	2.48	**0.01**	0.10
Total score	8.43 ± 3.13	6.59 ± 3.33	2.74	**<0.01**	0.19
WHOQOL – BREF:					
Global domain	58.33 ± 25.70	67.90 ± 17.07	-1.95	**0.05**	0.20
Physical domain	61.68 ± 15.83	70.41 ± 11.87	-2.83	**<0.01**	0.36
Psychological domain	65.78 ± 19.20	66.32 ± 15.02	-0.15	0.87	0.24
Social domain	56.31 ± 21.55	62.72 ± 17.45	-1.62	0.10	0.21
Environmental domain	61.64 ± 16.48	63.22 ± 14.12	-0.50	0.61	0.29

M = mean; SD = standard deviation; η^2= eta-squared; PSQI = Pittsburgh Sleep Quality Index; WHOQOL – BREF = World Health Organization Quality of Life – Brief version

Significant negative correlations were found between WHOQOL – BREF and PSQI, indicating that lower QoL correlates with worse sleep quality. WHOQOL – BREF global domain correlated [r= -0.20 to -0.29; p<0.05] with total PSQI score, subjective sleep quality, sleep disturbances and daytime dysfunction. WHOQOL – BREF physical domain was related [r= -0.25 to -0.43; p<0.01] with total PSQI score, subjective sleep quality, sleep latency, sleep disturbances and daytime dysfunction. WHOQOL – BREF psychological domain was associated [r= -0.19 to -0.25; p<0.05] with total PSQI score, subjective sleep quality, sleep disturbances, and daytime dysfunction. WHOQOL – BREF social domain correlated with daytime dysfunction (r= 0.22; p= 0.01). WHOQOL – BREF environmental domain correlated with habitual sleep efficiency and daytime dysfunction with the exact same values (r= 0.19; p= 0.04).

4. Discussion

This study examined the differences in sleep quality and QoL between physical and non-physical active patients with schizophrenia. Patients of the physical active group showed significantly better sleep quality. These findings are in line with research in general population, suggesting that PA improves sleep quality (Kredlow et al., 2015; Yang et al., 2012). In general population, better sleep quality was also found in PA groups compared with inactive groups (Zhang et al., 2017). Similar results were found in patients with major depression (Chien, Chung, Yeh, & Lee, 2015), affective disorder (Stanton, Donohue, Garnon, & Happell, 2016) and schizophrenia (Lalande et al., 2016).

The physical active group showed better subjective sleep quality and daytime dysfunction. Concerning the components of sleep quality, patients of the physical active group revealed lower use of sleep medication and daytime dysfunction (i.e., trouble staying awake while engaging in social activity). Similarly, Yang et al. (2012) found that, in general population, the physical active group had significantly reduced sleep latency (i.e., prolonged sleep onset time) and medication use, but did not differ significantly in sleep duration, sleep efficiency (i.e., proportion of hours slept to hours spent in bed), sleep disturbance, or daytime functioning. Is important to highlight that in the non-physical active group the portion of inpatients is higher compared with physical active group. Inpatients could present worse prognostic of the disease, which represents higher dosage of anxiolytics and suffering more often from daytime dysfunction. More research is necessary in order to explore the difference of sleep components between inpatients and outpatients. Physical active patients reported better QoL in all domains, compared to non-physical active patients, which is consistent with previous studies in patients with schizophrenia (Gomes et al., 2014; Vancampfort et al., 2011).

Although with low values, the results of correlation analysis showed that lower QoL correlates with worse sleep quality. Only two components of sleep (i.e., sleep duration and use of sleep medication) were not related with domains of QoL. Afonso et al., (2011) reported that patients with schizophrenia presented significantly higher periods of sleep

when compared with healthy controls. This situation can occur due to sedative effects of antipsychotics, high dosage of anxiolytics, absence of time schedules and psychological reasons (e.g. depressive symptoms). However, due to the disease characteristics, patients could not realize the negative effects in their QoL. For other hand, sleep disturbances and daytime dysfunction correlate with almost all the domains of QoL. This could be justified by daytime napping and night-time fragmentation that are common in patients with schizophrenia (Afonso et al., 2011). This uncontrollably irregular pattern of sleep could increase daytime sleepiness, also common in this population (Afonso et al., 2011), which could interfere with work, social and family activities (Afonso et al., 2011), compromised their QoL.

This study indicate that potentially intervening on regular PA could improve sleep quality and QoL in patients with schizophrenia. In mental illness context, patients reported preferences in the reduction of medication, and are interest in alternative non-pharmacological interventions to improve sleep quality (Peacey, Miller, Huthwaite, & Romans, 2012). Therefore, PA should be considered as an option of non-pharmacological approach. This would improve the QoL in patients with schizophrenia and could lead to a more successful rehabilitation and social integration (Afonso, Figueira, & Paiva, 2014). Other strategies, focusing on regular waking and sleep times, avoiding naps and morning bright light are also recommend (Afonso, Figueira, et al., 2014).

However due to some methodological considerations, these findings should be read with caution. This cross-sectional study did not observe the directionality of the relationships. In addition, the use of self-reported measures and the non-inclusion of psychopathological symptoms could be a limitation. Future longitudinal intervention studies should analyse the consequences of regular PA in sleep quality, considering the severity of the illness and type of medication used by the patients.

Acknowledgements

The authors would like to thank all of the participants, the collaborating psychiatrists', physiotherapists, nurses and physical activity teachers. We also would like to thank the following participating centres: (1) Associação Nova Aurora de Reabilitação Psicossocial (ANARP), Porto, Portugal; (2) Psychiatric Department of Hospital São João, Porto, Portugal; (3) Casa de Saúde São José, Barcelos, Portugal; (4) Casa de Saúde São João de Deus, Barcelos, Portugal; (5) Casa de Saúde do Bom Jesus, Braga, Portugal; (6) Clinica do Outeiro, Vila do Conde, Portugal; (7) Associação dos Familiares, Utentes e Amigos do Hospital Magalhães Lemos, Matosinhos, Portugal. The Research Centre on Physical Activity Health and Leisure (CIAFEL) is supported by UID/DTP/00617/2013.

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Study 5

Dietary intake, adherence to Mediterranean diet and lifestyle-related factors in people with schizophrenia

Dietary intake, adherence to Mediterranean diet and lifestyle-related factors in people with schizophrenia

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This study is submitted as:

Costa, R., Teasdale, S., Abreu, S., Bastos, T., Probst, M., Rosenbaum, S., Ward, P.B. & Corredeira, R. *Dietary intake, adherence to Mediterranean diet and lifestyle-related factors in people with schizophrenia.* Under review

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Abstract

The purpose of the present study was to examine the dietary intake of both inpatients and outpatients with schizophrenia in the Portuguese population as a potential key contributing factor to the poor physical health profiles, and understand the relationship of diet quality to other lifestyle factors. Material and methods: Participants of this cross-sectional study completed a semi quantitative food frequency questionnaire. Diet quality was determined by adherence to the Mediterranean Diet. In addition participants completed the International Physical Activity Questionnaire- Short Form and Pittsburgh Sleep Quality Index. Tobacco smoking was assessed through a series of general questions. Results: A total of 100 patients (50% inpatients and 28% female) with schizophrenia were included in the final analysis. Overall diet quality (Mediterranean Diet score) was low to moderate. Patients reported a high consumption of caffeine, while deficits were evident for fibre and folate intakes, when compared to the European Food Safety Authority recommendations. Outpatients had higher consumption of meat and meat products (p = 0.002), fruits and nuts (p = 0.001). Smokers reported poorer diet quality when compared to non-smokers (p < 0.001). Conclusions: Characteristics of dietary intake should be considered in further lifestyle interventions, in order to improve physical health of this population.

Keywords: dietary patterns; diet quality; smoking; physical activity; sleep quality; schizophrenia

1. Introduction

People with schizophrenia present two to three times higher rates of mortality when compared with general population (Brown, Inskip, & Barraclough, 2000; Brown, Kim, Mitchell, & Inskip, 2010; Correll et al., 2017; Saha, Chant, & McGrath, 2007). While a proportion of the excess of mortality is caused by suicide, the majority is related to natural causes (Brown et al., 2000). People with schizophrenia are at a more than fourfold increased risk for abdominal obesity (odds ratio [OR] of risk = 4.43), and more than double the risk of low HDL cholesterol (OR = 2.35), metabolic syndrome (OR = 2.35) and hypertriglyceridemia (OR = 2.73), and finally, almost twice the risk (by odds) for diabetes (OR = 1.99) and hypertension (OR = 1.36), when compared with general population (Vancampfort et al., 2013). The association of these comorbidities and schizophrenia is a complex interplay between lifestyle-related factors, illness related factors (e.g., negative symptoms), and also effects of psychotropic medication treatment. Psychotropic medication treatment is associated with several metabolic side effects namely, weight gain, glucose intolerance, leptin and insulin resistance, dyslipidemia and alterations of cardiac function (Osby, Correia, Brandt, Ekbom, & Sparen, 2000; Stahl, Mignon, & Meyer, 2009).

Concerning lifestyle-related factors, people with schizophrenia have unhealthy lifestyles behaviours, including lack of physical activity (PA) (Faulkner, Cohn, & Remington, 2006; Stubbs, Firth, et al., 2016; Stubbs, Williams, Gaughran, & Craig, 2016), poor sleep quality (Cohrs, 2008; Wulff, Dijk, Middleton, Foster, & Joyce, 2012), high rates of tobacco smoking (Kalman, Morissette, & George, 2005; Lasser et al., 2000; McCreadie, 2002), alcohol consumption and substances abuse (Brown, Birtwistle, Roe, & Thompson, 1999) and poor diet quality (Brown et al., 1999; Dipasquale et al., 2013; McCreadie, 2003; Stokes & Peet, 2004). In this population, dietary habits are generally characterized by a high intake of saturated fat (Amani, 2007; Brown et al., 1999; Henderson et al., 2010; Strassnig, Brar, & Ganguli, 2005), sugar (Stokes & Peet, 2004) and low intake of fibre, fruit and vegetables (Brown et al., 1999; Gupta & Craig, 2009; Henderson et al., 2006;

McCreadie, 2003). In addition, a significantly increased intake of energy (Strassnig, Brar, & Ganguli, 2003) and a low consumption of both monounsaturated and polyunsaturated fatty acids (Henderson et al., 2006) were also reported.

In people with schizophrenia, some factors could influence the adherence to a healthy dietary pattern. Although there is a consensus regarding the influence of low socioeconomic status (Roick et al., 2007; Samele et al., 2007), data on gender and smoking behaviours remain inconsistent (Dipasquale et al., 2013). Moreover, differences between inpatients and outpatients have been unexplored. Regarding smoking behaviours, current smoking was found to be significantly associated with increased prevalence of caffeine consumption, in inpatients and outpatients with schizophrenia (Arrojo-Romero et al., 2015). There is an increasing body of evidence concerning the influence of antipsychotic treatment in increase hunger and decrease satiety (Blouin et al., 2008; Treuer et al., 2009). Specifically, second-generation antipsychotics are associated with an increase in appetite and food intake that can contribute to weight gain (Cuerda, Velasco, Merchan-Naranjo, Garcia-Peris, & Arango, 2014; Fountaine et al., 2010). Additionally, adverse eating styles including disordered eating habits, fast-eating syndrome, and increased consumption of junk food and low food literacy were also observed (Blouin et al., 2008; Hardy & Gray, 2012; Treuer et al., 2009). Concerning that, and due to the role of healthy diet on weight lost, insulin resistance, dyslipidemia and hypertension (Bonfioli, Berti, Goss, Muraro, & Burti, 2012; Bruins et al., 2014; Wu, Wang, Bai, Huang, & Lee, 2007), traditional dietary patterns with proven benefits on health may be recommended for people with mental illness (Teasdale, Samaras, Wade, Jarman, & Ward, 2017). Additionally, it is important to highlight that extensive evidence supporting an association between healthy dietary patterns and a decreased risk of morbidity and mortality (Estruch, Ros, & Martinez-Gonzalez, 2013; Harmon et al., 2015; Sofi, Macchi, Abbate, Gensini, & Casini, 2014; Sotos-Prieto et al., 2017). Specifically, a meta-analyses showed that higher diet quality score measured with Mediterranean diet was 8% reduction of overall mortality, and a 10% reduced risk of cardiovascular disease (Sofi et

al., 2014). More recently Sotos-Prieto et al. (2017) found consistent associations between improved diet quality and a reduced risk of death. In contrast, worsening diet quality over 12 years was associated with an increase in mortality of 6 to 12%.

The Mediterranean diet is a dietary pattern characterized by the by high intake of legumes, fruits, nuts, cereals and olive oil, moderate intake of fish, seafood, poultry, dairy products, eggs and wine, and low intake of red meat. In the general population, an adequate adherence to the Mediterranean diet has found to reduce all-cause mortality and cardiovascular morbidity (Mitrou et al., 2007; Sotos-Prieto et al., 2017; Trichopoulou et al., 1995), reduce some types of cancer (de Lorgeril & Salen, 2006; Trichopoulou et al., 1995) and improve metabolic syndrome factors (Hill & Kris-Etherton, 2008; Panagiotakos, Chrysohoou, Pitsavos, & Stefanadis, 2006; Papakonstantinou et al., 2005). In mental heath field, namely in depression, a systematic review of randomised controlled trials (Opie, O'Neil, Itsiopoulos, & Jacka, 2015) and a recent randomised controlled trial (Jacka et al., 2017; Parletta et al., 2017) showed that dietary interventions can result in improved depression scores among different clinical and healthy populations. However, for people with schizophrenia there are minimal studies incorporating validated diet quality scores as outcomes in people with schizophrenia and none investigating Mediterranean diet applications and possible benefits.

