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Effects of a lifestyle intervention on psychosocial well-being of severe mentally ill residential patients: ELIPS, a cluster randomized controlled pragmatic trial

Annemarie P.M. Stiekema [a,b,1], Anne Looijmans [c,d,*,1], Lisette van der Meer [a,d,e], Richard Bruggeman [d,f], Robert A. Schoevers [f], Eva Corpeleijn [c], Frederike Jörg [d,g]

[a] Department of Rehabilitation, Lentis Psychiatric Institute, Zuidlaren, The Netherlands
[b] School for Mental Health and Neuroscience, Faculty of Health, Medicine and Life Sciences, Department of Psychiatry and Neuropsychology, Maastricht University Medical Center, Maastricht, The Netherlands
[c] Department of Epidemiology, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands
[d] University of Groningen, University Medical Center Groningen, Rob Giel Research Center, Groningen, The Netherlands
[e] University of Groningen, University Medical Center Groningen, Department of Neuroscience, Groningen, The Netherlands
[f] University of Groningen, University Medical Center Groningen, University Center of Psychiatry, Groningen, The Netherlands
[g] Research Department, Friesland Mental Health Services, Leeuwarden, The Netherlands

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ABSTRACT

Large studies investigating the psychosocial effects of lifestyle interventions in patients with a severe mental illness (SMI) are scarce, especially in residential patients. This large, randomized controlled, multicentre pragmatic trial assessed the psychosocial effects of a combined diet-and-exercise lifestyle intervention targeting the obesogenic environment of SMI residential patients. Twenty-nine sheltered and clinical care teams were randomized into intervention (n = 15) or control (n = 14) arm. Team tailored diet-and-exercise lifestyle plans were set up to change the obesogenic environment into a healthier setting, and team members were trained in supporting patients to make healthier choices. The control group received care-as-usual. The Calgary Depression Scale for Schizophrenia (CDSS), Positive and Negative Syndrome Scale (PANSS), Health of the Nation Outcome Scales (HoNOS) and the Manchester Short Assessment of Quality of Life (MANSA) were assessed at baseline and after three and twelve months. Data were available for 384 intervention and 386 control patients (48.6 ± 12.5 years old, 62.7% males, 73.7% psychotic disorder). Linear mixed model analysis showed no psychosocial improvements in the intervention group compared to care-as-usual; the intervention group showed a slightly reduced quality of life (overall) and a small increase in depressive symptoms (clinical care facilities) and psychotic symptoms (sheltered facilities). This may be due to difficulties with implementation, the intervention not being specifically designed for improvements in mental well-being, or the small change approach, which may take longer to reach an effect. Further research might elucidate what type of lifestyle intervention under what circumstances positively affects psychosocial outcomes in this population.

1. Introduction

Increased awareness of the somatic health of patients with a severe mental illness (SMI) has resulted in a large body of research on lifestyle interventions aiming at weight loss, weight gain prevention or improvements in cardiometabolic health. Lifestyle interventions can improve cardiometabolic risk factors such as waist circumference, triglycerides and fasting glucose in psychotic patients (Bruins et al., 2014). Lifestyle changes may also affect psychosocial well-being because of the association of lifestyle factors with symptoms of depression and anxiety in the general population (Lang et al., 2015; Penedo and Dahn, 2005; Ross and Hayes, 1988), and with negative and depressive symptoms in schizophrenia (Rosenbaum et al., 2014; Vancampfort et al., 2012).

A number of studies have investigated the effect of lifestyle interventions on psychosocial functioning in SMI patients. For example, programs of physical exercise have shown to reduce psychotic symptoms (Beebe et al., 2005; Rimes et al., 2015; Scheewe et al., 2013), depressive symptoms (Acil et al., 2008; Scheewe et al., 2013), anxiety (Wipfli et al., 2008) and stress (Hoffmann et al., 2005) and improved quality of life was found after a nutritional intervention (Evans et al., 2005) and a psycho-educational weight control program (Mauri et al., 2008). However,

* Corresponding author at: University Medical Center Groningen, Department of Epidemiology (FA40), PO box 30.001, 9700 RB Groningen, The Netherlands.
E-mail address: A.Looijmans@umcg.nl (A. Looijmans).
[1] These authors contributed equally to this work.

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symptomatic stability or unchanged quality of life were also reported (Ball et al., 2001; Brar et al., 2005; Forsberg et al., 2010; Heggelund et al., 2011; Kwon et al., 2006; Poulin et al., 2007; Wärdig et al., 2016). Drawing firm conclusions about the effect of lifestyle interventions on mental health is complicated due to small sample sizes (Acil et al., 2008; Ball et al., 2001; Beebe et al., 2005; Evans et al., 2004; Forsberg et al., 2010; Heggelund et al., 2011; Kwon et al., 2006; Mauri et al., 2008) or the lack of a control group (Daumit et al., 2011; Hoffmann et al., 2005; Richardson et al., 2005). Moreover, large trials including residential patients are lacking.

Adopting a healthy lifestyle is especially challenging for residential patients, due to the obesogenic environment of residential facilities. An obesogenic environment is characterized by limited opportunities for exercising and easy access to high-calorie food as opposed to healthy alternatives (Swinburn et al., 1999). Small environmental changes have led to weight loss in an uncontrolled inpatient population (Cohn et al., 2010). The Effectiveness of Lifestyle Interventions in PSychiatry (ELIPS) study was designed to change the obesogenic environment of residential facilities, with the primary aim to improve patients' somatic health (Looijmans et al., 2014). The intervention successfully reduced waist circumference and metabolic syndrome Z-score after three months intervention (Looijmans et al., 2017). The current paper describes the secondary, psychosocial, outcomes of the ELIPS study. We hypothesized that the lifestyle intervention would lead to reduced depressive and psychotic symptoms and improved overall functioning and quality of life.

