Published in final edited form as:
J Nutr Health Aging. 2018 ; 22(10): 1259–1265. doi:10.1007/s12603-018-1127-0.

QUALITY OF LIFE AND MENTAL HEALTH IN OLDER ADULTS WITH OBESITY AND FRAILTY: ASSOCIATIONS WITH A WEIGHT LOSS INTERVENTION

M.E. PAYNE[1], **K.N. PORTER STARR**[2,3], **M. ORENDUFF**[2,4], **H. S. MULDER**[5], **S.R. MCDONALD**[2,3,6], **A.P. SPIRA**[7], **C.F. PIEPER**[8], and **C.W. BALES**[2,3,6]

[1]Office of Research Development, Duke University School of Medicine, USA

[2]Center for the Study of Aging and Human Development, Duke University, USA

[3]Geriatric Research, Education, and Clinical Center, Durham VA Medical Center, USA

[4]Nutrition Graduate Program, The University of North Carolina at Chapel Hill, USA

[5]Duke Clinical Research Institute, Duke University, USA

[6]Department of Medicine, Duke University, USA

[7]Department of Mental Health, Johns Hopkins Bloomberg School of Public Health, USA

[8]Department of Biostatistics and Bioinformatics, Duke University, USA.

Abstract

Objective: To examine the bi-directional associations of a weight loss intervention with quality of life and mental health in obese older adults with functional limitations.

Design: Combined-group analyses of secondary variables from the MEASUR-UP randomized controlled trial.

Setting: Academic medical center.

Participants: Obese community-dwelling men and women (N = 67; age ≥60; BMI ≥30) with functional limitations (Short Physical Performance Battery [SPPB] score of 4–10 out of 12).

Intervention: Six-month reduced calorie diet at two protein levels

Measurements: Weight, height, body composition, physical function, medical history, and mental health and quality of life assessments (Center for Epidemiologic Studies Depression Scale

Corresponding author: M. E. Payne, Duke University School of Medicine, Davison Building, Suite 410, Durham, North Carolina, 27710 USA, Tel +1 919 681-1611, martha.payne@duke.edu.

Author contributions: ME Payne was responsible for study concept and design, interpretation of data, and preparation of this manuscript. She also provided guidance on data acquisition and analyses. KN Porter Starr, SR McDonald, CF Pieper and CW Bales contributed to study design and data interpretation. KN Porter Starr and M Orenduff performed participant recruitment and data acquisition. SR McDonald also acquired study data. HS Mulder and CF Pieper performed the statistical analyses. AP Spira contributed to the interpretation of data. All authors were involved in review and editing of manuscript, and provided approval of final version before submission.

Ethical standards: This study was approved by the Duke Institutional Review Board (IRB) and written informed consent was obtained from all participants. Further, this study was conducted in compliance with the laws of the United States.

Clinical Trial registration: ClinicalTrials.gov identifier – NCT01715753

[CES-D]; Profile of Mood States [POMS], Pittsburgh Sleep Quality Index [PSQI]; Perceived Stress Scale [PSS]; Satisfaction with Life Scale [SWLS]; and Short Form Health Survey [SF-36]) were acquired at 0, 3 and 6 months

Results: Physical composite quality of life (SF-36) improved significantly at 3 months ($\beta = 6.29$, $t2,48 = 2.60$, $p = 0.012$) and 6 months ($\beta = 10.03$, $t2,48 = 4.83$, $p < 0.001$), as did several domains of physical quality of life. Baseline depression symptoms (CES-D and POMS) were found to predict lower amounts of weight loss; higher baseline sleep latency (PSQI) and anger (POMS) predicted less improvement in physical function (SPPB).

Conclusion: The significant bi-directional associations found between a weight loss intervention and mental health/quality of life, including substantial improvements in physical quality of life with obesity treatment, indicate the importance of considering mental health and quality of life as part of any weight loss intervention for older adults.

