# Psychometric Assessment of a Weight Management Social Provisions Survey in a Sample of Adults with Prediabetes

**Kathryn E. Wilson** ( kwilson141@gsu.edu )
Georgia State University https://orcid.org/0000-0001-5847-5461

**Tzeyu L. Michaud**
University of Nebraska Medical Center

**Cynthia Castro Sweet**
Omaha Health, Inc

**Jeffrey A. Katula**
Wake Forest University

**Fabio A. Almeida**
University of Nebraska Medical Center

**Fabiana A. Brito**
University of Nebraska Medical Center

**Robert Schwab**
University of Nebraska Medical Center

**Paul A. Estabrooks**
University of Nebraska Medical Center

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Kathryn E. Wilson,[1,2] Tzeyu L. Michaud,[3,4] Cynthia Castro Sweet,[5] Jeffrey A. Katula,[6] Fabio A. Almeida,[3,4] Fabiana A. Brito,[3,4] Robert Schwab,[3,7] & Paul A. Estabrooks[3,4]

**Author Affiliations:**

[1]Department of Kinesiology and Health, College of Education and Human Development, Georgia State University, Atlanta, GA, USA

[2]Center for the Study of Stress, Trauma, and Resilience, College of Education and Human Development, Georgia State University, Atlanta, GA, USA

[3]Department of Health Promotion, College of Public Health, University of Nebraska Medical Center, Omaha, NE, USA

[4]Center for Reducing Health Disparities, College of Public Health, University of Nebraska Medical Center, Omaha, NE, USA

[5]Omada Health, Inc., Medical Affairs, San Francisco, CA, USA

[6]Department of Health and Exercise Science, Wake Forest University, Winston-Salem, NC, USA

[7]Internal Medicine Division of General Medicine, University of Nebraska Medical Center, Omaha, NE, USA

**Corresponding Author:** Kathryn E. Wilson, PhD, 125 Decatur St. SE, Sports Arena, Suite 137, Atlanta, GA 30303, USA. E-mail: kwilson141@gsu.edu. Tel: 404-413-8110

**Running head:** Social Provisions Scale

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**Abstract**

**Background:** The relevance of social support for weight management is not well documented in people with prediabetes. An important consideration is the adequate assessment of social provisions related to weight management in this population. **Purpose:** To assess the factor structure and measurement invariance of an adapted Social Provisions Scale specific to weight management (SPS-WM) in adults with prediabetes (n=599) . **Methods:** Participants of a diabetes prevention trial completed a demographic survey, and the SPS-WM. Confirmatory analyses tested the factor structure of the SPS-WM, and measurement invariance was assessed for gender, weight status, education level, and age. **Results:** Removal of two collinear items resulted in acceptable model fit, supporting six correlated factors for social provisions specific to weight management. Measurement invariance was supported across all subgroups. **Conclusion:** Results support score interpretations for these scales reflecting distinct components of social support specific to weight management in alignment with those of the original survey.

**Keywords:** social support, perceived support, diabetes prevention, factorial validity, measurement invariance

## Introduction

The development of translatable weight-loss and diabetes prevention programs is a public health priority [1-3] as an estimated 1 in 3 US adults have prediabetes and are therefore at risk for developing Type 2 Diabetes [3]. Modest weight loss resulting from lifestyle modification can substantially improve risk associated with diabetes and other weight related illnesses [4, 5]. An important consideration for behavioral interventions is assessing the impact of relevant psychosocial factors predictive of or related to successful behavior change. One such psychosocial factor that is related to health and successful behavior change is perceived social support [6, 7].

Generally, social support can be viewed as a multidimensional construct reflective of "the comfort, assistance, and/or information one receives through formal or informal contacts with individuals or groups" [8, p. 369]. Studies demonstrate that higher levels of social support have a positive impact on clinical outcomes, such as a reduced HbA1c, as they are related to improved physical activity and dietary behaviors, medication adherence, health-care decision making, motivation, and glucose monitoring among patients with diabetes [7, 9-12]. Cumulatively, the evidence supports a moderate association between social support and overall self-care among patients with Type 1 and Type 2 Diabetes [7], though less work has been done to quantify these effects in patients with prediabetes. An important preliminary step to assessing such effects is the confirmation of factorial validity and measurement invariance of scales designed to capture component factors of social support for weight management outcomes in representative samples of patients with prediabetes.

The Social Provisions Scale [13] was developed to assess the dimensions of social support postulated in R. S. Weiss's [29] theoretical model: (1) Guidance (advice or information), (2) Reliable Alliance (the assurance that others will provide assistance when needed), (3) Reassurance of Worth (the sense that one is viewed as competent and that their skills are valued by others), (4) Opportunity for Nurturance (the sense that others rely on oneself for their wellbeing), (5) Attachment (a sense of security derived from emotional closeness with another), and (6) Social Integration (a sense of belonging with others that share similar interests). Each scale includes four items (two of which are positively worded and two of which are negatively worded) and asks people to indicate their degree of agreement with each statement on a four-point Likert-type scale (4 – Strongly agree, 3 – Agree, 2 – Disagree, 1 – Strongly disagree). The scales are published in full as an appendix to Cutrona & Russell [13].