2. Materials and methods

2.1. Design

The study protocol of this multicentre cluster randomized controlled pragmatic trial was published elsewhere (Looijmans et al., 2014) and will be shortly explained below. The Medical Ethical Committee for Research in Mental Health Care (Metigg) concluded that study protocol and use of anonymized data from Routine Outcome Monitoring (ROM; below) was in accordance with the Declaration of Helsinki and (inter)national regulations, and that the study did not fall under the scope of the Medical Research Involving Human Subjects Act, thereby waiving informed consent. The trial was registered in the Dutch Trial Registry (NTR2720, www.trialregister.nl).

2.2. Study population

Out of eighteen sheltered and 11 long-term clinical care teams of two psychiatric institutions (Lentis and GGZ Friesland) in the Netherlands, clusters were made for teams that were comparable in terms of institution, location (rural or city), living situation (sheltered or clinical), and caseload (ranging from 20 to 65). Within each cluster, teams were randomly assigned to the lifestyle intervention or the treatment as usual control group, by a computerized random number generator by a non-participating research nurse. Recruitment was from September 2010 till December 2011. Patients taking part in the annual ROM

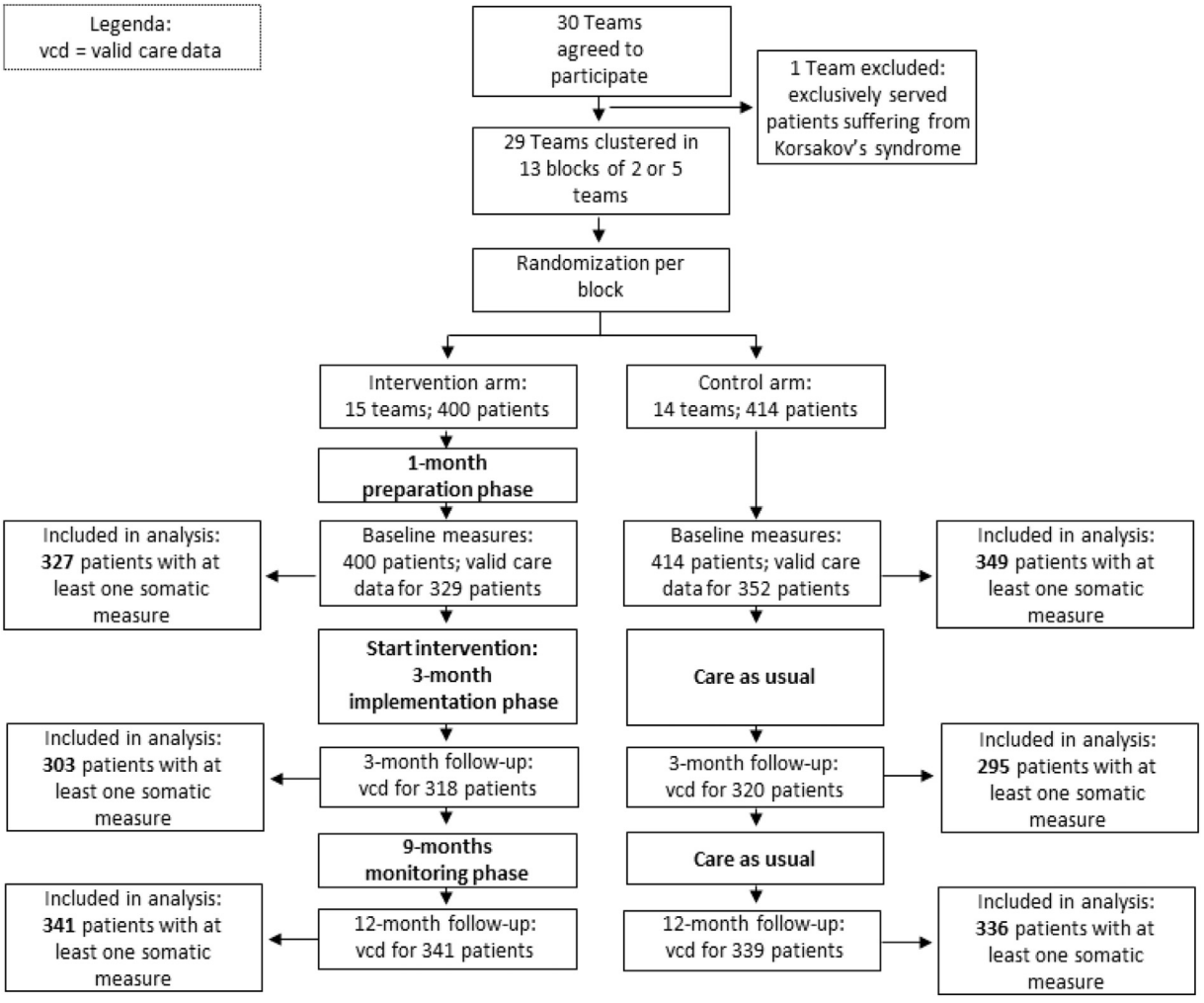

Fig. 1. Flowchart of patients in the ELIPS trial. A total of 770 patients have at least one psychosocial measure at baseline or 12-months follow-up and were included in the analysis (not retraceable in flow).

screening (addressed below) were automatically included. Exclusion criteria were age below 18, pregnancy, diagnosis of Korsakov's syndrome or inability to perform physical activity measurements. The sample size calculation was based on the primary outcome (waist circumference) and showed that 240 patients were needed in both the control and intervention group (Looijmans et al., 2014).