Keywords

Obesity; quality of life; older adults; mental health; weight reduction

Introduction

Obesity afflicts 38.5% of older adults (1) and contributes significantly to poor physical and mental health outcomes (2, 3). Suboptimal quality of life (QOL) and mental health conditions, including depression, often co-occur with obesity (4), and this co-occurrence may be especially likely in the presence of impaired physical function. The obesity-mental health association appears to be stronger in late life than early or middle adulthood (5, 6). Although weight loss interventions may help to alleviate both physical and mental health problems related to obesity, such interventions have been under-studied among older adults. Studies of young and middle-aged adults have shown that dietary and surgical weight loss interventions lead to a lessening of depression. Weight loss interventions have also been shown to lower stress levels (7) and to improve QOL (8, 9), although not in all trials (10, 11). Weight loss (diet and exercise) interventions offer the potential to improve mental health; however, in older adults these responses have only been explored in a small number of trials, with improvements demonstrated in health-related and overall quality of life, depression and perceived stress (8, 11–14).

A bidirectional relationship exists between weight loss and mental health, such that weight reduction often leads to improvements in QOL and depression while mental health problems predict poorer adherence and less success with weight loss interventions. Depressive symptoms have been associated with blunted weight loss success from both dietary and surgical interventions (15–17). Among non-elderly adults diagnosed with depression, those who were in remission were more successful with a behavioral weight loss intervention than were unremitted individuals (18). Consistent with these results, depression and low QOL scores predict lower adherence to weight loss interventions, including lower attendance at exercise sessions and higher attrition (19, 20) and, for this reason, depressed individuals are often excluded from weight loss studies. Inadequate sleep and increased stress also predict less weight loss, as shown among participants of a 6-month diet and exercise intervention

(7). Overall, studies of middle-aged adults show that mental health factors influence an individual's success during a weight loss intervention but evidence is lacking for such a relationship in older adults.

This study used mental health and quality of life assessments collected during a weight loss intervention trial to explore the bidirectional associations between weight loss and mental health/QOL in older adults.

Materials and methods

This study was conducted to examine secondary variables (QOL and mental health) from MEASUR-UP (Measuring Eating, Activity and Strength: Understanding the Response-Using Protein), a randomized controlled trial (RCT), conducted between 2012 and 2014, to evaluate a balanced, higher protein intake in comparison to a control (RDA-level) protein intake during a long-term weight loss intervention in obese older adults with functional limitations (21). The results by group have already been reported for primary outcomes of interest, namely, changes in physical function and lean body mass (22). Given minimal group differences for QOL and mental health variables, the absence of a protein-specific hypothesis, and in order to increase power, the two groups were combined for the current analyses. Thus, the role of the protein intervention was not evaluated.

Design

MEASUR-UP was a 6-month randomized controlled weight loss trial; participants were randomly assigned to either a high protein or an RDA-level protein intervention (2:1 allocation ratio), stratified by sex. Both groups were prescribed a 500 kcal/ day energy deficit, with a goal of 10% weight loss; Registered Dietitians provided an individualized meal plan. All participants attended weekly weigh-ins and group meetings for counseling and peer support. Protein group participants were counseled to consume 30 grams of high quality protein at each meal and were supplied with cooked lean beef. As noted above, the groups were combined for these mental health/QOL analyses.

Sample

All MEASUR-UP participants were included in the present analysis of secondary variables related to mental health and quality of life (N = 67). Participants were community-dwelling women and men, age 60 years or older, obese (BMI ≥ 30 kg/ m2) and with mild to moderate physical impairment (Short Physical Performance Battery [SPPB] score of 4–10 out of 12). Exclusion criteria included significant renal impairment and unstable/terminal medical conditions. This protocol was approved by the Duke Institutional Review Board (IRB) and meets the guidelines of the United States Office for Human Research Protections (OHRP), and written informed consent was obtained from all participants.

Assessments

Assessments were administered at 0 (baseline), 3 and 6 months. These assessments included weight, SPPB, sociodemographics, medical conditions and medication use (self-report of diagnoses at baseline only), and mental health/QOL.