A better understanding of the characteristics of dietary patterns in people with schizophrenia revealed great importance because diet are major and modifiable cause of cardiovascular disease (Dipasquale et al., 2013). Furthermore, interventions targeting dietary patterns in people with schizophrenia could offer a greater benefit if synergetic effects can be detected in relation to metabolic syndrome-related conditions. Therefore, the current study has three major aims. The first aim involved assessing the dietary intake of people with schizophrenia in a Portuguese population. The second aim was to determine the adherence to Mediterranean diet in this population, specifically analysing the difference between treatment setting (i.e., inpatients and outpatients). Finally, the

third aim was to explore the adherence to Mediterranean diet in relation with lifestyle-related factors (PA, tobacco smoking and sleep quality).

2. Method

2.1. Study design: participants and procedures

The study was planned and implemented using the guidelines of the Strengthening the Reporting of Observational Studies in Nutritional Epidemiology (STROBE-nut) Statement (Lachat et al., 2016). People diagnosed with schizophrenia from seven psychiatric centres, located in the northern region of Portugal, were invited to participate. Inclusion criteria were: (i) 18 years of age or older, and (ii) stabilised on psychotropic medication, defined as no medication changes within the last month. Exclusion criteria included: (i) an inability to provide informed consent, (ii) an inability to speak Portuguese, iii) an inability to concentrate for at least 20 minutes (as determined by the treating psychiatrist), (iv) diagnosed with a neurological disorder, or (v) diagnosis of substance abuse or dependence in the previous six months. Psychiatric diagnosis of the participants was based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (American Psychiatric Association, 2013) criteria and was determined by treating psychiatrists. The study procedure was approved by the Faculty Ethics Committee (CEFADE 13.2014) and by each one of the seven psychiatric centres. All participants provided written informed consent.

2.2. Instruments

2.2.1. Demographic and anthropometric

Socio-demographic details (e.g., age, educational level, current antipsychotic medication) and anthropometric measures (i.e., weight, height and waist circumference) were taken. Current antipsychotic medication was recorded for each participant and converted into a daily equivalent dosage of chlorpromazine (Gardner, Murphy, O'Donnell, Centorrino, & Baldessarini, 2010). Weight was measured to the nearest 0.1

kg using a Tanita scale (BC-418MA, Tanita Corporation, Tokyo, Japan). Height was measured to the nearest 0.1 cm using a portable stadiometer (Siber Hegner). Waist circumference was taken horizontally at the halfway point between the patients' lowest rib and top of the iliac crest. Waist circumference was classified in ideal or in increased risks, according to Alberti et al. (2005). In all procedures, participants wore light clothing with shoes removed. Body mass index (BMI) (kg/m^2) was calculated and classified according to the World Health Organisation (2016) categories of underweight, normal, overweight or obese (class I, II or III).

2.2.2. Lifestyle-related factors

Moderate to vigorous PA [MVPA (min/week)] was determined using the Portuguese version of the Short-Form International Physical Activity Questionnaire (IPAQ-SF) (Craig et al., 2003). A cut-off ≥ 150 minutes of MVPA per week discriminate between patients that follows the public health recommendation for adults (American College of Sports Medicine, 2016). Sleep quality was measured with the Portuguese version of Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). A global PSQI score higher than 5 indicates clinical levels of sleep disturbances (Waters, Naik, & Rock, 2013), which represents poor sleep quality.

Tobacco smoking was assessed by two verbal questions from the investigator; (i) does the patient smoke, and (if the patient did smoke) (ii) how many cigarettes the patient smoked per day.

2.2.3. Dietary assessment

Dietary intake was recorded using a semi quantitative food frequency questionnaire (FFQ) of the previous 12 months, designed according to Willett (1998) and adapted to include a variety of typical Portuguese food items (Lopes, Aro, Azevedo, Ramos, & Barros, 2007). The FFQ comprises 86 food items or beverage categories, with a frequency section with nine possible responses (i.e., never to six or more times per day).

Two previous studies have used the FFQ to assess the dietary intake in people with schizophrenia (Amani, 2007; Henderson et al., 2006). Food Processor Plus Software (ESHA Research, Salem, Oregon) was used based on values from the US Department of Agriculture. Values for typical Portuguese foods were computed using the Portuguese Tables of Food Composition (Porto & Oliveira, 2006). Nutrient intake data were obtained by multiplying the frequency of consumption of each food item by the nutrient content of the specified portion size, with once a day equal to one.

Adherence to the Mediterranean diet was determined according to the method developed by Trichopoulou et al. (1995), and revised to include fish intake (Trichopoulou, Costacou, Bamia, & Trichopoulos, 2003). Each of the nine components was assigned a value of 0 or 1, using sex-specific median as the cut-off. For beneficial components (i.e., vegetables, legumes, fruits and nuts, cereal, and fish), value of 0 was assigned when consumption was below the median and value of 1 was assigned when consumption was at or above the median. For components presumed to be detrimental (i.e., meat, poultry, and dairy products), a value of 0 was assigned when consumption was at or above the median and a value of 1 was assigned when consumption was below the median. For alcohol, a value of 1 was assigned when consumption ranged between 5 and 25 g per day for women, and when consumption ranged between 10 and 50 g per day for men. For fat intake, the ratio of monounsaturated lipids to saturated lipids was used. Thus, the total Mediterranean diet score (MDS) ranged from 0 (minimal adherence to Mediterranean diet) to 9 (maximal adherence).

Estimated energy requirement (EER) was calculated for each subject using the Schofield equation (Schofield, 1985) to determine basal metabolic rate (BMR) based on age, sex and weight, utilising adjusted body weight where appropriate (Krenitsky, 2005). Each individuals BMR was then multiplied by a physical activity level to determine the EER (Black, 2000). To assess for implausible data, the Goldberg et al. (1991) cut-off was utilised, with an estimated energy intake (EEI)/BMR ratio of <0.9 considered to be underreporting (Goldberg et al., 1991).

For males and females, the average daily intakes of energy, macro- and selected micro nutrients were compared to the follow references values: European Food Safety Authority (2017), Babor et al. (2001), and European Food Safety Authority (2015).

2.3. Statistical analysis

Descriptive statistics were summarized for the demographic characteristics, dietary intake and lifestyle-related factors of the participants. The mean and standard deviation were reported for continuous variables, and count and percentage was reported for categorical variables. For continuous variables, data were tested for normality using the Kolmogorov-Smirnov test. Independent sample *t*-test was used to calculate the difference between energy intake and calculated energy requirement. Mann–Whitney U-test was used to calculate the difference between caffeine consumption in smokers and non-smokers. For categorical variables, chi-square test was performed to identify differences between lifestyle-related factors. Statistical significance was set at $p < 0.05$. SPSS version 24.0 was used in all analyses (Chicago, IL, USA).

3. Results

A total of 115 Portuguese patients with a DSM-5 (American Psychiatric Association, 2013) diagnosis of schizophrenia were initially included in the analysis. A total of 15 (13.04%) patients were considered to be reporting implausible data (EI/BMR ratio of <0.9), and consequently were excluded from the analysis. The final sample characteristics are presented in Table 1. Results shows that 50% of the sample were inpatients. The majority of the sample (46%) had elementary level of education and 24% were employed. Regarding anthropometric characteristics, only 22% presented a normal weight, and 26% an ideal waist circumference.

Table 1. Demographic, anthropometric, clinical and lifestyle characteristics of people with schizophrenia (n=100).

	Mean (SD)
Age (years)	44.57 (9.68)
Sex	
Female (%)	28%
Employment situation	
With employment (%)	24%
Educational level	
Primary school (%)	17%
Elementary school (%)	46%
High school (%)	28%
University education (%)	9%
Treatment condition	
Inpatients (%)	50%
Weight (kg)	80.92 (17.12)
BMI (kg/m^2)	28.95 (5.67)
Weight status	
Underweight (%)	2 %
Normal weight (%)	22 %
Overweight (%)	32 %
Obesity class I (%)	29%
Obesity class II (%)	12%
Obesity class III (%)	3%
Waist circumference (cm)	99.62 (16.70)
Ideal (%)	26%
Increased risks	
Male >94 cm (%)	53%
Female ≥ 80 cm (%)	21%
Chlorpromazine equivalent dose (mg/day)	573.38 (537.58)
Antipsychotic medication	
No antipsychotic (%)	5%
Monotherapy first-generation (%)	5%
Monotherapy second-generation (%)	31%
Combination of antipsychotics	
First-generation (%)	11%
Second-generation (%)	17%
First- and second generation (%)	31%
MVPA (min/week)	42.07 (55.64)
≥ 150 minutes PA per week (%)	5%
Sleep quality global score	7.9 (4.1)

Poor sleepers (%)	57%
Smokers (%)	65%
Cigarettes per day	10.4 (10.8)

SD = standard deviation; mg/day = milligram per day; BMI = body mass index; MVPA = moderate to vigorous physical activity; PA = physical activity.

Average daily intakes of energy, macro- and selected micro-essential nutrients and reference values for males and females are presented in Table 2. Results showed that female reported an energy intake higher and males slightly lower than reference values. In both genders, values reported for proteins and the majority of the vitamins were higher than reference values. Values reported for total carbohydrates and total fats were consistent with reference values. In addition, energy intake was lower than calculated energy requirement 230 ± 551 kcal (t= 4.18 *p*= <0.001).

Table 2. Average daily intakes of energy, macro- and selected micro nutrients for the study participants.

	Male	Reference value	Female	Reference value [c]
Energy intake, kcal/day	2166 ± 378	2221 [c]	2039 ± 548	1791 [c]
Proteins, g/day	99 ± 21	70 [c]	98 ± 29	60 [c]
Total carbohydrates, g/day	279 ± 51		256 ± 74	
%EI	51 ± 5	45-60 [c]	50 ± 6	45-60 [c]
Sugar, g/day	114 ± 38		106 ± 40	
Complex Carbohydrate, g/day	87 ± 20		82 ± 25	
Fibres, g/day	21 ± 6	25 [c]	22 ± 8	25 [c]
Cholesterol, mg/day	321 ± 101		308 ± 120	
Total fats, g/day	74 ± 18	20-35 [c]	72 ± 24	20-35 [c]
%EI	31 ± 3		32 ± 5	
Saturated fats, g/day	23 ± 7		21 ± 8	
%EI	10 ± 1.5	< 10 [c]	9 ± 2	< 10 [c]
Trans fat g/day	1 ± 0.3		0.9 ± 0.5	
%EI	< 1	< 1 [c]	< 1	< 1 [c]
Monounsaturated fats, g/day	32 ± 8		33 ± 12	
Polyunsaturated fats, g/day	13 ± 4		12 ± 4	
Omega 3	1 ± 0.4		1 ± 0.4	
EPA + DHA	0.381 ± 0.249	0.250 [c]	0.440 ± 0.314	0.250 [c]
ALA	1.5 ± 0.4	0.5 [c]	1.2 ± 0.5	0.5 [c]
Omega 6/Omega 3 ratio	7.3 ± 1.6		7.0 ± 2.1	
Caffeine, mg/day	969 ± 53	400 [e]	679 ± 49	400 [e]
Alcohol, g/day	0.5 ± 1	< 20 [d]	0.3 ± 1	< 10 [d]
Vitamin A, RE µg/day	1837 ± 846	750 [a]	1674 ± 1095	650 [a]
Vitamin B1 (Thiamine), mg/day	2 ± 0.4	0.1 [a]	2 ± 0.5	0.1 [a]
Vitamin B2 (Riboflavin), mg/day	2 ± 0.5	1.6 [a]	2 ± 0.9	1.6 [a]
Vitamin B3 (Niacin), mg/day	24 ± 5	1.6 [a]	23 ± 7	1.6 [a]
Vitamin B5 (Pantothenic acid), mg/day	5 ± 1	5 [b]	5 ± 2	5 [b]
Vitamin B6, mg/day	2 ± 0.6	1.7 [a]	2 ± 0.6	1.6 [a]
Vitamin B9 (Folate), µg/day	315 ± 102	330 [a]	296 ± 113	330 [a]
Vitamin B12, µg/day	11 ± 6	4.0 [b]	10 ± 6	4.0 [b]
Vitamin C, mg/day	113 ± 45	110 [a]	130 ± 46	95 [a]
Vitamin D, µg/day	4 ± 2		4 ± 2	
Calcium, mg/day	878 ± 332	950 [a]	1028 ± 477	950 [a]
Iron, mg/day	16 ± 3	11 [a]	14 ± 4	16 [a]
Magnesium, mg/day	308 ± 74	350 [b]	323 ± 95	300 [b]
Sodium, mg/day	2157 ± 578	2000 [c]	1852 ± 715	2000 [c]
Phosphorous, mg/day	1379 ± 340	550 [b]	1446 ± 464	550 [b]
Potassium, mg/day	3350 ± 843	3500 [b]	3629 ± 1116	3500 [b]
Zinc, mg/day	12 ± 3	7.5-12.7 [c]	12 ± 4	7.5-12.7 [c]

EI = energy intake; RE = retinol activity equivalents. [a] RI – reference intake; [b] AI – adequate intake; [c] European Food Safety Authority (2017); [d] Babor et al. (2001); [e] European Food Safety Authority (2015).

The consumption of each of the 9 components of the Mediterranean diet, for total sample, and the difference of food components between inpatients and outpatients are presented on Table 3. Between inpatients and outpatients, statistical differences were found in meat and meat products group and fruits and nuts group. However no significant difference was found in total score MDS.