2.3. Intervention

Teams of health care professionals were trained to adjust the obesogenic environment according to pre-determined ELIPS lifestyle goals: 1) At least two physical activities per week (e.g. counselling conversations during a walk outside rather than sitting in the office, patients walk/cycle to shop for own groceries, organise group walks one or twice a week, organise a weekly football activity, WII-sports activity, or fitness centre visit), 2) At least three changes in daily food supply that favor health (e.g. offer low-fat cheese and whole wheat alternatives to white bread, pasta and rice, reduce consumption of sweetened dairy product or cakes, buy fresh vegetables rather than canned vegetables, offer snacks in small portions, and/or only in the weekends), 3) A weekly food focused activity (e.g. a workshop on buying, cooking and eating healthy foods, create a daily fruit moment, make a shopping list together, buy healthy groceries together, cook a healthy meal together or make smoothies together) and 4) A sustainable change on organization level (e.g. reduce access to food cupboards, adjust food supply in canteen (selling fried snacks only twice per week), provide a gym, set up contracts with fitness centres, purchase a WII sports, prepare breakfast every morning or put nutrition and physical activity standard on the team meeting's agenda) (Looijmans et al., 2014). We aimed for small changes because this has a high chance to lead to changes that are sustainable in long-term (Treweek and Zwarenstein, 2009). Consulting both patients and staff on their preferences (see Supplementary methods for more detailed information on patient involvement), two lifestyle coaches per team set up a lifestyle plan based on the ELIPS goals and team specific (un)healthy behaviors, activities, opportunities and logistic possibilities (1-month preparation phase). The lifestyle coaches worked out these plans by organizing activities and workshops to increase patients' intrinsic motivation and by training the teams in creating a healthy environment and stimulating a healthier lifestyle (3-month implementation phase). Teams gradually took over the responsibility and set goals to achieve in the next period (9-month monitoring phase). We hypothesized that improvements could be achieved in the implementation phase and sustained during and after the monitoring phase.

2.4. Assessments

Outcomes were administered by trained nurses during ROM, a standard care annual screening of mental and physical health. ROM procedures were fully explained to participants, after which they were free to opt-out for the use of anonymized data for research purposes. ROM-nurses were blind for the patients' allocation (except for one location where two teams assessed each other's patients). Regular assessments were used for the baseline and 12-month measurements with an additional ROM-screening for the 3-month measurement, for which participants received a €5,00 fee. Age, gender, living situation and medication were abstracted from patient charts.

The 9-item Calgary Depression Scale for Schizophrenia (CDSS; Addington et al., 1990) was used to assess depressive symptoms. Scores range from zero (absent) to three (severe) and were assessed during a structured interview and summed. The CDSS has good psychometric properties (Addington et al., 1996).

Psychotic symptoms were assessed using a shortened version of the Positive and Negative Syndrome Scale based on remission criteria (PANSS; Andreasen et al., 2005; Kay et al., 1987). Scores on the items assessing delusions, conceptual disorganization, hallucinatory behavior,

Table 1
Baseline characteristics of study participants.[a]

Variable	N[b]	Total	Intervention group	Control group	*p*-Values
Demographical					
Age, yrs	770	48.0 ± 12.5	49.1 ± 11.9	47.0 ± 13.0	**.020**
Male sex	770	63.2	64.6	61.9	.443
Housing	770				
Sheltered living		59.0	54.2	63.7	**.007**
Clinical care facilities		41.0	45.8	36.3	
Psychiatric diagnosis	770				
Psychotic disorder		73.7	76.6	70.7	.066
Mood disorder		10.0	9.9	10.1	.923
Personality disorder		32.7	29.7	35.8	.073
Anxiety disorder		3.6	2.3	4.9	.056
Substance related disorder		12.5	14.8	10.1	**.047**
Developmental disorder		9.2	7.8	10.6	.178
Psychiatric comorbidity		24.8	22.7	26.9	.168
BMI, kg/m^2	613	28.1 ± 6.3	27.8 ± 6.3	28.3 ± 6.2	.260
Overweight (25–30 kg/m^2)	613	34.1	34.0	34.2	.968
Obese (>30 kg/m^2)	613	32.0	29.6	34.2	.225
Antipsychotic medication					
Antipsychotics	651	90.0	91.8	88.4	.146
Chlorpromazine equivalent[c]	635	400 [153; 600]	450 [205; 640]	300 [150; 600]	**.006**
Scores for dependent variables					
CDSS[d]	406	1.0 [0.0; 4.0]	1.0 [0.0; 3.8]	2.0 [0.0; 5.0]	**.003**
PANSS	481	17.5 ± 6.2	17.7 ± 6.2	17.3 ± 6.1	.560
HoNOS	562	13.4 ± 6.2	13.2 ± 6.0	13.6 ± 6.4	.429
MANSA	578	60.1 ± 12.4	61.5 ± 12.0	58.9 ± 12.7	**.011**

Abbreviations: BMI: Body Mass Index; CDSS: Calgary Depression Scale for Schizophrenia; PANSS: Positive and Negative Syndrome Scale – remission items; HoNOS: Health of the Nation Outcome Scales; MANSA: Manchester Short Assessment of Quality of Life.
p-values significant at alpha < 0.5 were indicated in bold.
[a] Table represents mean ± standard deviation, median [25th;75th percentile] or percentage.
[b] The total N differs per variable due to missing data.
[c] Chlorpromazine equivalents of antipsychotic dosage were calculated according to Gardner et al. (2010).
[d] Median was presented because of the non-normal distribution of scores.

blunted affect, social withdrawal, lack of spontaneity, mannerisms and posturing and unusual thought content range from one (absent) to seven (extreme) and were summed.

Overall functioning was measured with the clinician-rated Health of the Nation Outcome Scales (HoNOS; Wing et al., 1998). Twelve questions on four domains (behavioral problems, organic problems, psychological symptoms, social problems) range from zero (no problems) to four (severe problems) and were summed. The scale has moderately high internal consistency and interrater reliability (Wing et al., 1998).

Quality of life was measured with the Manchester Short Assessment of Quality of Life (MANSA; Priebe et al., 1999), a 12-item self-report questionnaire capturing satisfaction within several psychosocial domains, scored on a scale from one (could not be worse) to seven (could not be better). Scores were summed. The MANSA has good construct validity and internal consistency (Priebe et al., 1999).