Self-administered mental health and QOL questionnaires included the Center for Epidemiologic Studies Depression Scale (CES-D)(23), Profile of Mood States (POMS)(24, 25), an unintentionally-modified version of the Pittsburgh Sleep Quality Index (PSQI)(26), Perceived Stress Scale (PSS)(27), Satisfaction with Life Scale (SWLS)(28), and Short Form Health Survey (SF-36) to examine quality of life (29).

CES-D—The CES-D measures symptoms of depression and is not a diagnostic tool for major depressive disorder (23). Participants scoring ≥16 (range 0–60) were considered at risk for prevalent depression. These participants were informed that they had symptoms of depression, given general information about depression, and encouraged to follow up with a health care provider. In addition, study protocol dictated that participants who endorsed suicidal thoughts or behaviors, at any point, would be evaluated and/or referred for psychiatric treatment. For the predictive analyses examining the relationships between baseline mental health and changes in weight/function, a dichotomous depression variable was used. Individuals were coded as positive for depression if they had a CES-D score of ≥16 and/or had self-report of depression diagnosis at baseline. In addition to the total score, the CES-D includes 4 subscales: depressed affect (range 0–21), positive affect (range 0–12), somatic (range 0–21), and interpersonal (range 0–6).

POMS—The 30-item POMS measures mood and mood changes, has low respondent burden, and includes 6 subscales: tension, depression, anger, fatigue, confusion and vigor (all with range 0–20). Total mood disturbance (TMD) is derived from POMS using the following formula, TMD = (Sum of all subscales except vigor) – vigor (range −20 – 100) (25).

PSQI—The intent was to use the standard PSQI (26) to evaluate sleep attributes. Unfortunately, after all participants had been enrolled, a mistake was discovered with one of the questions on daytime dysfunction. Because of this error, the authors felt it was inappropriate to report results for the daytime dysfunction component score as well as the global score, since the latter is derived by summing all 7 components. Reported PSQI values include only these six component scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, and use of sleeping medication (all with a range 0–3).

PSS—The PSS assesses the degree to which situations in one’s life are considered stressful (range 0–40)(27).

SWLS—The SWLS evaluates global life satisfaction, an important component of subjective well-being (range 5–35)(28).

SF-36—The SF-36 measures 8 QOL domains which are dichotomized into physical (functioning, role limitations-physical, pain, general health) and mental health (vitality, social functioning, role limitations-emotional, and emotional/ mental health)(29) and was scored as described by Hays et al. (30). Item scores were converted to a 0–100 point scale; domain scores were derived by averaging individual items within the subscale; and physical

composite and mental health composite scores were derived by averaging the four component domains of each. Higher values are indicative of better QOL.

Statistical methodology

Analyses were performed using SAS, version 9.4 (SAS Institute, Inc., Cary, NC) and were performed with the groups combined. Change score values (relative to baseline) for each outcome (mental health and QOL variables) were analyzed under 'intent to treat' principles, controlling for baseline levels of the outcomes of interest. A Mixed Models repeated measures approach was used to assess change from baseline at 2 time points, the 3-month midpoint and the 6-month endpoint, controlling for baseline (31). Models also examined the association of baseline mental health and QOL variables with success in the intervention, defined as weight loss and ΔSPPB score, controlling for baseline values (weight or SPPB score, respectively). Statistical significance was declared at an alpha level of 0.05 (two-tailed). Since this was not a confirmatory intervention and the limited sample size was likely to lead to Type-II errors, we did not make adjustments by the usual techniques (32) for the family-wise Type-I error rate inherent in testing of multiple outcomes.