Table 3. Components of the MDS, for total sample, and the difference between inpatients and outpatients.

Components of the MDS (g/day)	Total sample M ± SD	Inpatients M ± SD	Outpatients M ± SD	*p*-value	η^2
Fish	66.12 ± 36.70	62.14 ± 33.37	70.10 ± 39.69	0.32	0.012
Meat and meat products	121.25 ± 45.59	109.69 ± 41.90	132.81 ± 46.59	**0.002**	0.065
Dairy products	382.22 ± 267.13	364.06 ± 191.03	400.38 ± 327.12	0.46	0.005
Legumes	43.75 ± 40.42	46.83 ± 34.37	40.68 ± 45.82	0.06	0.006
Vegetables	123.32 ± 79.33	113.72 ± 70.98	132.93 ± 86.53	0.28	0.015
Cereals	296.91 ± 79.80	281.89 ± 53.42	311.94 ± 97.73	0.14	0.036
Fruits and nuts	221.62 ± 123.04	186.62 ± 107.83	256.62 ± 128.30	**0.001**	0.082
Ethanol	0.42 ± 1.25	0.27 ± 0.96	0.58 ± 1.48	0.17	0.016
Ratio of monounsaturated fatty acids to saturated fatty acids	1.48 ± 0.28	1.48 ± 0.27	1.48 ± 0.30	0.83	0.000
Total score MDS	4.33 ± 1.64	4.18 ± 1.45	4.48 ± 1.82	0.21	0.008

M = mean; SD = standard deviation; MDS = Mediterranean Diet Score

Finally, regarding lifestyle-related factors, total score MDS was significantly higher in non-smokers (5.20 ± 1.18), compared with smokers (3.86 ± 1.67) ($p<0.001$; $\eta^2= 0.152$). Additionally, results showed that caffeine consumption in non-smokers (56.84 ± 47.65

mg/day) is significantly lower compared with smokers (104.22 ± 48.57 mg/day) (Z = -3.62 $p<0.001$). No significant differences were found between good (4.41 ± 1.78) and poor sleepers (4.26 ± 1.54) ($p= 0.46$; $\eta^2= 0.002$). Due to the small number of patients (8%) that follow the public health recommendations of MVPA per week (American College of Sports Medicine, 2016) comparative analyses were not performed on PA behaviour.

4. Discussion

The knowledge about dietary patterns in people with schizophrenia could help to reduce risks factors, improving physical health in this population. Some studies have examined dietary habits in this population, however more research is needed, specifically in the Portuguese context. To the authors' knowledge, the present study is the first to analyse dietary patterns in Portuguese people with schizophrenia and to compare the difference in quality of diet between inpatients and outpatients with schizophrenia.

In the present study, demographic characteristics of the participants showed higher rates of both elementary education level and unemployment. These factors could be barriers in achieving adequate dietary intakes, since socioeconomic status is associated with poor diet in people with schizophrenia (Roick et al., 2007; Samele et al., 2007). In this population, low socioeconomic status could compromise access to nutritious food, and instead provide easy access to fast food and pre-prepared convenience foods (Henderson et al., 2006). In addition to benefits, such as access to financial resources, employment is also associated with less severe symptoms (Bond et al., 2001; Mueser et al., 1997) and reduced hospital readmission rates (Rummel-Kluge, Pitschel-Walz, Bauml, & Kissling, 2006).

Anthropometric characteristics revealed that only a small number of participants presents a normal weight status as well as an ideal waist circumference, values that are consistent with the literature (De Hert et al., 2011). Several factors can justify this situation, namely, adverse effect of antipsychotic medication (De Hert et al., 2011; De

Hert et al., 2012; Leucht et al., 2009), psychological factors (Daumit et al., 2013; Manu et al., 2015; Thornicroft, Brohan, Rose, Sartorius, & Leese, 2009) and unhealthy lifestyle (Cohrs, 2008; Dipasquale et al., 2013; Faulkner et al., 2006; Kalman et al., 2005; Lasser et al., 2000; McCreadie, 2002; Stubbs, Firth, et al., 2016; Stubbs, Williams, et al., 2016; Wulff et al., 2012). Antipsychotic medication can increase hunger and decrease satiety (Blouin et al., 2008; Treuer et al., 2009). Specifically the effects of second generation of antipsychotic medication on appetite and energy intake are likely key driving factors for elevated weight and waist circumference in people with schizophrenia (Elman, Borsook, & Lukas, 2006). Furthermore, other medications (i.e., mood stabilizers and antidepressants) can also contribute to weight gain, and adversely affect lipid and glucose metabolism (Torniainen et al., 2015). Despite the evidence, limited information has been reported on the influence of antipsychotic medication on diet in people with schizophrenia (Dipasquale et al., 2013). Psychosocial factors have influence on the aetiology of obesity in people with schizophrenia by restricting food choices and decreasing caloric expenditure (Daumit et al., 2013). Together with low education and unemployed status, as previously mentioned, negative discrimination and social isolation could limit opportunities for access to healthier food and adopt adequate PA behaviours (Centorrino et al., 2006; Daumit et al., 2013; Thornicroft et al., 2009).

Concerning unhealthy lifestyles, in the present study, results showed that total minutes of MVPA per week were lower than public health recommendations of 150 minutes. This situation has already has been reported in previous study (Faulkner et al., 2006). Regarding sleep quality, more than a half of the sample were considered as poor sleepers, consistently with Cohrs (2008) that indicated that 30 to 80% of people with schizophrenia present with sleep disturbances. Finally, consistently with the literature, high rates of tobacco smoking were reported (Kalman et al., 2005; Lasser et al., 2000; McCreadie, 2002).

In the present study, participants reported less energy intake that the calculated for energy requirement. In general population, under-reporting of dietary intake is a common

problem in nutritional research and has been observed to persist across diet assessment methods (e.g., FFQ, 24 h recalls, food records) (Crispim et al., 2012; Freedman et al., 2014; Trabulsi & Schoeller, 2001; Trijsburg et al., 2017). Several determinants are associated with underreporting of energy intake, namely gender, older age, weight status and smoking. In schizophrenia there is a lack of evidence regarding this problem. Given the cognitive, memory and motivational challenges in schizophrenia it is possible that under-reporting could be a significant issue. Identifying the determinants associated with under-reporting of dietary intake in people with schizophrenia may help to facilitate the adjustment of dietary assessment methods and the development of correction methods. Additionally, preliminary evidence (Cuerda et al., 2011; Cuerda et al., 2014; Nilsson, Forslund, Olsson, Hambraeus, & Wiesel, 2006) has found that people with schizophrenia receiving antipsychotic medication have a reduced basal metabolic rate, suggesting that current formulas over estimate energy requirements. Further studies need to investigate this and develop modified formulas specific to this population if indicated.

The present results revealed that, comparing with the reference values, female reported higher consumptions energy intake. Contrarily, Jahrami et al. (2017) reported higher values for men (2904 ± 745 kcal) compared with female (2772 ± 713 kcal) patients with schizophrenia. In the study of Amani (2007) it was reported that female patients compared with healthy controls, revealed lower dietary pattern scores. Results from this study showed that both men and female reported lower consumption of fibres. Similarly, Fusar-Poli et al. (2009) revealed that in patients with psychosis, including schizophrenia, the fibre consumption was lower than recommended. In addition, studies revealed that patients presented lower consumption of fibres when compared with control groups (Brown et al., 1999; Gupta & Craig, 2009; Henderson et al., 2006; Osborn, Nazareth, & King, 2007; Roick et al., 2007).

Regarding the values for total fat, participants reported an adequate consumption. However, in the literature inconsistencies in the results were found. For one hand some studies (Amani, 2007; Archie et al., 2007; Brown et al., 1999; Ryan, Flanagan, Kinsella,

Keeling, & Thakore, 2004) demonstrated that total fat intake was higher in patients compared with controls. One study (Henderson et al., 2006) demonstrated that total fat intake was lower in patients compared with controls. In contrast, other studies (Blouin et al., 2008; Gupta & Craig, 2009; McCreadie, 2003; Roick et al., 2007; Samele et al., 2007) reported non difference between patients and control groups for fat intake.

In the present study, both male and female patients showed deficits in vitamin B9 (folate), which is consistent with a meta-analyses study in long-term schizophrenia (Wang, Zhai, & Liu, 2016). Similarly, female patients showed deficits in vitamin C, as has previously been observed in this population (Flatow, Buckley, & Miller, 2013). Contrarily, compared to health recommendations higher values of vitamin B12 was reported in both sexes, which is inconsistent with previously reported in long-term schizophrenia (Cao et al., 2016). The lack of comparative studies for some nutrients, and the inconsistencies demonstrated for others nutrients reveals the need for more research in this field.

Finally, higher consumption of caffeine was reported in the present study. These results are well established in the literature, which reveals that both inpatients and outpatients with schizophrenia presented higher caffeine consumption compared with the general population (Gurpegui et al., 2006; Strassnig, Brar, & Ganguli, 2006). Since caffeine consumption is associated with tobacco smoking (Gurpegui et al., 2007; Zimmermann, Lubman, & Cox, 2012), findings of the present study are consistent with the literature, showing that caffeine consumption in non-smokers was significantly lower compared with smokers. According to Arrojo-Romero et al. (2015), even after controlled for confounders, smoking was strongly and consistently associated with caffeine use and high caffeine use in both inpatients and outpatients with schizophrenia. In fact, tobacco smoking is associated with an induction of caffeine metabolism, and smokers tend to need two to three times more caffeine than non-smokers to reach the same plasma caffeine levels (Gurpegui, Aguilar, Martinez-Ortega, Diaz, & de Leon, 2004). Therefore, the high rates of caffeine intake reported for the participants could be related with the high prevalence of smoking in our sample. In addition, high caffeine intake could be

explain by the availability of caffeine in form of coffee, soft drinks, chocolate and tea both for inpatients and outpatients conditions.

When compared the adherence to Mediterranean diet, results demonstrated that outpatients showed a significant higher consumption of meat and meat products, and fruits and nuts, compared with inpatients. Comparative studies are non-existent. It is important to highlight that both inpatients in outpatients reported a high consumption of meat products. A meta-analysis of colorectal cancer in ten cohort studies reported a statistically significant dose–response relationship, with a 17% increased risk per 100 g per day of red meat and an 18% increase per 50 g per day of processed meat (Chan et al., 2011). Despite the difference between inpatients and outpatients in some components of Mediterranean diet, the total score was similar, both presented a mean score of 4 that represents low to moderate adherence. Outpatients could have less structured time, increased opportunities to sleep, and miss meals resulting in lower dietary intake (Henderson et al., 2006). On another hand in inpatient conditions, the hospital environment naturally influenced the patients' nutrition and eating habits. Dietary intake could be more easily supervised. Therefore more research is necessary in order to explore the differences between treatment conditions characteristics.

When analysed risk factors, results demonstrated that non-smokers present a higher adherence to Mediterranean diet, compared with smokers. These results are consistent with the literature, with non-smokers showed healthier eating habits than smokers (Bobes, Arango, Garcia-Garcia, & Rejas, 2010; McCreadie, 2003). According to Bobes et al. (2010), smokers' patients were more likely to use salt, saturated fat and were less likely to follow a high-fibre and low-caloric diet. Is important to note that the relationship between MDS and PA was not possible to explore, due to the small sample size and the low MVPA levels of the participants. Regarding the importance of both health behaviours (i.e., diet and PA) for physical and mental conditions of people with schizophrenia, future studies should explore this interaction.

4.1. Limitations and strengths of the study

The strengths of this study include the innovative approach concerning dietary intake in people with schizophrenia, namely collected information, adherence to Mediterranean diet and the inclusion of both treatment condition.

Assessing dietary patterns in people with schizophrenia presents a challenge due to intake variability and the wide range of nutrients to consider. FFQ's represent a subjective and retrospective method, for that reason misreporting of portion size, food type and preparation methods occurs. According to Henderson et al. (2006), people with schizophrenia presents higher risk for making reporting errors. This situation highlight the significant gap in the literature regarding the non-existence of a valid nutrition assessment tool for people with schizophrenia or other mental disorder (Teasdale, Ward, Rosenbaum, Samaras, & Stubbs, 2017), therefore it is unclear how closely the FFQ analyses reflect actual intake. Although the recognized limitations of FFQ, it is commonly used in people with schizophrenia (Amani, 2007; Archie et al., 2007; Chuang, Mansell, & Patten, 2008; Henderson et al., 2006; Roick et al., 2007; Samele et al., 2007) as gold standard measures such as doubly-labelled water or weighed-food records are not considered feasible.

In addition, lack of reference values or an incongruence on reference values reported can also represent a barrier for a possible understanding about nutritional patterns in people with schizophrenia. For instance, in most countries, separate dietary recommendations exist for total fat intake, saturated fatty acids, monounsaturated fatty acids, polyunsaturated fatty acids, and *trans* fatty acids (EFSA Panel on Dietetic Products Nutrition and Allergies, 2010). Another example are the reference values for water consumption of 2 litres per day for female and 2.5 for male (European Food Safety Authority, 2017) includes water from beverages of all kind, including drinking and mineral water, and from food moisture. However, through the FFQ, only water present on food moisture is considered and therefore adequacy of intake was not able to be assessed. The FFQ does not account for nutritional supplements and therefore the nutrient intakes

displayed in the tables may not be a true indication of overall intake but do demonstrate rates of dietary adequacy.