2.5. Statistical analysis

Non-normally distributed data were transformed. Group differences on baseline characteristics were examined with the chi-square test for categorical variables, independent Student's *t*-tests for normally distributed continuous variables and Mann-Whitney *U* tests for non-normally distributed continuous variables. Differences on psychosocial outcomes over time were analyzed according to the intention-to-treat principle using a likelihood-based multi-level linear mixed model with an unstructured covariance structure, taking the randomization strata of teams into account. To investigate the effect for the two phases of the intervention separately, we created two dummy variables for time, where the reference category was baseline compared to the 3-month and 12-month measurements respectively. Condition, dummy variables for time and interaction terms of condition x time were entered into the model as fixed factors. Age, gender, chlorpromazine equivalents and living situation were entered as covariates. SPSS version 22 was used with alpha set at 0.05.

2.6. Post hoc analyses

Post-hoc analyses were performed to investigate whether baseline differences could be explained by the uneven distribution of living situation over the groups, as living situation might reflect the severity of illness and illness-related consequences (i.e. the degree of dependence on others for daily tasks is likely higher in clinical care facilities). Analysis of variance (ANOVA) was performed on baseline differences with condition as predictor and living situation as covariate. In addition, the effect

Table 2
Psychosocial outcomes after three and twelve months of lifestyle intervention in SMI residential patients.[*]

	β	95% CI	SE	*p*-Value
CDSS (N = 629)				
Intervention[a]	−0.30	[−0.50;−0.10]	0.10	**.004**
Three months[b]	−0.01	[−0.16;0.14]	0.08	.880
Twelve months[b]	0.09	[−0.06;0.23]	0.07	.248
Intervention * three months[c]	0.19	[−0.03;0.40]	0.11	.095
Intervention * twelve months[d]	0.17	[−0.05;0.39]	0.11	.131
PANSS (N = 597)				
Intervention	−0.16	[−1.19;0.86]	0.52	.754
Three months[b]	0.06	[−0.55;0.67]	0.31	.844
Twelve months[b]	0.51	[−0.10;1.11]	0.31	.102
Intervention * three months[c]	0.17	[−0.67;1.00]	0.42	.695
Intervention * twelve months[d]	0.77	[−0.10;1.64]	0.44	.082
HoNOS (N = 700)				
Intervention	−0.74	[−1.68;0.19]	0.48	.120
Three months[b]	0.32	[−0.53;1.16]	0.43	.464
Twelve months[b]	0.21	[−0.63;1.05]	0.43	.618
Intervention * three months[c]	−0.02	[−1.13;1.09]	0.56	.970
Intervention * twelve months[d]	0.02	[−1.15;1.19]	0.60	.976
MANSA (N = 670)				
Intervention	2.36	[0.31;4.41]	1.05	**.024**
Three months[b]	1.81	[0.21;3.41]	0.81	**.026**
Twelve months[b]	1.50	[0.09;2.91]	0.72	**.038**
Intervention * three months[c]	−2.80	[−4.96;−6.29]	1.10	**.011**
Intervention * twelve months[d]	−4.18	[−6.20;−2.16]	1.03	<**.001**

Note: in order to calculate the estimated mean differences between the intervention and control group over time, the following formula can be used, with X_1 and $X_2 = 0$ for the control group, 1 for the intervention group:

$$Y_{3\ months} = \beta_{Intervention} * X_1 + \beta_{Three\ months} + \beta_{Intervention*Three\ months} * X_2$$
$$Y_{12\ months} = \beta_{Intervention} * X_1 + \beta_{Twelve\ months} + \beta_{Intervention*Twelve\ months} * X_2$$

Example MANSA:
Estimated mean for the intervention group: $Y_{3months} = 2.36 * 1 + 1.81 + (-2.80 * 1) = 1.37$.
Estimated mean for the control group: $Y_{3months} = 2.36 * 0 + 1.81 = (-2.80 * 0) = 1.81$.
Estimated mean difference between intervention and control group: $\Delta Y_{3\ months} = 1.37–1.81 = -0.44$.
The MANSA score for the intervention group is −0.44 lower compared to the control group after three months of intervention.
Abbreviations: CDSS: Calgary Depression Scale for Schizophrenia; PANSS: Positive and Negative Syndrome Scale – remission items; HoNOS; Health of the Nation Outcome Scales; MANSA: Manchester Short Assessment of Quality of Life; CI: confidence interval; SE: standard error.
p-values significant at alpha <0.5 were indicated in bold.
[a] Reference category is control condition.
[b] Time was entered as dummy variables for the 3-month and 12-month measurement; baseline is the reference category.
[c] Reference category is the difference from baseline to the 3-month measurement for the control condition.
[d] Reference category is the difference from baseline to the 12-month measurement for the control condition.
[*] Results of linear mixed models analyses on CDSS, PANSS, HoNOS and MANSA scores adjusted for age, gender, chlorpromazine equivalents and living situation.

of the intervention on psychosocial outcomes was investigated separately for sheltered facilities and clinical care facilities using the linear mixed models described above, to examine whether the intervention may have a different effect on patients in sheltered facilities than on patients in clinical facilities. Finally, we investigated whether the improvement on somatic outcome waist circumference (WC) after three months of intervention (Looijmans et al., 2017), was related to improvements in mental well-being in patients in the intervention group. Intervention patients were split by median on WC differences scores from baseline till 3-months, leading to an 'improvement/equal' group (increase WC ≤ 0 cm) and a 'deterioration' group (increase WC >1 cm). Linear mixed models analyses were used to test whether groups differed in their psychosocial outcomes over time.