Results

Sample characteristics are shown in Table 1. The overall mean age was 68 years and BMI was 37 kg/m2; most participants were women, the majority were White, and all had completed high school. The most common comorbidity reported was hypertension. A total of eleven participants reported depression (at baseline), and seven reported other psychiatric conditions (i.e., anxiety, bipolar disorder or attention deficit hyperactivity disorder [ADHD]). Five participants had baseline CES-D scores of 16 or higher, indicating a risk of prevalent depression. Two participants had both a diagnosis of depression and CES-D score of 16+; overall, fourteen individuals had either high CES-D score (N = 3) or depression diagnosis (N = 9), or both (N = 2). None of the participants endorsed suicidal thoughts or behaviors during the study. As reported previously, there was significant weight loss (mean = −8.4 kg) and physiologically-important improvements in SPPB scores at the 6-month end point for both groups, with a significantly greater improvement in the SPPB score for the Protein group (+2.4 points) relative to Control group (+0.9 point) (22).

Influence of weight loss intervention on mental health and QOL measures

Baseline values and change scores for QOL variables are presented in Table 2. A number of improvements in QOL (SF-36) measures were reported, including improved physical composite QOL scores at 3 and 6 months. Component domains of physical QOL that showed significant improvements were physical functioning, role limitations, and pain. The mental health composite QOL scores improved significantly at 3 months only. Components of mental health QOL that improved significantly were vitality and social functioning.

Baseline values and change scores for the mental health variables are presented in Table 3. Depression (CES-D) and mood disturbance (POMS) scores tended to be low in this sample. For CES-D, positive affect improved significantly at 3 months. Significant improvements in POMS scores were identified for total mood disturbance, depression, anger, fatigue, and

vigor. PSQI components that improved significantly were sleep duration and sleep efficiency. Scores for PSS and SWLS did not change significantly during the intervention.

Baseline mental health and QOL predictors of success in intervention

Several mood/depression variables were associated with weight loss success. In analyses controlling for baseline weight, higher baseline CES-D total and somatic scores were associated with less weight loss, although the association of these variables decreased over time (total CES-D score*time: $\beta = -0.24$, $t_{1,43} = -3.55$, $p < 0.001$; somatic*time: $\beta = -0.43$, $t_{1,47} = -2.72$, $p < 0.001$). In addition, from the POMS, higher values for total mood disturbance (TMD) and fatigue were associated with less weight loss, but the association of these variables also decreased over time (TMD*time: $\beta = -0.074$, $t_{1,44} = -2.06$, $p = 0.046$; fatigue*time: $\beta = -0.28$, $t_{1,45} = -2.55$, $p = 0.014$).

Two variables were associated with change in SPPB score. Longer baseline sleep onset latency (PSQI), defined as the time it takes to fall asleep, was associated with less improvement in SPPB score ($\beta = -0.81$, $t_{1,46} = -2.87$, $p = 0.006$). Higher baseline anger (POMS) was associated with less improvement in SPPB score, and the time interaction term was significant, indicating that the association of anger increased with time (anger*time: $\beta = 0.22$, $t_{1,47} = 3.22$, $p = 0.002$).

Discussion

Primary findings from this study of obese older adults with functional impairment include 1) beneficial effect of a weight loss intervention on physical QOL and mental health measures, and 2) predictive capacity of mental health measures for both weight loss and improvement in physical function. These results indicate the importance of evaluating mental health and QOL as part of a weight loss intervention for older adults.

Participation in the MEASUR-UP weight loss RCT was associated with robust improvements in physical QOL, primarily evidenced by the SF-36 (physical functioning, role limitations, pain, vitality, and physical composite score) but also shown by the POMS (fatigue and vigor). Although vitality (SF-36) is a domain for the mental health composite QOL, it is also recognized as an important factor for physical QOL (33). These QOL improvements are consistent with studies showing QOL benefits derived from weight loss interventions in obese middle-aged and older individuals (8, 34). Given that our sample of obese older adults had impaired physical function at baseline and that weight loss improves physical function, it is not surprising that the participants experienced significant improvements in their physical QOL. Indeed, when the physical composite findings were examined for explanatory variables, there was a trend for an association between change in SPPB score and change in SF-36 physical composite score ($p = 0.06$). Our findings are consistent with a study of 107 obese and physically frail older adults who demonstrated QOL improvements, particularly in physical function, with a weight loss intervention (8). In that study, both increased strength and weight loss were independent predictors of change in QOL. Interestingly, in our study, weight loss was not significantly associated with QOL change ($p = 0.8$). Researchers have speculated that other aspects of participation in a weight loss program, including one-on-one counseling and social support, are responsible for the