In this sense, as with any cross-sectional analysis, the results of this study should be interpreted carefully. The relationship between smoking and diet quality and caffeine consumptions requires further investigation. Longitudinal studies should provide significant additional information about the contribution of dietary intake in symptomatology and in lifestyle behaviours in this population. Participants may make errors in reporting portion size or underreport foods consumed. In addition, desired response behaviour or minimizing existing problems, as with alcohol consumption, for instance, cannot be excluded.

4.2. Study implications

As dietary patterns could be a therapeutic target to control metabolic abnormalities in patients with schizophrenia (Dipasquale et al., 2013), it is important to identify the main characteristics of these behaviours. Due to the limited literature concerning dietary practices and nutritional requirements in people with schizophrenia, the present findings could be important for clinical practice. The results found in this study revealed that people with schizophrenia need counselling concerning dietary intake, namely regarding caffeine consumption, energy intake, fibre and folate. At the same time intervention targets should also focus on better dietary pattern, for example increase the consumptions of fruit, vegetables and wholegrains, as well as in the reduction of processed and sweetened foods. Therefore, the results suggested that dietary and PA interventions targeting weight management, cardiometabolic health, diet quality, sedentary behaviour and cardiorespiratory fitness should be included in this population. To ensure the effectiveness of these interventions, the integration of dietitians and PA professionals (with experience in mental illness) into multidisciplinary mental health teams should be considered. This because, only qualified professionals will ensure an adequate management of barriers, challenges, symptoms characteristics and effects of

antipsychotic medications in people with schizophrenia, or other mental illness (Teasdale, Ward, et al., 2017).

5. Conclusion

The present research showed that, compared with reference values, female patients reported a high energy intake. Both female and male patients reported a high consumption of caffeine, while deficits were evident for fibre and folate intakes. Outpatients showed a significant higher consumption of meat and meat products, and fruits and nuts, compared with inpatients. Both inpatients and outpatients presented a low to moderate adherence to Mediterranean diet. Finally, non-smokers patients presented high adherence to Mediterranean diet. This study provided new evidence regarding dietary intake in people with schizophrenia. The knowledge about the characteristics of diet in inpatients and outpatients provides targets for lifestyle interventions.

Acknowledgements

The authors would like to thank all of the participants, the collaborating psychiatrists, physiotherapists, nurses and physical activity teachers. We also would like to thank the following participating centres: (1) Associação Nova Aurora de Reabilitação Psicossocial (ANARP), Porto, Portugal; (2) Psychiatric Department of Hospital São João, Porto, Portugal; (3) Casa de Saúde São José, Barcelos, Portugal; (4) Casa de Saúde São João de Deus, Barcelos, Portugal; (5) Casa de Saúde do Bom Jesus, Braga, Portugal; (6) Clinica do Outeiro, Vila do Conde, Portugal; (7) Associação dos Familiares, Utentes e Amigos do Hospital Magalhães Lemos, Matosinhos, Portugal.

Disclosure statement

The authors report no conflicts of interest

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Study 6

Association of lifestyle-related factors and psychological factors on quality of life in people with schizophrenia

Association of lifestyle-related factors and psychological factors on quality of life in people with schizophrenia

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This study is submitted as:

Costa, R., Bastos, T., Probst, M., Seabra, A., Abreu, S. Rosenbaum, S., Ward, P.B., Vilhena, E. & Corredeira, R. *Association of lifestyle-related factors and psychological factors on quality of life in people with schizophrenia.* Psychiatry Research (acceptable for publication pending suitable minor revision)

Abstract

In people with schizophrenia several factors are associated with poor quality of life (QoL), namely, lifestyle-related factors and psychological factors. However, there has been little research on the impact of these factors on QoL. Therefore, the relation between lifestyle-related factors, psychological factors, and QoL in people with schizophrenia was assessed. A cross-sectional study was conducted among 115 persons with schizophrenia (25% women and 50% inpatients). QoL was measured by World Health Organisation Quality of Life- Brief Version. Lifestyle-related factors were assessed, namely physical activity (International Physical Activity Questionnaire- Short Form), sleep quality (Pittsburgh Sleep Quality Index) and dietary intake (Mediterranean Diet score). Psychological factors such as self-esteem (Rosenberg Self-Esteem Scale) and autonomous motivation (Behavioural in Regulation Questionnaire- version 3) were also measured. Regression analyses were performed to identify significant predictors of QoL. Results showed that physical activity behaviours and self-esteem predicted better QoL across all domains. Autonomous motivation predicted better physical, psychological and environmental QoL. Identifying predictors of QoL has implication for the effective design and delivery of lifestyles interventions, including physical activity, dietary education and smoking cessation in people with schizophrenia. Adopting healthy lifestyles behaviours may lead to improved physical health, psychological well-being and QoL in people in schizophrenia.

Keywords: quality of life, lifestyle, physical activity, motivation, self-esteem, schizophrenia.

1. Introduction

People with schizophrenia are at high risk of developing a range of physical health conditions, such as cardiovascular disease, obesity, cancer, metabolic syndrome and diabetes (Cimo, Stergiopoulos, Cheng, Bonato, & Dewa, 2012; Correll et al., 2017; Crump, Winkleby, Sundquist, & Sundquist, 2013). Behavioural and lifestyle-related factors appear to be significant contributors for poor physical health (Leas & McCabe, 2007), namely insufficient engagement in moderate and vigorous physical activity (Stubbs, Firth, et al., 2016), poor sleep quality (Cohrs, 2008; Wulff, Dijk, Middleton, Foster, & Joyce, 2012), unhealthy dietary habits (Brown, Birtwistle, Roe, & Thompson, 1999; Dipasquale et al., 2013; Peet, 2004; Teasdale, Samaras, Wade, Jarman, & Ward, 2017) and tobacco smoking (Brown et al., 1999; Kalman, Morissette, & George, 2005).

People with schizophrenia are more sedentary than the general population (Stubbs, Firth, et al., 2016; Stubbs, Williams, Gaughran, & Craig, 2016). Only a minority (about 25%) of persons with schizophrenia adhere to public health recommendations of 150 minutes of physical activity per week (Faulkner, Cohn, & Remington, 2006). Similarly, around 30 to 80% of people with schizophrenia present with sleep disturbances (Cohrs, 2008), that are negatively associated with greater positive symptoms (Afonso, Brissos, Figueira, & Paiva, 2011) and difficulties in activities of daily living (Waters, Faulkner, Naik, & Rock, 2012). Unhealthy dietary habits are also common in this population (Dipasquale et al., 2013), characterized by a high intake of fat and sugar (Stokes & Peet, 2004) and low intake of dietary fibre (Brown et al., 1999), fruits and vegetables (McCreadie, 2003). People with schizophrenia also smoke tobacco at a rate 3-4 times greater than the general population (Kalman et al., 2005; Lasser et al., 2000; McCreadie, 2002).

The adoption of a healthy lifestyle is a process that also involves motivation to plan change, in addition to physical, psychological and material resources to adhere to the plan. Due to illness characteristics (i.e., impairments in cognition, perception, affect and volition) people with schizophrenia may experience difficulties in each step of this

process (Hasnain, Victor, & Vieweg, 2011). In people with schizophrenia, low self-esteem is associated with negative symptoms (Frank & Davidson, 2012). In addition, a reduction of these symptoms is positively associated with improvements in self-esteem (Jones, Hansen, Moskvina, Kingdon, & Turkington, 2010). In the general population, self-esteem processes are also associated with motivation to physical activity (Biddle & Mutrie, 2008). When people are physically active in an environment that is perceived as supportive, they are more likely to be autonomously motivated and experience increased levels of well-being. However, if the environment is perceived as not being supportive, more controlled types of motivation, known to be associated with lower rates of physical activity participation, would be expected. In addition, in controlled motivation, one's behaviour is a function of external contingencies of punishment or reward, that may encourage the person to be more active (Deci & Ryan, 2000). In people with schizophrenia, controlled motivation is related to the tendency to feel, think, or behave in particular ways (e.g., guilt or seeking social approval), which in turn is associated with lower physical activity participation (Vancampfort et al., 2013). On the other hand, autonomous motivation towards physical activity is associated with voluntary exercise over longer periods of time, and people who experience this are therefore more likely to experience the multitude of health benefits conferred by an active lifestyle (Vancampfort, Vansteenkiste, et al., 2014).

These lifestyle-related factors and psychological factors lead to a decrease in functionality and a reduction in quality of life (QoL) (Chan & Yu Iu, 2004). QoL is a multidimensional construct that comprises subjective well-being and objective mental and physical indicators. Over time, people with schizophrenia may experience a reduction in the ability to perform activities of daily living, which can promote financial difficulties (Awad & Voruganti, 2012). In addition, they often suffer stigma and social discrimination, which affects the ability to maintain social relationships and an adequate social functioning (Lysaker, Yanos, Outcalt, & Roe, 2010). All these factors make it difficult for people with schizophrenia to self-manage the illness (Allison, Mackell, &

McDonnell, 2003) and, consequently, they tend to have a poorer QoL, when compared to general population.

In people with schizophrenia several factors are associated with poor QoL, such as severity of psychopathology and pharmacotherapy (Fitzgerald et al., 2001; Pinikahana, Happell, Hope, & Keks, 2002; Michael Ritsner et al., 2002; Tomotake, 2011), demographic (Munikanan et al., 2017; Pinikahana et al., 2002), psychological (Brekke, Kohrt, & Green, 2001; Gureje, Harvey, & Herrman, 2004; M. Ritsner, Lisker, & Grinshpoon, 2014), and clinical factors, including obesity, hypertension and metabolic syndrome (Allison et al., 2003; Malhotra, Kulhara, Chakrabarti, & Grover, 2016), as well as unhealthy lifestyles (Deenik et al., 2017; Hofstetter, Lysaker, & Mayeda, 2005; M. Ritsner, Kurs, Ponizovsky, & Hadjez, 2004; Vancampfort et al., 2011).

Regarding psychopathology, depressive and negative symptoms were associated with poor QoL (Browne et al., 1998; Dickerson, Ringel, & Parente, 1998; Fitzgerald et al., 2001; Norman et al., 2000; Tomotake, 2011), while the association of positive symptoms is scarce and controversial (Fitzgerald et al., 2001; Norman et al., 2000; M. S. Ritsner & Gibel, 2007). Side effects of antipsychotic agents also have been found to play a significant role in QoL (Michael Ritsner et al., 2002). On demographic variables, male gender was associated with poor QoL in psychological domain (Li et al., 2017), while female gender significantly predicted better QoL in physical and psychological domains (Munikanan et al., 2017). However others studies (Chou, Ma, & Yang, 2014; Wartelsteiner et al., 2016) reported no effect of gender on QoL. Being unemployed was associated with poor QoL in the majority of the studies (Cai & Yu, 2017; Chou et al., 2014; Li et al., 2017; Marwaha et al., 2008), while in others studies (Munikanan et al., 2017; Wartelsteiner et al., 2016) no associations were found. On educational level, patients with higher levels of education reported lower QoL (Caron, Mercier, Diaz, & Martin, 2005; Ruggeri et al., 2005). Treatment setting, namely living arrangements was also associated with better QoL (Caron et al., 2005). On psychological variables, some factors such as low self-esteem and self-efficacy were also associated with poor QoL

(Brekke et al., 2001; Gureje et al., 2004; M. Ritsner et al., 2014). In the study of Wartelsteiner et al. (2016) self-esteem was significantly correlated with QoL. In the same study, self-esteem was also identified as a predictor of QoL. On clinical variables, the association between BMI and QoL domains in the literature is inconsistent, the majority of previous studies reported that overweight and/or higher BMI was associated with impairments in the physical aspects of QoL (Bressington et al., 2016; Faulkner, Cohn, Remington, & Irving, 2007; Vancampfort et al., 2011). Other studies (Kolotkin et al., 2008; Sugawara et al., 2013), reported that both physical and psychological aspects of QoL were significantly and positively associated with an overweight status in this population. On lifestyle-related factors, poor sleep quality (Hofstetter et al., 2005; M. Ritsner et al., 2004), and lack of physical activity (Vancampfort et al., 2011) were associated with poor QoL in people with schizophrenia. Recent research (Deenik et al., 2017) demonstrated that physical activity is a significant predictor of some domains of QoL including physical, psychological and social domains. There is a lack of research evaluating the associations between diet quality and QoL in people with schizophrenia. However, in non-clinical populations the diet quality was associated with a better QoL (Henriquez Sanchez et al., 2012; Munoz, Fito, Marrugat, Covas, & Schroder, 2009).

Despite the high prevalence of poor lifestyle behaviours in people with schizophrenia and high rates of physical health comorbidity, there has been limited research on the contribution of lifestyle-related factors to the domains of QoL. To the best of our knowledge, there has not been any study which has simultaneously analysed lifestyle-related factors (i.e., physical activity, sleep quality, smoking and dietary habits) as predictive factors of QoL in people with schizophrenia. Identification of predictors of QoL would be helpful in designing more effective psychoeducational interventions to reduce lifestyle-related risk in people with schizophrenia. Therefore, the present study aimed to assess the association between lifestyle-related factors, psychological factors, and QoL in a sample of people with schizophrenia.

2. Method

2.1. Participants and study sites

All participants in this cross-sectional study were recruited using convenience sampling determined by recruitment opportunities in seven psychiatric centres (see acknowledgments), located in the northern region of Portugal. Inpatients were long-term hospitalized patients recruited from four psychiatric hospitals. In these hospitals, mental healthcare and residence is provided when even clinically stable patients are unable to live independently or in sheltered homes (e.g., lack of social support, lack of family members, or financial conditions). Outpatients were recruited from three community mental health centres where therapeutic approaches are provided.