3. Results

3.1. Patient characteristics

Fifteen teams (nine sheltered and six clinical care teams, 400 patients) were allocated to the intervention group and 14 teams (nine sheltered and five clinical care teams, 414 patients) to the control group. Out of the 814 patients automatically included, 770 patients (384 intervention and 386 control patients) had data on at least one psychosocial measure at baseline or the 12-month measurement, making them eligible for analysis (see Fig. 1). Despite randomization, patients in the intervention group were on average older, were prescribed higher doses of antipsychotic medication and more patients in the intervention group were diagnosed with a substance related disorder or living in clinical care facilities (see Table 1). The intervention group reported less depressive symptoms and had a higher quality of life at baseline. Living situation fully explained baseline differences between intervention and control group for antipsychotic dosage, partly explained differences in age but could not explain the difference between the groups with regard to substance related disorder, depressive symptoms and quality of life.

3.2. Psychosocial outcomes

The intervention had no effect on the course of depressive symptoms, psychotic symptoms or overall functioning (Table 2, Fig. 2). The course of quality of life (possible range 12–84) differed between groups; the intervention group showed a significant reduction (−0.97 points after three months and −1.66 points after twelve months), the control group a significant increase (1.38 points after three months and 1.36 points after twelve months). Group difference were significant for both periods ($\beta = -2.80$, $p = .011$ and $\beta = -4.18$, $p < .001$, respectively), but the main change took place in the first three months. In sensitivity analyses controlling for initial baseline differences, the effects remained the same.

3.3. Post hoc analyses

Outcomes were different for the sheltered and clinical facilities (Supplementary Table 1, Supplementary Fig. 1). The clinical care intervention group showed a significant increase in depressive symptoms (possible range 0–27) after three (mean difference: 0.93 points) and after twelve months (0.96 points), while the depressive symptoms of the control group reduced (−0.40 and −0.16 points after three and twelve months; $\beta = 0.57$, $p = .003$ and $\beta = 0.39$, $p = .030$). The sheltered intervention group showed a significantly greater increase in psychotic symptoms (possible range 8–56) from baseline to the 12-month measurement (2.61 points) than the control group (0.05 points; $\beta = 1.79$, $p = .001$). For quality of life, the intervention group showed a decrease over time (−1.07 points after three months and −3.03 points after twelve months) compared to an increase of the control group

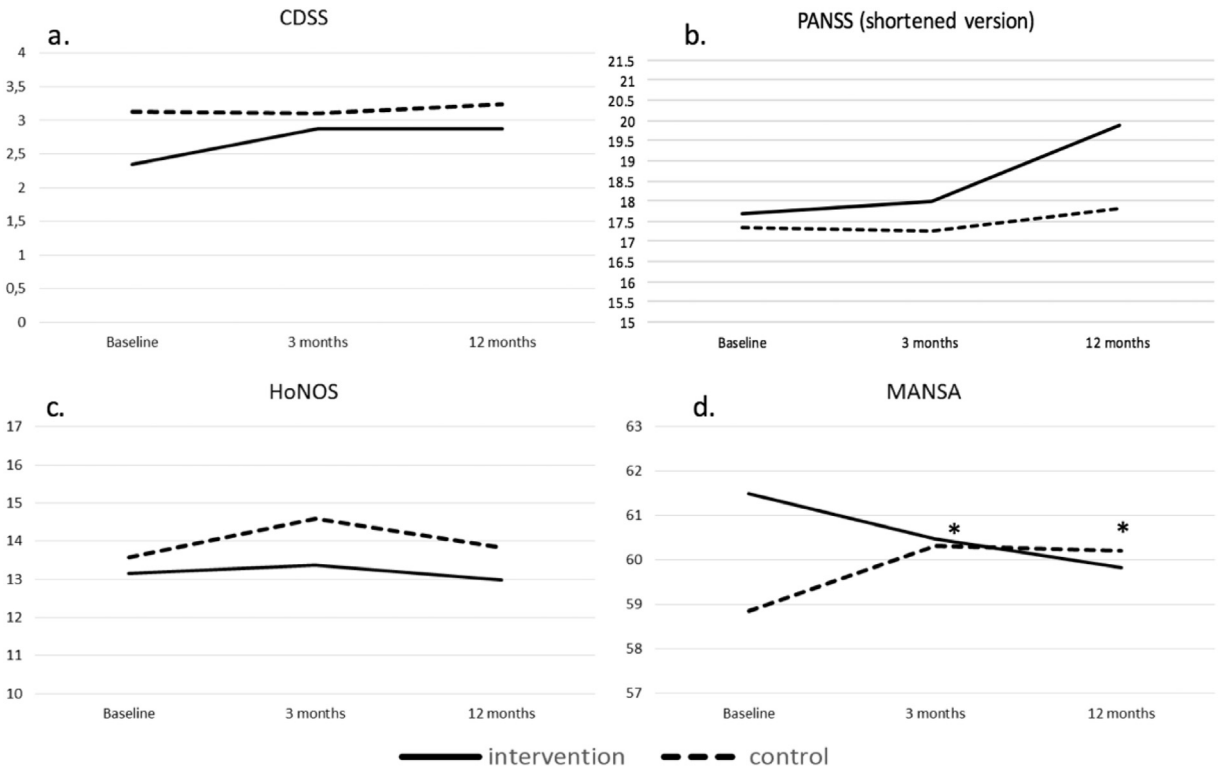

Fig. 2. Crude mean scores on psychosocial outcomes over time. Crude mean scores on the a) depressive symptoms (CDSS; range 0–27), b) psychotic symptoms (remission items of PANSS; range 7–56), c) overall functioning (HoNOS; range 0–48) and d) quality of life (MANSA; range 12–84) for intervention and control group over time. Note that higher scores indicate worse symptoms/functioning on CDSS, PANSS and HoNOS, but better quality of life on MANSA. Asterisks indicate significant differences between the intervention and control group of the marked time point compared to baseline.

(1.65 points after three months and 1.48 points after twelve months; β = −2.84, $p = .040$ and β = −5.84, $p < .001$, respectively).