beneficial effects. These supportive components were prominent features in MEASUR-UP and may explain a portion of the QOL and mental health benefits. In summary, this weight loss intervention for obese older adults with functional limitations led to significant improvements in physical QOL across a variety of domains.

In addition to physical QOL, there were significant improvements in mental health QOL (SF-36 social functioning, vitality [mentioned above], and mental health composite score), mood (CES-D positive affect; POMS total mood disturbance, depression and anger), and sleep (PSQI duration and efficiency). Some of these mental health benefits were evident only at 3 months. The psychological benefits from participation in MEASUR-UP are likely due to several factors including the above-mentioned social support and one-on-one counseling, the effect of weight loss on health, and the substantial improvements in physical function. However, some changes, while statistically significant, are unlikely to be clinically meaningful (e.g., sleep duration change of −0.2 [on a 3-point scale]). And, although we did not see improvements in CES-D total score (depression), stress, and satisfaction with life, it is worth noting that no mental health scores were worsening with the MEASUR-UP weight loss interventions. Some measures may not have shown significant improvement because of low baseline scores (e.g., CES-D total score), consistent with prior studies (8). There may have been a selection bias in that depressed individuals were less likely to volunteer for this intensive weight loss intervention. Overall, mental health benefits were less robust than physical QOL improvements.

In addition to the beneficial effects of the MEASUR-UP intervention on QOL and mental health, specific mood and sleep factors were found to be predictors of weight loss and improvement in physical function. Higher baseline values for CES-D total and somatic scores, as well as total mood disturbance and fatigue (POMS), were associated with less weight loss. Elevated depression symptoms may have decreased motivation or ability to adhere to the prescribed dietary regimen or to participate in physical activity, compromising the goal of negative energy balance. In terms of function, longer sleep latency (PSQI) and anger (POMS) were associated with less SPPB improvement. The influence of sleep latency is consistent with prior work showing that poor sleep efficiency, a construct that includes sleep latency, predicts functional decline in older women (35). In addition, poor sleep has been associated with slower gait speed and reduced proficiency with chair stands (36), factors that are primary determinants of the SPPB score. Greater sleep latency may also indicate the presence of an underlying process (e.g., inflammation) that is responsible for diminished physical function. Higher baseline anger was also associated with less functional improvement, and this relationship increased over time. Additional studies are warranted to examine predictive relationships between mental health and weight loss outcomes.

The current study has a number of strengths, including its focus on obese older adults with functional limitations, an important population at particular risk for health complications, poor QOL, and loss of independence. In addition, there were no exclusions based on psychiatric conditions, avoiding potential bias and improving generalizability. Limitations of this exploratory study include a modest sample size and potential for bias due to attrition. The low baseline levels of depression made it less likely that intervention benefits would be

observed for depressive symptoms. Another limitation was the use of self-report measures of sleep quality.

In this study of obese older adults with impaired physical function, a weight loss intervention led to improvements in QOL and mental health. In addition, mood, sleep and QOL measures predicted weight loss and improvements in physical function. These results indicate the importance of evaluating mental health and QOL as part of a weight loss intervention for older adults and warrant further evaluation on large scale trials.

Acknowledgments:

We thank the research participants. We also acknowledge E Granville, G Jones, K Maloney, L McClure, J Miller, C Ocampo, and Y Wang for participant recruitment and assessment, and data management.