All participants met the following inclusion criteria: 18 years of age or older, acute symptoms (at least partially) remitted and, prescribed a stable medication regimen (i.e., no medication changes within the last month). Exclusion criteria included an inability to provide informed consent, or to speak Portuguese, an inability to concentrate for at least 20 minutes (as determined by the treating psychiatrist), neurological disorders, and a diagnosis of substance abuse or dependence in the previous six months. Psychiatric diagnosis of the participants was based on the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) (American Psychiatric Association, 2013) criteria and was established by experienced psychiatrists. The study procedure was approved by the Faculty Ethics Committee (CEFADE 13.2014) and by all seven ethics committees. All participants provided written informed consent.

2.2. Assessment measures

2.2.1. Demographic, anthropometric and clinical factors

Demographic variables included gender, age and anthropometric measures. Weight was measured to the nearest 0.1 kg using a Tanita scale (BC-418MA, Tanita Corporation,

Tokyo, Japan). Height was measured to the nearest 0.1 cm using a portable stadiometer (Seca 213, Hamburg, Germany). In both procedures, participants wore light clothing with shoes removed. Body mass index (BMI) (kg/m^2) was then calculated.

Dichotomous variables categorised employment status (currently employed or unemployed), educational level (lower: basic education [i.e., grade 1 to grade 9] versus higher [secondary education or college], physical activity participation (participation at least 1-2 times per week versus non-participation) and treatment setting (in-patient versus out-patient treatment).

Current antipsychotic medication use was recorded for each participant and converted into a daily equivalent dosage of chlorpromazine (Gardner, Murphy, O'Donnell, Centorrino, & Baldessarini, 2010).

2.2.2. Quality of life

QoL was assessed using the Portuguese version of the World Health Organization Quality of Life Scale – Brief version (WHOQOL-BREF) (Vaz-Serra et al., 2006). WHOQOL-BREF includes 26 items categorised into four domains: i) physical (e.g., pain, mobility, energy and fatigue); ii) psychological (e.g., memory and concentration, positive and negative feelings); iii) social relationships (e.g., social support and personal relationships); and iv) environment (e.g., physical safety and security; health and social care; leisure activities) and two questions related to global perception of QoL and health. Each domain consists of three to eight items and each item is assigned a score on a five-point Likert scale. Higher scores mean better QoL. The Portuguese version of WHOQOL-BREF was found to be a valid and reliable instrument for clinical population (including psychiatric population), with an intra-class correlation coefficient (R) of 0.65 and a Cronbach's alpha of .92 (Vaz-Serra et al., 2006).

2.2.3. Lifestyle related factors

Physical Activity

Total minutes of physical activity per week and sedentary time per day were determined using the Portuguese version of the short-form of the International Physical Activity Questionnaire (IPAQ-SF) (Craig et al., 2003). IPAQ-SF provides information on time spent walking, in vigorous- and moderate intensity activity and in sedentary activity. Data from the IPAQ-SF were summed within each item (i.e., vigorous intensity, moderate intensity, and walking) to estimate the total amount of time spent in physical activity per week. The IPAQ-SF sitting question is an additional indicator variable of time spent in sedentary activity and is not included as part of any summary score of physical activity. Validity and reliability data from 12 countries (including Portugal) showed that the IPAQ-SF is a valid and reliable measure of physical activity in general population (Craig et al., 2003). Previous research in people with schizophrenia (Faulkner et al., 2006) shows that the IPAQ-SF is a reliable and valid tool to assess physical activity levels in this population.

Sleep quality

Sleep quality was measured with the Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). This self-report questionnaire rates sleep quality and patterns during the previous month, and evaluates seven components of sleep: subjective quality, latency, duration, habitual efficiency, sleep disturbances, medication use, and daytime dysfunction. A global score of < 5 is used to discriminate between good and poor sleep quality. PSQI is a valid, reliable and standardised measure of sleep quality to be used in psychiatric patients (Buysse et al., 1989). This questionnaire has favourable psychometric properties, with internal consistency reliability of .83 and test-retest reliability of .85 (Buysse et al., 1989). PSQI has been previously used in Portuguese with people with schizophrenia (Afonso, Brissos, Canas, Bobes, & Bernardo-Fernandez, 2014; Afonso et al., 2011).

Adherence to the Mediterranean diet

Dietary intake was recorded using a semi-quantitative food frequency questionnaire (FFQ), designed according to Willett (1998) and adapted to include a variety of typical Portuguese food items (Lopes, Aro, Azevedo, Ramos, & Barros, 2007). The FFQ comprised 86 food items or beverage categories, with a frequency section with nine possible responses (i.e., never to six or more times per day). Previous studies have used the FFQ to assess dietary intake in individuals with schizophrenia (Amani, 2007; Henderson et al., 2006). To the best of our knowledge no validation studies were conducted in this population. Nutrient intake data were obtained by multiplying the frequency of consumption of each food item by the nutrient content of the specified portion size, with once a day equal to one. The software program Food Processor Plus (ESHA Research, Salem, Oregon) was used, based on values from the US Department of Agriculture. Values for typical Portuguese foods were computed using the Portuguese Tables of Food Composition (Porto & Oliveira, 2006). Adherence to the Mediterranean diet was calculated according to the method developed by Trichopoulou et al. (1995), revised to include fish intake (Hu, Cho, Rexrode, Albert, & Manson, 2003). Each of the nine components was assigned a value of 0 or 1, using sex-specific median as the cut-off. For beneficial components (i.e., vegetables, legumes, fruits and nuts, cereal, and fish), value of 0 was assigned when consumption was below the median and value of 1 was assigned when consumption was at or above the median. For components presumed to be detrimental (i.e., meat, poultry, and dairy products), a value of 0 was assigned when consumption was at or above the median and a value of 1 was assigned when consumption was below the median. For alcohol, a value of 1 was assigned when consumption ranged between 5 and 25 g per day for women, and when consumption ranged between 10 and 50 g per day for men. For fat intake, the ratio of monounsaturated lipids to saturated lipids was used. Thus, the total Mediterranean diet score (MDS) ranged from 0 (minimal adherence to Mediterranean diet) to 9 (maximal adherence).

Tobacco smoking behaviour

Tobacco smoking behaviour was recorded as smoking status, and for smokers, the number of cigarettes smoked per day.

2.2.4. Psychological factors

Self-esteem

Self-esteem was assessed using the Portuguese version of the Rosenberg Self-Esteem Scale (Vasconcelos-Raposo, Fernandes, Teixeira, & Bertelli, 2012). The scale consists of 10 items (five positively and five negatively-coded items) measured on a 4-point Likert-scale, from 1 ("strongly disagree") to 4 ("strongly agree"). Negatively-worded items were reversed before subsequent analysis, allowing the calculation of a global score with values ranging between 10 and 40, where higher values represent higher levels of self-esteem. This questionnaire was found to be valid and reliable in persons with severe mental illness (Torrey, Mueser, McHugo, & Drake, 2000). Specifically, in people with schizophrenia the questionnaire has successfully been used with both national (Salgado, Rocha, & Marques, 2008) and international samples (Jones et al., 2010; Kumar & Mohanty, 2016).

Controlled and autonomous motivation

Motivation towards physical activity was assessed using the Portuguese version of Behavioural in Regulation Questionnaire – version 3 (BREQ-3) (Cid et al., 2016). The BREQ-3 comprises 24-items related to six motivation subscales (amotivation, external regulation, introjected regulation, identified regulation, integrated regulation and intrinsic regulation). Each item was measured on a five-point Likert-scale, from 0 ("Not true for me") to 4 ("Very true to me"). The mean of the six subscales was calculated on a five-point scale to score the extent of each motivation type.

This questionnaire was found to be valid and reliable in patients with schizophrenia (Costa et al., 2017). Following the previously mentioned study methodology, motivation towards physical activity was calculated according to controlled (i.e., external and

introjected regulation) and autonomous (i.e., identified, integrated and intrinsic regulation) motivation.

2.3. Statistical analyses

Demographic and clinical characteristics of the sample were expressed as either means and standard deviations or proportions, depending on the data type. Simple and multiple linear regression models were constructed where the dependent variable was QoL. Independent variables included: i) demographic, anthropometric and clinical measures (i.e., gender, employee, educational level, treatment condition, BMI and chlorpromazine -equivalent antipsychotic dosage); ii) lifestyle measures (i.e., physical activity behaviours, sleep quality, adherence to MDS and smoking habits) and; iii) psychological measures (i.e., self-esteem, autonomous motivation and controlled motivation). The MDS score was divided into tertiles. The respective tertiles of the score ranged from 0 to 3 (tertile 1 – low) (reference), 4 to 5 (tertile 2 – moderate) and higher than 5 (tertile 3 – high).

Stepwise multiple regression analyses were used to select the statistically significant variables to enter/remove in the final multivariable model. At each step, the independent variable not in the model that had the smallest p-value was entered, and variables already in the model were removed if their p-value was greater than the significance level. The model was terminated when no further variables were eligible for inclusion or removal. Regression coefficients and respective 95% confidence intervals (CI) were estimated. A significance level of $p < 0.05$ was used. SPSS version 24.0 was used in all analyses.

3. Results

3.1. Sample characteristics

A total of 115 Portuguese patients with a DSM-5 (American Psychiatric Association, 2013) diagnosis of schizophrenia were include in the analysis. The sample characteristics are presented in Table 1.

Table 1. Demographic, anthropometric, clinical, lifestyle and psychological factors characteristics of people with schizophrenia (n=115).

Variables	M ± SD
- Demographic, anthropometric and clinical factors	
Age (years)	44.51 ± 9.81
Sex n (%) female	29 (25%)
Employment status n (%) employee	29 (25%)
Educational level n (%) low	48 (42%)
Treatment condition n (%) inpatients	58 (50%)
BMI (kg/m^2)	28.78 ± 5.47
Underweight and normal weight n (%)	27 (24%)
Overweight n (%)	41 (37%)
Obesity n (%)	47 (39%)
Chlorpromazine-equivalent AP dose (mg/day)	565.87 ± 509.90
- Lifestyle-related factors	
Participation in PA	80 (70%)
PA minutes per week	74.51 ± 64.453
Sitting (min/ day)	343.21 ± 166.91
Good Sleep quality n (%)	37 (32%)
Mediterranean Diet score	4.04 ± 1.80
Smoking habits n (%) smokers	75 (65%)
Cigarettes per day	15.82 ± 9.07
- Psychological factors	
Self-esteem	29.44 ± 4.41
Controlled motivation	1.34 ± 0.84
Autonomous motivation	2.67 ± 0.82
- Quality of life	
Global domain	63.95 ± 21.40
Physical domain	67.15 ± 13.60
Psychological domain	65.81 ± 16.69
Social domain	60.49 ± 19.75
Environmental domain	63.11 ± 14.96

M= mean; SD = standard deviation; mg/day = milligram per day; BMI = body mass index; PA = physical activity AP = antipsychotic.

3.2. Predictors of Global domain of QoL (multiple linear regression analyses: enter and stepwise method)

Crude and adjusted coefficients and 95% CI with global domain of QoL as the dependent variable in multiple linear regression analyses are presented in Table 2. Total minutes of physical activity per week, sedentary time (i.e. minutes sitting per day), good sleep quality and self-esteem were significant predictive factors of global domain of QoL.

Using stepwise multiple regression analysis, total minutes of physical activity per week (B = 0.10, p = 0.004), and self-esteem (B = 1.30, p = 0.02) were significant predictive factors of global domain of QoL, that explained 15.7% of this variance.

Table 2. Results multiple linear regression analyses: enter and stepwise method, with global domain of QoL as the dependent variable and demographical, anthropometric, clinical, lifestyle and psychological factors as independent variables.

Explanatory variable QoL Global domain	Crude B (95% CI)	*p*-value	Adjusted B (95% CI)	*p*-value
- ***Demographic, anthropometric and clinical factors***				
Gender	-3.57 (-12.96 to 5.81)	0.45		
Employee	8.75 (-0.63 to 18.14)	0.06		
Educational level	1.03 (-7.17 to 9.24)	0.80		
Treatment setting*	-0.72 (-8.77 to 7.33)	0.85		
BMI (Kg/m^2)	0.009 (-0.74 to 0.76)	0.98		
Chlorpromazine (mg/day)	-0.007 (-0.01 to 0.00)	0.06		
- Lifestyle related factors				
Participation in PA	8.41 (0.19 to 17.03)	0.06		
PA min. total week	0.11 (0.05 to 0.17)	**<0.001**	0.10 (0.03 to 0.16)	**0.004**
Sitting min/ day	-0.02 (-0.04 to 0.00)	**0.04**		
Sleep quality	10.95 (2.64 to 19.25)	**0.01**		
Adherence to Mediterranean Diet				
Tertil 1 (low) *Reference*	63.06 (56.61 to 69.51)			
Tertil 2 (moderate)	1.75 (-7.41 to 10.93)	0.70		
Tertil 3 (high)	0.93 (-9.78 to 11.64)	0.86		
Tobacco smoking status	4.68 (-3.72 to 13.09)	0.27		
Cigarettes per day	-0.24 (-0.82 to 0.33)	0.39		
- Psychological factors				
Self-esteem	1.43 (0.55 to 2.31)	**0.002**	1.30 (0.18 to 2.42)	**0.02**
Controlled motivation	-1.40 (-6.16 to 3.35)	0.55		
Autonomous motivation	3.64 (-1.21 to 8.49)	0.14		

BMI = body mass index; PA = physical activity; min = minutes; (Gender: female = 0, male = 1; Educational level: lower = 0, higher = 1; Employment: without = 0, with = 1; Treatment condition: inpatient = 0, outpatient = 1; Sleep quality: poor sleep = 0, good sleep = 1; Tobacco smoking status: no = 0, yes = 1).