Intervention patients who improved or stabilized in waist circumference after three months of intervention (N = 99; 53.5%) did not differ in quality of life, psychosocial functioning or depressive and psychotic symptoms after three and twelve months of intervention compared to deteriorating patients (N = 86; 46.5%; data not shown).

4. Discussion

This study examined the psychosocial effects of a 12-month diet-and-exercise lifestyle intervention targeting the obesogenic environment of residential patients with SMI. The intervention did not lead to improvements in psychosocial well-being compared to standard care. Instead, the intervention group showed an increase of depressive symptoms (only in clinical care facilities) and a decreased quality of life (only in sheltered facilities). Improvements in somatic health (waist circumference) after three months of intervention (Looijmans et al., 2017), were not associated with improvements in psychosocial well-being.

Interpreting the slight deterioration in mental well-being is complicated since the intervention group had significantly less depressive symptoms and better quality of life at baseline. Thus, changes over time could be the result of regression toward the mean rather than an effect of the intervention. Furthermore, these changes are small: one point on the CDSS, of which the minimal clinically important difference (MCID) is 1.3 points (Amri et al., 2014) and 1.5 point on the MANSA which, although the MCID is unknown, seems small compared to the possible range of 12–84 points. In addition, baseline levels of all psychosocial outcomes were already remarkably good. This may be due to an optimal medication balance that has been established over the years, patients having come to terms with their current living situation, and the high level of psychosocial support in residential settings (Heggelund et al., 2011). Improvements are therefore harder to achieve, especially by an intervention not specifically designed for improvements in mental well-being. Thus, these findings may be a result of non-optimal randomization and may not reflect clinically relevant changes in well-being. The increase in psychotic symptoms in the sheltered intervention groups is hard to interpret, it is unclear whether this is due to factors related or unrelated to the study.

Nevertheless, it is possible that a growing awareness of the risks of having an unhealthy lifestyle, while possibly having insufficient opportunities to change lifestyle behaviors, unintentionally affected psychosocial outcomes negatively. While not assessed, some experimental teams indeed perceived barriers to implementation of the intervention on organizational level (e.g. in changing the food that is prepared by a central kitchen), on team level (e.g. staff members are hesitant to take away unhealthy choices) and on patient level (e.g. some patients could not be motivated or considered reducing health risks difficult). Furthermore, changing the environment requires a change in the existing culture in which lifestyle and somatic health have long been neglected, which takes time (Cohn et al., 2010; Walsh, 2011). At some sites the changes were implemented in the monitoring phase rather than in the implementation phase and therefore had less time to become effective. In addition, the small change approach may have led to environmental changes that were too small to bring about detectable changes in psychosocial functioning during the study period.

Another possible explanation for our findings is that the causal relationship between lifestyle factors and psychosocial well-being is weaker in the SMI population than in the general population. Several pathways have been proposed for the general population. For example, exercise is thought to have a positive effect through increased levels of endorphins or serotonin, and through psychological changes such as increased self-efficacy, self-esteem, and interruptions from negative thoughts (Ross and Hayes, 1988; Stathopoulou et al., 2006). Dietary quality may have an effect through biological processes such as the stress response system (Sarris et al., 2014) or, when shifting to healthier diet, through the experience of successful behavior change (Carson et al., 2014). Despite positive effects of lifestyle interventions in the general population (Rethorst et al., 2009), the evidence in SMI is limited or stems from methodologically challenged studies (Ball et al., 2001; Beebe et al., 2005; Brar et al., 2005; Forsberg et al., 2010; Heggelund et al., 2011; Hoffmann et al., 2005; Kwon et al., 2006; Mauri et al., 2008; Melamed et al., 2008; Poulin et al., 2007). The current findings could indicate that the effects of changes in lifestyle on psychosocial functioning is not as strong, or even absent, in SMI patients compared to the general population. This should be elucidated in future research.

The ELIPS study has unique strengths beyond the large representative sample of a population that is rarely the subject of intervention studies. The pragmatic nature of the trial has several advantages, such as a high generalizability and high clinical value (Patsopoulos, 2011): The study design allowed regular staff members to adopt changes in real life settings that fitted well within the team's specific daily working routine. However, the downside of pragmatic trials is limited control over the specific interventions used, the degree of implementation in the experimental teams and the degree to which health behaviors were stimulated in the control group. Future pragmatic trials should include a process evaluation to investigate the reach, dose delivery and adherence of the intervention, and whether sites with a higher level of implementation are able to reach more health gain. Another limitation is that no specific efforts were undertaken to improve psychosocial functioning, as the primarily aim was to reduce cardiometabolic risk factors. Lifestyle interventions may need to be combined with individual counselling or behavioral therapy to have a positive effect on psychosocial functioning. However, studies primarily focusing on improving psychosocial well-being in patients with long-term complex mental illness have failed in doing so, suggesting that psychosocial outcomes are difficult to influence in this more complex group of patients (Crawford et al., 2010; Killaspy et al., 2015).

This is the first large multicentre randomized trial to investigate the effect of a lifestyle intervention targeting the obesogenic environment of residential SMI patients. The study showed no improvements in psychosocial well-being after three or twelve months. More research, including process evaluation, is needed to investigate the effect of different types of lifestyle interventions on somatic as well as psychosocial outcomes, including an examination of barriers to success and how to overcome them.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.schres.2018.02.053.

Conflict of interest

The authors declare that they have no conflict of interest.

Contributors

EC and FJ designed the study and wrote the protocol. APMS and AL performed the analysis and wrote the first draft of the manuscript. All authors have contributed to and have approved of the manuscript.

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References

Acil, A.A., Dogan, S., Dogan, O., 2008. The effects of physical exercises to mental state and quality of life in patients with schizophrenia. J. Psychiatr. Ment. Health Nurs. 15, 808–815.

Addington, D., Addington, J., Schissel, B., 1990. A depression rating scale for schizophrenics. Schizophr. Res. 3, 247–251.