Funding Sources and Sponsors' Roles: For this research, the authors received support from the Beef Checkoff Program (KN Porter Starr, M Orenduff, SR McDonald and CW Bales); the United States Department of Veterans Affairs Rehabilitation Research and Development Service Program (CDA-2/ IK2 RX002348 to KN Porter Starr); and the United States National Institutes of Health (NIH: T32 AG000029 to KN Porter Starr; P30 AG028716 to CF Pieper; and K12 HD043446 to ME Payne). The sponsors had no role in the design, methods, participant recruitment, data collection, analysis, or preparation of this paper.

Funding sources: United States (U.S.) National Institutes of Health (BIRCWH K12 HD043446, T32 AG000029, P30 AG028716), United States (U.S.) Department of Veterans Affairs Rehabilitation Research and Development Service Program (CDA-2/ IK2 RX002348), and the Beef Check-off Program. Preliminary results were presented at the 2014 annual meetings of the American Association for Geriatric Psychiatry and the Building Interdisciplinary Research Careers in Women's Health program (NIH BIRCWH K12).

Conflict of Interest: Dr. Payne reports grants from National Institutes of Health, during the conduct of the study; Dr. Starr reports grants from United States (U.S.) Department of Veterans Affairs Rehabilitation Research and Development Service Program (CDA-2/IK2 RX002348), grants from United States National Institutes of Health 5T32 AG000029, during the conduct of the study; Ms. Orenduff has nothing to disclose; Ms. Mulder has nothing to disclose; Dr. McDonald reports grants from Beef Checkoff Program, during the conduct of the study; grants from Dairy Management, Inc., grants from National Pork Board, outside the submitted work; Dr. Spira agreed to serve as a consultant to Awarables, Inc. in support of an NIH grant outside the submitted work; Dr. Pieper has nothing to disclose; and Dr. Bales reports grants from National Cattlemen's Beef Association, during the conduct of the study.

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Table 1:

Baseline characteristics: Sociodemographics, anthropometrics, comorbidity and physical function[a]

	Total N=67
Age (years)	68.2 (5.6)
Sex (female)	53 (79%)
Race	
White	47 (70%)
African American	17 (25%)
Other	3 (4%)
Education	
High School	15 (22%)
More than High School	52 (78%)
Marital Status	
Single	8 (12%)
Married	38 (57%)
Widowed	9 (13%)
Divorced	12 (18%)
Weight (kg)	103.2 (19.6)
Body mass index (kg/m2)	36.9 (6.3)
Comorbidities[b]	
Cardiovascular Disease	17 (26%)
Hypertension	45 (68%)
Diabetes	14 (21%)
Depression	11 (17%)
Other Psychiatric Condition[c]	7 (11%)
Short Physical Performance Battery (SPPB)[d]	8.6 (1.6)

[a] Mean (SD) or # (%)

[b] Self-report; N=66

[c] Conditions reported include anxiety, ADHD and bipolar II disorder

[d] SPPB range 0–12; score of 4–10 was required for enrollment

Table 2:

Quality of life outcomes (SF-36)[a,b]

	Baseline	Change at 3 months	P value[c]	Change at 6 months	P value[c]
Physical Composite Score	62.2 (18.6)	6.7 (16.8)	0.012	9.2 (15.2)	<0.001
Physical Functioning	58.1 (24.4)	8.7 (17.9)	<0.001	12.7 (19.6)	<0.001
Role Limitations (Physical)	60.2 (33.7)	11.2 (35.7)	0.029	10.4 (40.1)	0.017
Pain	62.5 (23.1)	4.7 (21.3)	0.164	7.4 (17.0)	<0.001
General Health	66.7 (18.0)	2.6 (15.7)	0.262	3.3 (14.5)	0.065
Mental Health Composite Score	75.5 (17.4)	5.0 (14.6)	0.007	2.1 (13.0)	0.072
Emotional Well-Being/Mental Health	82.3 (16.7)	1.7 (8.7)	0.091	0.6 (8.7)	0.477
Role Limitations (Emotional)	79.6 (31.6)	2.5 (35.8)	0.149	−5.0 (34.9)	0.975
Social Functioning	83.1 (20.4)	8.0 (19.5)	0.004	5.7 (20.3)	0.020
Vitality	57.2 (19.5)	6.9 (16.2)	<0.001	6.9 (11.8)	<0.001