3.2. Predictors of Physical, Psychological, Social and Environmental domains of QoL (multiple linear regression analyses: enter and stepwise method)

Crude (multiple linear regression analyses: enter method) and adjusted *(multiple linear regression analyses: stepwise method)* coefficients and 95% CI with physical, psychological, social and environmental domains of QoL as the dependent variables are presented in Table 3. Participation in physical activity, total minutes of physical activity per week, good sleep quality, moderate adherence to MDS, when compared to low adherence, self-esteem and autonomous motivation were significant predictive factors of the physical domain of QoL. However, after using stepwise multiple regression analysis only participation in physical activity (B = 8.35, p = 0.004), good sleep quality (B = 7.43, p = 0.01) and self-esteem (B = 7.43, p = 0.01) contributed to predict the physical domain of QoL, that explained 35.3% of this variance.

Total minutes of physical activity per week, sedentary time, good sleep quality, high adherence to MDS, tobacco smoking, self-esteem and autonomous motivation were significant predictive factors of the psychological domain of QoL. However, after using stepwise multiple regression analysis only autonomous motivation (B = 1.75, p = <0.001) and self-esteem (B = 4.56, p = 0.02) contributed to predict the psychological domain of QoL, that explained 30.8% of this variance.

Employment status, sedentary time and self-esteem were significant predictive factors of the social domain of QoL. However, after using stepwise multiple regression analysis only employment status (B = 12.62, p = 0.01) was a significant predictive factor of the social domain of QoL, that explained 7% of this variance.

Finally, employment status, total minutes of physical activity per week, number of cigarettes smoked per day, self-esteem and autonomous motivation were significant predictive factors of the environmental domain of QoL. However, after using stepwise multiple regression analysis only sedentary time (B = -0.02, p = 0.03), tobacco smoking

(B = -0.54, *p* = 0.004) and self-esteem (B = 0.81, *p* = 0.04) were significant predictive factors of the environmental domain of QoL, that explained 18.3% of this variance.

Table 3. Results multiple linear regression analyses: enter and stepwise method, with the domains of QoL as the dependent variables and demographical, anthropometric, clinical, lifestyle and psychological factors as independent variables.

	Physical domain				Psychological domain			
	B (95% CI)	***p***	**Adjusted B (95% CI)**	***p***	**B (95% CI)**	***p***	**Adjusted B (95% CI)**	***p***
- Demographic, anthropometric and clinical factors								
Gender	2.32 (-3.64 to 8.28)	0.44			-4.77 (-12.05 to 2.51)	0.19		
Employee	3.78 (-2.23 to 9.80)	0.21			3.61 (-3.79 to 11.02)	0.33		
Educational level	-0.64 (-5.86 to 4.57)	0.80			2.12 (-4.26 to 8.52)	0.51		
Treatment setting*	-1.12 (-6.23 to 3.99)	0.66			-2.42 (-8.68 to 3.84)	0.44		
BMI (Kg/m^2)	-0.27 (-0.74 to 0.20)	0.25			-0.56 (-1.14 to -0.01)	0.06		
Chlorpromazine (mg/day)	-0.004 (-0.009 to 0.001)	0.13			-0.003 (-0.009 to 0.003)	0.36		
- Lifestyle related factors								
Participation in PA	8.49 (3.16 to 13.82)	**0.002**	8.35 (2.72 to 13.99)	**0.004**	-0.18 (-7.01 to 6.65)	0.95		
PA min per week	0.06 (0.02 to 0.10)	**0.001**			0.05 (0.002 to 0.09)	**0.04**		
Sitting (min/ day)	-0.01 (-0.02 to 0.00)	0.08			-0.02 (-0.03 to -0.002)	**0.03**		
Sleep quality	10.99 (5.96 to 16.02)	**<0.001**	7.43 (1.70 to 13.16)	**0.01**	7.15 (0.61 to 13.69)	**0.03**		
Adherence to Mediterranean Diet								
Tertil 1 (low) *Ref.*	64.52 (60.50 to 68.55)				67.14 (62.27 to 72.00)			
Tertil 2 (moderate)	5.89 (0.17 to 11.62)	**0.04**			1.85 (-5.06 to 8.77)	0.59		
Tertil 3 (high)	1.61 (-5.06 to 8.30)	0.63			-9.14 (-17.22 to -1.06)	**0.02**		
Tobacco smoking status	2.99 (-2.34 to 8.33)	0.26			10.16 (3.85 to 16.47)	**0.002**		
Cigarettes per day	-0.21 (-0.56 to 0.13)	0.22			0.01 (-0.37 to 0.41)	0.93		
- Psychological factors								
Self-esteem	1.55 (1.04 to 2.05)	**<0.001**	1.17 (0.56 to 1.78)	**<0.001**	1.93 (1.31 to 2.55)	**<0.001**	1.75 (1.05 to 2.44)	**<0.001**
Controlled motivation	-1.04 (-4.06 to 1.97)	0.49			-2.11 (-5.80 to 1.58)	0.26		
Autonomous motivation	3.67 (0.63 to 6.71)	**0.01**			5.47 (1.79 to 9.15)	**0.004**	4.56 (0.82 to 8.29)	**0.02**

BMI = body mass index; PA = physical activity; min = minutes; (Gender: female = 0, male = 1; Educational level: lower = 0, higher = 1; Employment: without = 0, with = 1; Treatment condition: inpatient = 0, outpatient = 1; Sleep quality: poor sleep = 0, good sleep = 1; Tobacco smoking status: no = 0, yes = 1).

Table 3. Continued

	Social domain				Environmental domain			
	B (95% CI)	***p***	**Adjusted B (95% CI)**	***p***	**B (95% CI)**	***p***	**Adjusted B (95% CI)**	***p***
- Demographic, anthropometric and clinical factors								
Gender	5.69 (-2.92 to 14.31)	0.19			-1.42 (-7.99 to 5.15)	0.66		
Employee	11.38 (2.85 to 19.92)	**0.009**	12.62 (2.75 to 2.49)	**0.01**	8.43 (1.96 to 14.90)	**0.01**		
Educational level	-2.27 (-9.83 to 5.29)	0.55			-2.70 (-8.41 to 3.01)	0.35		
Treatment setting*	-2.60 (-10.02 to 4.80)	0.48			-3.82 (-9.40 to 1.75)	0.17		
BMI (Kg/m^2)	-0.56 (-1.25 to 0.11)	0.10			-0.01 (-0.54 to 0.50)	0.94		
Chlorpromazine (mg/day)	-0.002 (-0.01 to 0.005)	0.50			0.002 (-0.003 to 0.008)	0.45		
- Lifestyle related factors								
Participation in PA	4.50 (-3.52 to 12.54)	0.26			0.89 (-5.22 to 7.01)	0.77		
PA min per week	0.02 (-0.02 to 0.08)	0.33			0.05 (0.008 to 0.09)	**0.01**		
Sitting (min/ day)	-0.02 (-0.05 to -0.007)	**0.009**			-0.01 (-0.03 to 0.003)	0.10	-0.02 (-0.04 to -0.002	**0.03**
Sleep quality	5.52 (-2.30 to 13.35)	0.16			4.00 (-1.93 to 9.93)	0.18		
Adherence to Mediterranean Diet								
Tertil 1 (low) *Ref.*	60.98 (55.06 to 66.91)				63.92 (59.42 to 68.42)			
Tertil 2 (moderate)	-2.65 (-11.08 to 5.77)	0.53			-2.22 (-8.62 to 4.17)	0.49		
Tertil 3 (high)	2.35 (-7.49 to 12.19)	0.63			0.19 (-7.27 to 7.67)	0.95		
Tobacco smoking status	3.96 (-3.79 to 11.73)	0.31			-0.65 (-6.56 to 5.25)	0.82	-0.54 (-0.90 to -0.17)	**0.004**
Cigarettes per day	-0.17 (-0.67 to 0.33)	0.49			-0.58 (-0.96 to -0.20)	**0.003**		
- Psychological factors								
Self-esteem	0.83 (0.001 to 1.67)	**0.05**			0.93 (0.32 to 1.55)	**0.003**	0.81 (0.04 to 1.58)	**0.04**
Controlled motivation	0.67 (-3.71 to 5.07)	0.76			1.87 (-1.43 to 5.18)	0.26		
Autonomous motivation	3.66 (-0.80 to 8.13)	0.10			4.09 (0.75 to 7.43)	**0.01**		

BMI = body mass index; PA = physical activity; min = minutes; (Gender: female = 0, male = 1; Educational level: lower = 0, higher = 1; Employment: without = 0, with = 1; Treatment condition: inpatient = 0, outpatient = 1; Sleep quality: poor sleep = 0, good sleep = 1; Tobacco smoking status: no = 0, yes = 1).

4. Discussion

The influence of lifestyle-related factors on QoL in people with schizophrenia is an important issue in clinical practice. However there have been few studies that have examined role of lifestyle-related factors (i.e., physical activity, sleep quality, smoking and dietary habits) and their impact on QoL in this population. Results of this study demonstrated that, physical activity behaviours and self-esteem predicted better QoL across all domains in people with schizophrenia. In addition, good sleep quality was a significant predictor of global, physical and psychological domains of QoL. Finally, autonomous motivation was identified as an important predictor of physical, psychological and environmental domains of QoL. After controlling variables, self-esteem was identified as the most significant predictor of QoL (with exception of social domain) in this population.

4.1 Demographic, anthropometric and clinical measures

Of all the demographic variables, employment status was the only parameter significantly associated with QoL. Results demonstrated that employment status was a significant predictor of better QoL across both social and environmental domains. In addition, after controlling all variables, employment status was the only significant predictor of social domain. These results support the findings of previous studies (Cai & Yu, 2017; Chou et al., 2014; Li et al., 2017; Marwaha et al., 2008; Priebe, Warner, Hubschmid, & Eckle, 1998) which found that current employment is associated with better QoL in people with schizophrenia. In addition to benefits such as access to financial resources, employment is also associated with reduced hospital readmission rates (Rummel-Kluge, Pitschel-Walz, Bauml, & Kissling, 2006), less severe symptoms (Bond et al., 2001; Mueser et al., 1997), improved positive affect (Priebe et al., 1998), self-esteem, self-efficacy (Bond et al., 2001; Mueser et al., 1997; Priebe et al., 1998), feelings of a socially valued role (McGurk, Mueser, DeRosa, & Wolfe, 2009) and personal safety and leisure satisfaction (Priebe et al., 1998). It is likely that people with schizophrenia who are employed are

more likely to have a more positive perception regarding the social and environmental domains of QoL.

Contrarily to previous studies (Bressington et al., 2016; Faulkner et al., 2007; Kolotkin et al., 2008; Sugawara et al., 2013; Vancampfort et al., 2011) in the present study, BMI was not found as a significant predictor of QoL. Although, in the psychological domain results of linear regression was near the significant value. In people with schizophrenia the ethology of weight gain and obesity includes adverse effects of antipsychotics, unhealthy lifestyle behaviours, and psychosocial and socioeconomic risk factors (Manu et al., 2015). Specifically regarding psychosocial factors, low interest in social achievement, social isolation, and unemployment can lead to decreased levels of participation in physical activity (Daumit et al., 2013). In addition, due to the physical, psychological and social consequences of obesity, it is important to highlight that obesity may directly, and also indirectly, influence QoL in people with schizophrenia. Therefore, clinicians should support and motivate persons to participate in weight reduction programmes, and these should be included as part of routine care.

4.2 Lifestyle-related factors

This study revealed that physical activity behaviour was a significant predictor of better QoL in all domains of the WHOQOL-BREF. Additionally, total minutes of physical activity per week was a significant predictor of global QoL, even when gender, BMI and smoking were included in the regression model. These results were similar to the recent study of Dennik et al. (2017), where the authors reported that physical activity was associated with QoL in people with severe mental illness (about 77% of the sample had schizophrenia). In the Dennik study, physical activity was found to be a significant predictor of physical, psychological and social QoL. The results obtained in the present study were also consistent with previous findings, where active behaviours are positively associated with better QoL in people with schizophrenia (Acil, Dogan, & Dogan, 2008; E. Gomes et al., 2014; Vancampfort et al., 2011). The present study highlights the

importance of physical activity for people with schizophrenia. It is recognized that physical activity should be prescribed as an adjunct treatment in psychiatric rehabilitation (Vera-Garcia, Mayoral-Cleries, Vancampfort, Stubbs, & Cuesta-Vargas, 2015), due to the psychological (Dauwan, Begemann, Heringa, & Sommer, 2016) and physical benefits (Gorczynski & Faulkner, 2010).

Good sleep quality was found to be associated with global, physical and psychological domains of QoL. Previous research reported significant associations between these two variables in people with schizophrenia. Afonso et al. (2014) and Ritsner et al. (2004) found that lower values of QoL correlated with worse sleep quality. Li et al. (2017) found that patients with sleep problems presented poorer Qol, compared to those without sleep problems. In multiple regressions analyses, Hofstetter et al. (2005) reported that poor sleep quality predicted low QoL. Therefore, sleep quality should be considered a critical factor for QoL in people with schizophrenia, and clinicians should provide specific interventions to address sleep problems (e.g., avoiding naps, and training regular waking and sleep times), in order to improve QoL in this population.