Addington, D., Addington, J., Atkinson, M., 1996. A psychometric comparison of the Calgary depression scale for schizophrenia and the Hamilton depression rating scale. Schizophr. Res. 19, 205–212.
Amri, I., Millier, A., Toumi, M., 2014. Minimum Clinically Important Difference in the Calgary Depression Scale for Schizophrenia. Poster Presented at the International Society for Pharmacoeconomics and Outcomes Research Asia-Pacific Conference, Beijing, China. Abstract retrieved from. http://www.ispor.org/ScientificPresentationsDatabase/Presentation/50149.
Andreasen, N.C., Carpenter, W.T., Kane, J.M., Lasser, R.A., Marder, S.R., Weinberger, D.R., 2005. Remission in schizophrenia: proposed criteria and rationale for consensus. Am. J. Psychiatry 162, 441–449.
Ball, M.P., Coons, V.B., Buchanan, R.W., 2001. A program for treating olanzapine-related weight gain. Psychiatr. Serv. 52, 967–969.
Beebe, L.H., Tian, L., Morris, N., Goodwin, A., Allen, S.S., Kuldau, J., 2005. Effects of exercise on mental and physical health parameters of persons with schizophrenia. Issues Ment. Health Nurs. 26, 661–676.
Brar, J.S., Ganguli, R., Pandina, G., Turkoz, I., Berry, S., Mahmoud, R., 2005. Effects of behavioral therapy on weight loss in overweight and obese patients with schizophrenia or schizoaffective disorder. J. Clin. Psychiatry 66, 205–212.
Bruins, J., Jörg, F., Bruggeman, R., Slooff, C., Corpeleijn, E., Pijnenborg, M., 2014. The effects of lifestyle interventions on (long-term) weight management, cardiometabolic risk and depressive symptoms in people with psychotic disorders: a meta-analysis. PLoS One 9, e112276.
Carson, T.L., Hidalgo, B., Ard, J.D., Affuso, O., 2014. Dietary interventions and quality of life: a systematic review of the literature. J. Nutr. Educ. Behav. 46, 90–101.
Cohn, T., Grant, S., Faulkner, G.E., 2010. Schizophrenia and obesity: addressing obesogenic environments in mental health settings. Schizophr. Res. 121, 277–278.
Crawford, M.J., Killaspy, H., Kalaitzaki, E., Barrett, B., Byford, S., Patterson, S., Soteriou, T., O'Neill, F.A., Clayton, K., Maratos, A., Barnes, T.R., Osborn, D., Johnson, T., King, M., Tyrer, P., Waller, D., 2010. The MATISSE study: a randomised trial of group art therapy for people with schizophrenia. BMC Psychiatry 65:1–9. https://doi.org/10.1186/1471-244X-10-65.
Daumit, G.L., Dalcin, a T., Jerome, G.J., Young, D.R., Charleston, J., Crum, R.M., Anthony, C., Hayes, J.H., McCarron, P.B., Khaykin, E., Appel, L.J., 2011. A behavioral weight-loss intervention for persons with serious mental illness in psychiatric rehabilitation centers. Int. J. Obes. 35, 1114–1123.
Evans, S.M., Newton, R., Higgins, S., 2004. Nutritional intervention to prevent weight gain in patients commenced on olanzapine: a randomised controlled study. Aust. N. Z. J. Psychiatry 14, S239.
Evans, S., Newton, R., Higgins, S., 2005. Nutritional intervention to prevent weight gain in patients commenced on olanzapine: a randomized controlled trial. Aust. N. Z. J. Psychiatry 39, 479–486.
Forsberg, K.a., Björkman, T., Sandman, P.O., Sandlund, M., 2010. Influence of a lifestyle intervention among persons with a psychiatric disability: a cluster randomised controlled trail on symptoms, quality of life and sense of coherence. J. Clin. Nurs. 19, 1519–1528.
Gardner, D.M., Murphy, A.L., O'Donnell, H., Centorrino, F., Baldessarini, R.J., 2010. International consensus study of antipsychotic dosing. Am. J. Psychiatry 167, 686–693.
Heggelund, J., Nilsberg, G.E., Hoff, J., Morken, G., Helgerud, J., 2011. Effects of high aerobic intensity training in patients with schizophrenia: a controlled trial. Nord. J. Psychiatry 65, 269–275.
Hoffmann, V.P., Ahl, J., Meyers, A., Schuh, L., Shults, K.S., Collins, D.M., Jensen, L., 2005. Wellness intervention for patients with serious and persistent mental illness. J. Clin. Psychiatry 66, 1576–1579.
Kay, S.R., Fiszbein, A., Opler, L. a, 1987. The positive and negative syndrome scale (PANSS) for schizophrenia. Schizophr. Bull. 13, 261–276.
Killaspy, H., Marston, L., Green, N., Harrison, I., Lean, M., Cook, S., Mundy, T., Craig, T., Holloway, F., Leavey, G., Koeser, L., McCrone, P., Arbuthnott, M., Omar, R.Z., King, M., 2015. Clinical effectiveness of a staff training intervention in mental health inpatient rehabilitation units designed to increase patients' engagement in activities (the Rehabilitation Effectiveness for Activities for Life [REAL] study): single-blind, cluster. Lancet Psychiatry 2, 38–48.
Kwon, J.S., Choi, J.-S., Bahk, W.-M., Yoon Kim, C., Hyung Kim, C., Chul Shin, Y., Park, B.-J., Geun Oh, C., 2006. Weight management program for treatment-emergent weight gain in olanzapine-treated patients with schizophrenia or schizoaffective disorder: a 12-week randomized controlled clinical trial. J. Clin. Psychiatry 67, 547–553.
Lang, U.E., Beglinger, C., Schweinfurth, N., Walter, M., Borgwardt, S., 2015. Nutritional aspects of depression. Cell. Physiol. Biochem. 1029–1043.