[a.] N=67; baseline values are the observed mean (SD); change scores are the least-squares adjusted means (SD) from the repeated measures analysis

[b.] SF-36: Range for all scores 0–100; Physical Composite – average of physical functioning, role limitations (physical), pain and general health; Mental Health Composite – average of emotional well-being, role limitations (emotional), social and vitality

[c.] P value for change from baseline

Table 3:

Mental health outcomes[a]

	Baseline	Change at 3 months	P value[b]	Change at 6 months	P value[b]
Depression (CES-D)[c]					
Total Score	7.2 (7.2)	−0.7 (5.6)	0.239	0.7 (4.4)	0.923
Depressed Affect	1.6 (2.8)	0.5 (2.8)	0.276	0.03 (1.6)	0.890
Positive Affect	2.3 (3.2)	−0.9 (3.7)	0.002	−0.4 (3.4)	0.068
Somatic	3.2 (2.9)	0.7 (2.6)	0.182	0.7 (3.3)	0.348
Interpersonal	0.4 (0.8)	0.0 (1.0)	0.956	0.2 (1.1)	0.621
Profile of Mood States (POMS)[d]					
Total Mood Disturbance	6.4 (15.8)	−2.4 (8.5)	0.048	−2.0 (9.6)	0.123
Tension	2.7 (3.1)	−0.4 (1.8)	0.204	0.3 (2.6)	0.646
Depression	2.3 (3.1)	−0.4 (2.0)	0.027	−0.2 (2.0)	0.255
Anger	3.0 (3.1)	−0.5 (2.3)	0.002	−0.4 (2.1)	0.027
Fatigue	5.7 (4.6)	−1.1 (2.9)	<0.001	−0.6 (3.1)	0.018
Confusion	3.3 (2.3)	0.06 (1.9)	0.781	0.07 (2.6)	0.863
Vigor	10.3 (3.7)	0.8 (3.6)	0.118	1.3 (3.2)	0.005
Pittsburgh Sleep Quality Index (PSQI, 6 of 7 components)[e]					
Sleep Duration	0.6 (1.0)	−0.2 (0.8)	0.005	0.03 (0.9)	0.926
Sleep Disturbance	2.5 (0.5)	−0.06 (0.7)	0.170	0.0 (0.6)	0.327
Sleep Latency	1.6 (0.8)	−0.1 (0.7)	0.201	0.0 (0.6)	0.393
Sleep Efficiency	1.1 (1.3)	−0.4 (1.4)	0.002	−0.4 (1.3)	0.002
Sleep Medication	0.7 (1.2)	−0.04 (0.6)	0.856	0.08 (0.8)	0.563
Overall Sleep Quality	0.7 (0.7)	0.06 (0.6)	0.506	0.08 (0.5)	0.783
Perceived Stress Scale (PSS)[f]	10.5 (5.9)	−0.5 (4.8)	0.300	0.0 (4.9)	0.570
Satisfaction with Life (SWLS)[g]	26.1 (6.2)	0.3 (4.6)	0.413	0.2 (3.6)	0.364

[a] N=67; baseline - observed mean (SD); change - least-squares adjusted mean (SD) from the repeated measures analysis

[b] P value for change from baseline

[c] Center for Epidemiologic Studies – Depression (CES-D): total score range 0–60 (≥ 16 indicates a risk for depression), Depressed Affect range 0–21, Positive Affect range 0–12, Somatic range 0–21, and Interpersonal range 0–6

[d] POMS: Total Mood Disturbance = (Sum of all subscales except Vigor) minus Vigor, score range (−20)-100; range for subscales 0–20

[e] PSQI: Due to an error on the questionnaire, the Daytime Dysfunction and Global scores are not reported; range for components 0–3

[f] PSS: Range 0–40

[g] SWLS: Range 5–35