Moderate to high adherence to MDS was associated with better QoL in physical and psychological domains. However, after including the remaining variables in the regression analysis, significant results were not found. We were not able to identify comparable studies from other clinical samples. Two studies with non-clinical populations showed that the adherence to the MDS seems to be an important factor associated with a better QoL (Henriquez Sanchez et al., 2012; Munoz et al., 2009). MDS has been associated with lower cardiovascular risk, prevention of cognitive deterioration and decreased all-cause mortality (Feart et al., 2009). Specifically, cardiovascular disease is highly prevalent among people with schizophrenia, and is the leading cause of death in this population (Brown, Kim, Mitchell, & Inskip, 2010). MDS has also been associated with lower odds of depression and favourable mental and physical health outcomes in a sample of obese and type 2 diabetes patients (Schroder, 2007). Therefore it is possible that benefits related to adherence to MDS could positively affect QoL in

people with schizophrenia. The MDS refers to not only the type of food consumed, but also lifestyle and social customs associated with eating.

Despite the impact of an adequate diet on the burden of preventable diseases, knowledge regarding the dietary habits of people with schizophrenia or other severe mental illness is limited (Teasdale, Ward, & Samaras, 2017). This population infrequently receive evidence-based dietary advice (Teasdale, Ward, & Samaras, 2017). In fact, although limited randomized controlled trials actually measured changes in food intake, those that did tended to find improvements in dietary intake in severe mental illness population (Teasdale, Ward, Rosenbaum, Samaras, & Stubbs, 2017). Therefore, more research is needed and feasible and acceptable dietary interventions should be provided.

In the present study tobacco smoking habits were found to be associated with better QoL, in the psychological domain. In the study of Munikanan et al. (2017), multiple regression analyses showed that smoking habits predicted better QoL, reaching statistical significance in the physical domain. It is possible that tobacco smoking could alleviate schizophrenia symptomatology, particularly negative symptoms, by improving the sensory gating and cognitive deficits (Kumari & Postma, 2005; Winterer, 2010). In the present study tobacco smoking habits were also found to be associated with poor QoL in the environmental domain. Results showed that smokers presented poor QoL in this domain, when compared to non-smokers. Specifically in the smokers' sample, a higher the number of cigarettes smoked per day was associated to a poor QoL in the environmental domain. The environmental domain of WHOQOL-BREF represents, among others, the perception concerning the physical environment. Therefore, smokers can perceive their physical environment as unhealthy and also restricted, due to the increased rates of smoking-restricted environments prevalent in the community, and consequently reported poor QoL in this domain.

4.3 Psychological factors

Regarding psychological factors, this study revealed that self-esteem predicted QoL in all domains of the WHOQOL-BREF. Additionally, after controlling variables self-esteem was found to be a significant predictor of global, physical, psychological and environmental domain. These results are consistent with previous findings, regarding the relationship between low self-esteem and low QoL in people with schizophrenia (Brekke et al., 2001; Gureje et al., 2004). Chou et al. (2014) analysed five factors including sociodemographic, clinical, psychopathological, neurocognitive, and psychosocial factors as potential determinants of QoL in people with schizophrenia. They found that QoL was most strongly affected by psychosocial factors, when self-esteem, self-efficacy and social stigma was included. People with schizophrenia with high self-esteem experienced confidence and optimism, exhibit better adaptation abilities, are highly motivated and have a greater chance of succeeding in work tasks and achieving their goals (Jones et al., 2010). When experiencing low self-esteem, they experience feelings of loneliness, adopt a defensive attitude towards others, suffer from anxiety and underestimate their actual capabilities (Jones et al., 2010). All these characteristics highlight the importance of self-esteem in relation to QoL in people with schizophrenia. Therefore, rehabilitation should focus on improving self-esteem, self-worth and self-efficacy, to positively impact QoL in people with schizophrenia.

Finally, autonomous motivation was associated with better QoL in physical, psychological and environmental domains. In addition, together with self-esteem, autonomous motivation was a significant predictor of the psychological domain of QoL. Autonomous motivation is related to a sense of security, connectedness and lower feelings of shame, self-worth and depression (Ryan & Deci, 2000). These feelings may explain why people with schizophrenia who are more autonomously motivated report a better physical, psychological and environmental QoL.

In the present study, autonomous motivation is presented as an index incorporating identified, integrated and intrinsic regulations, which it is related with more self-determined forms of behavioural regulation (Deci & Ryan, 2000). In rehabilitation and

healthcare settings, autonomous motivation has been linked to positive behavioural health outcomes, such as improved diabetes self-management and vocational rehabilitation engagement, increased physical activity and smoking cessation (Fortier, Sweet, O'Sullivan, & Williams, 2007; Moran, Russinova, Yim, & Sprague, 2014; Williams et al., 2006; Williams, McGregor, Zeldman, Freedman, & Deci, 2004). Specifically, in people with schizophrenia, autonomous motivation is known to be related to fewer negative symptoms (Vancampfort et al., 2015), higher physical activity participation (Vancampfort et al., 2013) and long-term maintenance of physical activity (Vancampfort, Vansteenkiste, et al., 2014).

Improve physical health (e.g., weight lost) and psychological well-being (e.g., reduction of mood and stress) were identified as the most common motivating factors to participate in physical activity in people with severe mental illness (predominantly schizophrenia) (Firth et al., 2016). Therefore, due to the importance that autonomous motivation can have in the adoption and maintenance of health-promoting behaviours (Vancampfort et al., 2013; Vancampfort, Vansteenkiste, et al., 2014) and in the QoL of people with schizophrenia, clinical practice guidelines should highlight the importance of more self-determined forms of behavioural regulation.

4.4 Limitations and future research

A number of methodological limitations need to be considered when interpreting these findings. This study is a cross-sectional study and therefore directionality of the relationships observed cannot be determined. The participants were recruited using convenience sampling, therefore sample size was not priori calculated. Consequently, further studies with a larger sample and including a balance number of female participants are recommended.

Self-report measures can result in inaccurate assessment of variables of interest. For example, in the IPAQ-SF, people with schizophrenia might experience difficulties in

properly identifying the frequency, duration and intensity of physical activity. Therefore, accurate self-report measures of physical activity levels among this population is crucial (Rosenbaum, Ward, & International Working, 2016). Additionally, future studies can incorporate an objective measure of PA (e.g., pedometers or accelerometers). Regarding the assessment of QoL, it is recognized that there is still a need for standardized disease specific QoL measures for people with schizophrenia (Awad & Voruganti, 2012; Karow, Wittmann, Schottle, Schafer, & Lambert, 2014). There is no consensus about which instrument should be used for measuring QoL in this population (Karow et al., 2014). WHOQOL-BREF was identified as one of the generic QoL scales most often used in research with people with schizophrenia (Karow et al., 2014). The Portuguese version of WHOQOL-BREF was found to be a valid and reliable instrument in clinical population (Vaz-Serra et al., 2006) and was previously used in people with schizophrenia (E. Gomes et al., 2016; E. Gomes et al., 2014). Future studies should provide a combination of standardized generic and disease specific QoL instruments.

The Mediterranean Diet Score is determined on the sex-specific median value of 9 food groups assigning equal weights for individual components of the score and presumed the same importance for every component. However, this is acknowledge as a study limitation, Mediterranean Diet Score have been widely used and associated to reduction of mortality and no communicable diseases (Feart et al., 2009; Schroder, 2007).

The positive relationship between physical activity behaviours and QoL found in the present study should also need to be interpreted with caution, due to the lack of direct mechanisms between physical activity and schizophrenia. For example, biochemical changes (e.g., increased levels of neurotransmitters) and psychological changes (e.g., sense of autonomy, social support and self-efficacy) can explain improvements in positive and negative symptoms through physical activity (Firth, Cotter, Elliott, French, & Yung, 2015; Vancampfort et al., 2010; Vancampfort, Probst, et al., 2014). Pajonk et al. (2010) also reported that aerobic fitness improvements following physical activity were associated with enhancements in short-term memory, along with increases in

hippocampal volume. However, more interventional and longitudinal research regarding the physical activity mechanisms is needed.

The specific psychopathological symptoms of the sample and medication were not formally assessed, and the impact of these could not be examined, which another limitation of present study. Namely depressive and negative symptoms have been described as associated with poor QoL (Fitzgerald et al., 2001; Norman et al., 2000; Tomotake, 2011).Regarding medication, some psychotropic medications can influence the lifestyle-related factors of people with schizophrenia. For example in the sleep, it is recognized that to deal with sleep disturbances sleep-inducing medication is often prescribed or antipsychotics are chosen because of their enhanced sedative properties (Wilson & Argyropoulos, 2012). In physical activity, the sedative effects of psychotropic medications can inhibit an active behaviour (Soundy, Stubbs, Probst, Hemmings, & Vancampfort, 2014). Therefore, future research should examine whether the impact of psychopathology and medication as a modifying variable.

5. Conclusion

This study investigated the effects of lifestyle-related factors and psychological factors on QoL in people with schizophrenia. The results demonstrated that all these factors had comparatively large influence in the QoL of this population, highlighting the importance of physical activity behaviours and self-esteem.

To the best of our knowledge, this study was the first to a simultaneously evaluate lifestyle-related factors and psychological factors and their relationship with QoL in people with schizophrenia. The present findings have implications for psychosocial and psycho-educational treatments aimed at increasing the self-esteem and motivation towards physical activity, as well as improving positive lifestyle behaviours in people with schizophrenia. Clinicians should consider using routine lifestyle risk stratification in this

population and work to develop and implement individualized physical health promotion interventions targeting modifiable lifestyle factors.

Acknowledgements

The authors would like to thank all of the participants, the collaborating psychiatrists, physiotherapists, nurses and physical activity teachers. We also would like to thank the following participating centres: (1) Associação Nova Aurora de Reabilitação Psicossocial (ANARP), Porto, Portugal; (2) Psychiatric Department of Hospital São João, Porto, Portugal; (3) Casa de Saúde São José, Barcelos, Portugal; (4) Casa de Saúde São João de Deus, Barcelos, Portugal; (5) Casa de Saúde do Bom Jesus, Braga, Portugal; (6) Clinica do Outeiro, Vila do Conde, Portugal; (7) Associação dos Familiares, Utentes e Amigos do Hospital Magalhães Lemos, Matosinhos, Portugal.

Disclosure statement

The authors report no conflicts of interest

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General discussion

General discussion

Main findings

This doctoral thesis deals in more detail with issues in the dimension of lifestyle-related factors that generate a lower level of physical health, influencing the QoL of patients with schizophrenia. Therefore, the general purpose of this doctoral thesis was to explore lifestyle-related factors and psychological determinants, and to analyse the impact of these in QoL of patients with schizophrenia. Due to the fact that the research questions and respective results have already been extensively reported in previously studies, only a brief summary is provided here.

Despite the promising evidence that PA is an effective non-pharmacological intervention to reduce comorbidities in patients with schizophrenia (Beebe et al., 2005; Cimo et al., 2012; Dauwan et al., 2016; Vancampfort, Probst, et al., 2013), only a minority of patients practice PA at a level compatible with public health recommendations (Sharpe et al., 2006). One explanation for this is that many patients lack sufficient motivation to adopt and maintain an active lifestyle (Soundy et al., 2014; Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013). Nevertheless, a better understanding of the motivational deficits in patients with schizophrenia, may hold the key to increasing PA in this population. Although a theoretically based research investigating the motivational processes linked to the adoption and maintenance of PA in patients with schizophrenia is needed, there is a lack of reliable and valid instruments to determine the processes that motivate this patients to practice PA. Therefore, due to the limited comprehensive psychometric analyses of the BREQ-2 in patients with schizophrenia, specifically in the Portuguese context, the purpose of the Study 1 was to examine the construct validity of the Portuguese version of the BREQ-2 and the Portuguese version of the BREQ-3 in this population. Results demonstrated that the Portuguese BREQ-2 has acceptable construct

validity and is adequate to be used in clinical and research settings. The preliminary analysis of the construct validity of the Portuguese version of the BREQ-3 revealed that this version is an appropriate measure to assess controlled and autonomous motivation for PA in patients with schizophrenia. The findings achieved in this study revealed special importance in clinical practice, because it will allow mental health professionals to identify and follow the motivational processes related to PA in patients with schizophrenia, and consequently, to promote interventions that are experienced as pleasant and enjoyable so that patients are engaged for intrinsic reasons.

In addition to the lack of motivation, others several factors (e.g., lower education and socio-economic status, longer illness duration, presence of negative symptoms, side-effects of antipsychotic medication, cardio-metabolic comorbidity, lack of social support and lower self-efficacy) could be identified as determinants to achieve active behaviours in patients with schizophrenia (Johnstone, Nicol, Donaghy, & Lawrie, 2009; McDevitt et al., 2006; Soundy et al., 2014; Vancampfort, Knapen, et al., 2012). For that reason, in the Study 2 we aimed to explore the association between factors which are recognized as a determinants to PA. Demographic, anthropometric, clinical, physical and psychological factors were included. Results revealed that of all the candidate factors to predict PA, autonomous motivation and global domain of QoL were found as significant predictors. These results highlight the importance of autonomous motivation and QoL in order to improve PA behaviour in patients with schizophrenia. Therefore, the achievements of this study could contribute to the effectiveness of PA interventions, which must adequately address the barriers to activity and promote factors that enable it.