Looijmans, A., Jörg, F., Schoevers, R.a., Bruggeman, R., Stolk, R.P., Corpeleijn, E., 2014. Changing the obesogenic environment of severe mentally ill residential patients: ELIPS, a cluster randomised study design. BMC Psychiatry 14, 293.
Looijmans, A., Stiekema, A.P.M., Bruggeman, R., van der Meer, L., Stolk, R.P., Schoevers, R.A., Jörg, F., Corpeleijn, E., 2017. Changing the obesogenic environment to improve cardiometabolic health in residential patients with a severe mental illness: ELIPS, a cluster randomized controlled trial. Br. J. Psychiatry 211 (5):296–303. https://doi.org/10.1192/bjp.bp.117.199315.
Mauri, M., Simoncini, M., Castrogiovanni, S., Iovieno, N., Cecconi, D., Dell'Agnello, G., Quadrigli, M., Rossi, A., Donda, P., Fagiolini, A., Cassano, G.B., 2008. A psychoeducational program for weight loss in patients who have experienced weight gain during antipsychotic treatment with olanzapine. Pharmacopsychiatry 41, 17–23.
Melamed, Y., Stein-Reisner, O., Gelkopf, M., Levi, G., Sivan, T., Ilievici, G., Rosenberg, R., Weizman, A., Bleich, A., 2008. Multi-modal weight control intervention for people with persistent mental disorders. Psychiatr. Rehabil. J. 31, 194–200.
Patsopoulos, N.A., 2011. A pragmatic view on pragmatic trials. Dialogues Clin. Neurosci. 13, 217–224.
Penedo, F., Dahn, J., 2005. Exercise and well-being: a review of mental and physical health benefits associated with physical activity. Curr. Opin. Psychiatry 18, 189–193.
Poulin, M.-J., Chaput, J.-P., Simard, V., Vincent, P., Bernier, J., Gauthier, Y., Lanctôt, G., Saindon, J., Vincent, A., Gagnon, S., Tremblay, A., 2007. Management of antipsychotic-induced weight gain: prospective naturalistic study of the effectiveness of a supervised exercise programme. Aust. N. Z. J. Psychiatry 41, 980–989.
Priebe, S., Huxley, P., Knight, S., Evans, S., 1999. Application and results of the Manchester Short Assessment of Quality of Life (MANSA). Int. J. Soc. Psychiatry 45, 7–12.
Rethorst, C.D., Wipfli, B.M., Landers, D.M., 2009. The antidepressive effects of exercise: a meta-analysis of randomized trials. Sports Med. 39, 491–511.
Richardson, C.R., Avripas, S.a., Neal, D.L., Marcus, S.M., 2005. Increasing lifestyle physical activity in patients with depression or other serious mental illness. J. Psychiatr. Pract. 11, 379–388.
Rimes, R.R., Moura, A.M. de S., Lamego, M.K., Filho, A.S. de S., Manochio, J., Paes, F., Carta, M.G., Mura, G., Wegner, M., Budde, H., Rocha, N.B.F., Rocha, J., Tavares, J.M.R.S., Arias-Carrion, O., Nardi, A.E., Yuan, T.-F., Machado, S., 2015. Effects of exercise on physical and mental health, and cognitive and brain functions in schizophrenia: clinical and experimental evidence. CNS Neurol. Disord. Drug Targets 14, 1244–1254.
Rosenbaum, S., Tiedemann, A., Sherrington, C., Curtis, J., Ward, P.B., 2014. Physical activity interventions for people with mental illness: a systematic review and meta-analysis. J. Clin. Psychiatry 75, 964–974.
Ross, C.E., Hayes, D., 1988. Exercise and psychologic well-being in the community. J. Epidemiol. 127, 762–771.
Sarris, J., O'Neil, A., Coulson, C.E., Schweitzer, I., Berk, M., 2014. Lifestyle medicine for depression. BMC Psychiatry 107, 1–13.
Scheewe, T.W., Backx, F.J.G., Takken, T., Jörg, F., van Strater, A.C.P., Kroes, A.G., Kahn, R.S., Cahn, W., 2013. Exercise therapy improves mental and physical health in schizophrenia: a randomised controlled trial. Acta Psychiatr. Scand. 127, 464–473.
Stathopoulou, G., Powers, M.B., Berry, A.C., Smits, J.A.J., Otto, M.W., 2006. Exercise interventions for mental health: a quantitative and qualitative review. Clin. Psychol. Sci. Pract. 13, 179–194.
Swinburn, B., Egger, G., Raza, F., 1999. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. Prev. Med. 29, 563–570.
Treweek, S., Zwarenstein, M., 2009. Making trials matter: pragmatic and explanatory trials and the problem of applicability. Trials 37, 9.
Vancampfort, D., Probst, M., Knapen, J., Carraro, A., De Hert, M., 2012. Associations between sedentary behaviour and metabolic parameters in patients with schizophrenia. Psychiatry Res. 200, 73–78.
Walsh, R., 2011. Lifestyle and mental health. Am. Psychol. 6–9.
Wärdig, R.E., Foldemo, A., Hultsjö, S., Lindström, T., Bachrach-Lindström, M., 2016. An intervention with physical activity and lifestyle counseling improves health-related quality of life and shows small improvements in metabolic risks in persons with psychosis. Issues Ment. Health Nurs. 37:43–52. https://doi.org/10.3109/01612840.2015.1092187.
Wing, J.K., Beevor, A.S., Curtis, R.H., Park, S.B.G., Hadden, S., Burns, A., 1998. Health of the nation outcome scales (HoNOS): research and development. Br. J. Psychiatry 172, 11–18.
Wipfli, B.M., Rethorst, C.D., Landers, D.M., 2008. The anxiolytic effects of exercise: a meta-analysis of randomized trials and dose-response analysis. J. Sport Exerc. Psychol. 30, 392–410.