Another factor that could influence PA behaviours in patients with schizophrenia is the sleep quality. In general population, sleep and PA influence each other through complex, reciprocal interactions including multiple physiological and psychological pathways (Chennaoui et al., 2015). Specifically, insufficient sleep has been identified as an

associated risk factor for major public health concerns namely obesity, type 2 diabetes, cardiovascular diseases and depression (Cappuccio, D'Elia, Strazzullo, & Miller, 2010; Grandner, Hale, Moore, & Patel, 2010; Knutson, 2010), comorbidities that are prevalent in patients with schizophrenia (Cimo et al., 2012; Correll et al., 2017; Crump et al., 2013). In addition to poor physical health, poor sleep quality is also prevalent in this patients, affecting activities of daily living, psychiatric symptoms (e.g., positive symptoms) and QoL (Afonso et al., 2011; Brissos et al., 2013; Hofstetter et al., 2005; Ritsner et al., 2004; Waters et al., 2012). A significant body of research confirmed the effects of PA on sleep in general population (Chennaoui et al., 2015; Kredlow et al., 2015). However, comparable data for patients with schizophrenia are lacking. Therefore, the Study 3 had as main purpose to assess the associations between PA levels and sleep quality. The results revealed that sleep quality was positively associated with time of moderate and total PA per week. In the same line, in the Study 4 we found that patients of regular physical active group have better quality of sleep and QoL. These achievements highlights the importance of PA as a non-pharmacological approach for sleep quality in patients with schizophrenia. Although pharmacological approach is the main strategy used to tackle sleep problems for these patients (Wilson & Argyropoulos, 2012), patients prefers to take less medication (Peacey et al., 2012) and are interested in behavioural sleep interventions (Huthwaite, Miller, McCartney, & Romans, 2014). Therefore, PA should be include in the treatment of sleeping problems, to reduce sleep medication, and to improve sleep quality and quality of life in patients with schizophrenia.

In addition to PA and sleep, an adequate diet is also considered as highly important to a healthy lifestyle. Unhealthy diet is leading global risks to health (World Health Organisation, 2015). Contrarily, an adequate diet improve weight lost, insulin resistance, dyslipidemia and hypertension in people with mental illness (Bonfioli et al., 2012; Bruins et al., 2014; Wu et al., 2007). For these reasons, diet and factors underlying poor dietary patterns may represent an important therapeutic target to control metabolic

abnormalities in patients with schizophrenia (Dipasquale et al., 2013). Therefore, Study 5 was carried out to deal with the lack of research regarding dietary intake, diet quality and schizophrenia in Portuguese reality, and also to promote new evidence regarding the relationship between diet quality and lifestyle-related factors in patients with schizophrenia. Results revealed that analysing macro- and selected micro-essential nutrients patients reported higher values of proteins and the majority of the vitamins compared with reference values. Contrarily, values reported for total carbohydrates and total fats were consistent with reference values. In the adherence to Mediterranean diet, results demonstrated that outpatients reported significant higher consumptions of meat and meat products group and fruits and nuts group, compared with inpatients. Finally, regarding lifestyle-related factors, results showed that adherence to Mediterranean diet was significantly higher in non-smokers, compared with smokers. These findings represent an added value for existing literature. Due to the limited information concerning dietary practices and nutritional requirements in patients with schizophrenia, the findings could positively influence clinical practice. Specifically, the new evidence about the characteristics of diet in inpatients and outpatients provides targets for lifestyle interventions.

The previous studies (Study 3, 4 and 5) confirmed the existent literature, revealing that patients with schizophrenia presents inadequate lifestyles (Deuschle et al., 2013; Gardner-Sood et al., 2015; Gutierrez-Rojas et al., 2016; Olsson et al., 2015). The results of these studies demonstrated the need to understand the underlying lifestyle-related factors associated with QoL in patients with schizophrenia. Therefore, Study 6 was carried out, in order to simultaneously analysed lifestyle-related factors (i.e., PA, sleep quality, smoking and dietary habits) and psychological determinants on QoL of patients with schizophrenia. Results demonstrated that PA behaviours and self-esteem predicted better QoL across all domains. In addition, positive sleep behaviours were a significant predictor of global, physical and psychological domains of QoL. Finally, autonomous

motivation was identified as an important predictor of physical, psychological and environmental domains of QoL. The results achieved have implications for psychosocial and psycho-educational treatments aimed at increasing the self-esteem and motivation towards PA, as well as improving healthy lifestyle behaviours in patients with schizophrenia.

Practical implications

First of all, and regarding the importance of autonomous motivation for a healthy and active lifestyle in patients with schizophrenia (Soundy et al., 2014; Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013), clinical practice guidelines should highlight the importance of autonomous motivation. Based on SDT, the transition from controlled to autonomous motivation can be facilitated in environments that support three psychological constructs, namely need for autonomy (i.e., experiencing a sense of psychological freedom when engaging in PA), competence (i.e., ability to attain desired outcomes) and relatedness (i.e., being socially connected) (Deci & Ryan, 1985, 2000). Regarding autonomy, it is important that clinicians support the needs for autonomy of the patients. For example, to take the perspective of the patient, support their choices, minimize pressure, offering relevant information for changing PA behaviour and using autonomy supportive language (Farholm & Sorensen, 2016; Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013). Concerning competence, feelings of competence are obtained when patients are succeed in PA tasks. For that reason is important to offer activities that are experienced as pleasant and enjoyable as well as provide optimally challenging tasks tailored to the capabilities of the patient (Sorensen, 2006; Vancampfort, De Hert, et al., 2013). Sufficient instructions and positive feedback are also needed. Finally, regarding relatedness it is important that clinicians create an empathetic and positive environment, to show unconditional regard, enthusiasm and

interest in their patients. Increase the feeling of relatedness and decrease de the feeling of being isolated can be promoted by offering group session of PA (Farholm & Sorensen, 2016; Vancampfort, De Hert, et al., 2015; Vancampfort, De Hert, et al., 2013).

Secondly, to improve sleep quality in patients with schizophrenia, attention for sleep disturbances should be incorporated into standard clinical care. The importance of non-pharmacological interventions, namely PA should be highlighted by clinicians, offering psycho-education sessions that are considered as an essential component of the therapy program. Other strategies, focusing on regular waking and sleep times, avoiding naps and morning bright light are also recommend (Afonso, Figueira, & Paiva, 2014; Klingaman, Palmer-Bacon, Bennett, & Rowland, 2015).

Third, regarding the importance of diet quality and factors underlying dietary patterns for metabolic abnormalities in patients with schizophrenia, some interventions (e.g., weight management, cardiometabolic intervention strategies, PA interventions, dietary assessment and specific nutritional cares) should be include on psycho-educational treatments in this population. It was demonstrated that patients with schizophrenia need counselling concerning dietary intake, namely regarding caffeine consumption, energy intake, fibre and folate. At the same time intervention targets should also focus on better dietary pattern, for example increase the consumptions of fruit, vegetables and wholegrains, as well as in the reduction of processed and sweetened foods. Is important to highlight that, in order to ensure the effectiveness of these interventions, the integration of dietitians and PA professionals (with qualification in mental illnesses) within the interdisciplinary mental health teams should be considered. Only these qualified professionals will ensure an adequate management of barriers, challenges, symptoms characteristics and effects of antipsychotic medications in patients with schizophrenia.

Lastly, the results achieved in Study 6, showing that self-esteem is a predictor of all domains of QoL, suggests that assessment of self-esteem should be conducted as part of outcome evaluations (Gureje et al., 2004). In patients with schizophrenia, PA participation could leads to appropriate psychosocial adjustment, which consequently is linked to body weight and image, self-value and physical well-being of each patient (Maggouritsa et al., 2014). These improvements could help the patients to adopt more healthy attitudes as part of their everyday routine improving their psychological well-being. For these reasons, PA should be provided as pleasant and enjoyable in order to ensure adherence, allowing physical self-perception enhancement to take place. To ensure this, the goals of PA should be concrete, specific, and short-range provide greater motivation, and evidence of efficacy, allowing patients with schizophrenia to identify the specific behaviours needed for successful achievement of their objectives. In this sense, clinicians should provide a PA intervention focus on confidence in the physical self, in goal achievement and success experiences and on perceived improvements in physical fitness (Vancampfort, De Hert, et al., 2011). In addition, clinicians should try to anticipate the detrimental effects of a low physical self-perception. This can be ensure, for example in conversations about barriers that patient perceived for PA participation. An individual treatment plan taking into account these barriers will increase the confidence of the patient and consequently will promote the success of PA participation (Vancampfort, De Hert, et al., 2011).

This doctoral thesis is among the first Portuguese data on lifestyle-related factors and psychological determinants, therefore is a first step in achieving culture change and to ensure that physical health in Portuguese patients with schizophrenia is looked after. Namely the importance of PA for physical and mental health, which should be integrated in educational and intervention programs regarding lifestyle behaviours, to increase and assist health-promoting behaviours among patients with schizophrenia. This because in

Portugal there is still a significant lack of awareness regarding the benefits of PA for patients with schizophrenia.

In the last decades, a growing evidence base has shown the importance of PA for physical, physiological, psychological and social domains in patients with schizophrenia. However there still a gap between research and changes in clinical practice. In fact, integrating PA as a therapeutic intervention requires a shift in culture and system reform, from the design of mental health facilities through to changing staff attitudes (Vancampfort, Stubbs, Ward, Teasdale, & Rosenbaum, 2015). Concerning that, for a successful incorporation of PA into standard clinical care for this population, changes in the health care system are needed. In order to achieve the progress and consequently increase the credibility of PA as a therapeutic modality in mental health services, important challenges should be considered, namely, i) not to underestimate the value of PA as a therapeutic approach in promoting physical and mental well-being; ii) mental health should have the same priority as physical health; iii) to ensure the integration of PA professionals (with qualification in mental illnesses) within the interdisciplinary mental health teams and; iv) an optimal alliance between mental health services and society (e.g., promote PA events to facilitate the reduction of individual and social stigma towards mental illness, acting as an instrument to fight discrimination and promote the inclusion of patients with schizophrenia in the community).

Methodologic considerations

Strengths of this doctoral thesis include the instrument validation, exploring new variables that are undeveloped in this population and novelty of the analyses of combined associations of lifestyle-related factors and psychological determinants in QoL of patients with schizophrenia. The findings highlight the importance to considered adequate lifestyle behaviours, specifically an active behaviour, in order to have an impact

on physical health and consequently on QoL. Therefore, we hope that our outcomes can influence interventions integrated in patient's treatment. For this, evidence-based practice sustain that clinicians should considerer, for one hand research evidence, and for another hand take into consideration preferences and patient's choices and also their own clinical expertise. As such, standardized assessment tools are likely to become increasingly important in daily clinical practice. In fact, integrating standardized assessment of for example PA behavior, motivation to PA, self-esteem, sleep quality, dietary intake and QoL into clinical practice and using this information to guide monitor clinical decisions will improve the quality, efficiency and effectiveness of the psychiatric treatment. However, the equipment required for an assessment of these variables is often expensive and very sophisticated and may not always be available to the clinician. In light of this demands, the present thesis was based in instruments that can be easily administrated in psychiatry centers and allow a large number of participants to be tested simultaneously, without financial costs.

Some limitations can be drawn from this doctoral thesis. First, all the studies are cross-sectional and therefore directionality of the relationships observed cannot be determined. Second, the selection of subjects was also a limitation as patients with low symptoms are not likely to be representative of the patient population as a whole. Therefore, these results may not be extrapolated to patients whose symptoms are severe. Third, self-report measures can result in inaccurate assessment of variables of interest. Notwithstanding the reliability and validity of the IPAQ-SF in patients with schizophrenia (Faulkner et al., 2006), they might experience difficulties to properly identify the frequency, duration and intensity of PA. Regarding Rosenberg Self-esteem Scale, is a method that has received some criticism (Andrews & Brown, 1993; Barrowclough et al., 2003b) and has not been specifically validated for use in this population. Nevertheless, although there are limitations to this questionnaire, it is the most widely used self-report measure of self-esteem and is sensitive to change. Concerning dietary patterns, semi

quantitative food frequency questionnaire (FFQ) represent a subjective and retrospective method, for that reason misreporting of portion size, food type and preparation methods occurs. Lack of reference values or an incongruence on reference values reported can represent a barrier for a possible understanding about nutritional patterns in people with schizophrenia. In addition, current formulas for under-reporting of dietary intake can over estimate energy requirements in this population. Although all participants were informed about the anonymously analyze of the data, a bias in the sense of social desirability cannot be ruled out. Finally, the specific psychopathological symptoms (e.g., medication side effects, length of illness, depressive symptomatology) of the sample were not formally assessed, and the impact of these could not be examined on our analyses. This situation was more visible on Study 6, when the levels of explained variance of the models confirm the complex constructs of QoL, in which many individual aspects of psychopathological symptoms may play a role.

Future research directions

Future research should aim to improve the poor health status of patients with schizophrenia, by increasing the adoption of positive lifestyle behaviours. Longitudinal (prospective) studies should be conducted in order to tease apart more in detail cause and effect among the identified variables. Further studies should expand sample sizes and representativeness (i.e., severe symptomatology), address concerns related to multiple comparisons, and incorporate different instruments from those used in the current study, namely objective measure of PA (e.g., pedometers or accelerometers). More research is needed to explore the role of self-esteem in PA behaviours and QoL in this population. Due to the importance of the psychopathological symptoms in the outcomes of the disorder, future studies should examine the impact of psychopathology as a modifying variable.

Conclusion

This doctoral thesis provided new and relevant evidence regarding lifestyle-related factors and psychological determinants in patients with schizophrenia. As summary of the findings found in the studies presented in this research, some conclusions are possible highlight, namely, the importance of autonomous motivation as a determinant for an active PA behaviour and better QoL, the reciprocal interactions between sleep quality and PA behaviours, the poor dietary patterns (in both inpatients and outpatients), and finally, the importance of self-esteem on QoL of patients with schizophrenia.

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