The scores of the Social Provision Scale have demonstrated evidence of reliability and predictive and convergent validity [13]. However, internal consistency reliability coefficients are, in some cases, marginal and the latent factor structure has been a topic of some controversy [14]. Initial factor analyses supported the presence of six strongly correlated factors reflective of the unique provisions targeted by these scales and the possibility that strong inter factor correlations reflect a higher order factor for general social support [13]. This is the structure reflected by the scoring paradigm published with the scales themselves. There is also some evidence that the scales capture variance related to four unique factors rather than six [15]. Mancini & Blieszner [15] were unable to fit a six-factor model to their data from a sample of older adults. Upon examining inter-item correlations they collapsed items from the Reliable Alliance, Guidance, and Attachment scales into a single "Intimacy" factor and found acceptable model fit [15]. Most recently, however, a bi-factor solution was supported indicating that items

load onto a general social support factor independent of their unique variance reflective of individual subscales [14]. It is possible that difference in latent factor structure reflect sample differences or shifting societal norms. Nevertheless, tests of the latent factor structure of the Social Provisions Scale have not yet been performed in samples undergoing diabetes prevention efforts and are an important precursor to examining the role of social provisions in diabetes prevention programs.

The purpose of the current investigation was to assess the underlying factor structure of an adaptation of the Social Provisions Scale in a sample of adults with prediabetes enrolled in a digital diabetes prevention program. Items of the Social Provisions Scale were contextualized to weight management paradigms, and a cross-sectional design was used to test the intended factor structure of the survey (i.e., six correlated factors) compared to alternative factor structures. Tests of measurement equivalence/invariance according to gender, age, education level and BMI status, as well as bivariate associations between scale scores and behavioral outcomes were also conducted. It was expected that the factor structure would reflect a hierarchical model with a single second-order factor of generalized perceived social support related to weight management reflected by six first order factors representative of the survey subscales for social provisions. It was also expected that measurement invariance will be supported across demographic subgroups, supporting the continued use of the Social Provisions Scale in similar clinical samples.

## Methods

**Scale adaptation.** Items of the Social Provisions Scale [13] were carefully revised to focus on social provisions specific to weight management for use in the PREventing Diabetes with dIgital health and Coaching for Translation and Scalability (PREDICTS) trial, a parent

hybrid effectiveness/implementation trial delivered through the Nebraska Medicine System. An interdisciplinary team of investigators with over 20 years of experience delivering behavioral physical activity, nutrition, and weight-loss intervention trials considered the potential to either create a new scale to reflect the specific study or adapt an existing scale assessing the components of social provisions while allowing for the contextualization of items to weight management specifically. Items are closely worded to those presented in the original scale [13], with slight adjustments to focus on social provisions related to weight management. The entire scale is presented in Supplemental Appendix A.

**Sample.** A total of 599 adult patients with prediabetes were recruited for PREDICTS trial. Recruitment and intervention protocols are described elsewhere [16]. Eligibility extended to patients who were overweight and obese (Body mass index [BMI] $\geq$ 25 kg/m$^2$), $\geq$19 years old, with a glycated hemoglobin (HbA1c) blood test in the prediabetes range (5.7% - 6.4%). Individuals with a diagnosis of Type 1 or 2 diabetes, who were identified as medically unstable or having contraindications to physical activity or weight loss as indicated by their primary care physician, were pregnant or planning to become pregnant, did not speak English, or were diagnosed with congestive heart failure, coronary artery disease, chronic obstructive pulmonary disease, pulmonary hypertension, dementia, Alzheimer's disease, chronic kidney disease, or were in active cancer treatment were excluded from participation. Informed consent was provided by all participants.

**Procedure.** This study was part of a randomized clinical trial for which procedures are described elsewhere [16]. All data used in this assessment was obtained at the baseline visit of the trial.

**Measures.** Demographic information (i.e. gender, age, race, education level) was gathered by self-report survey.

***Social Provisions*.** The weight management social provisions scale (SPS-WM), presented in Supplemental Appendix A was used to assess six weight management related perceived provisions: Guidance, Reassurance of Worth, Social Integration, Attachment, Nurturance, and Reliable Alliance. Each scale was composed of four items, rated using a 4-point forced answer scale ranging from (1) strongly disagree to (4) strongly agree, in alignment with the original scale format [13].

***BMI.*** A calibrated scale and stadiometer were used to objectively assess body weight and height at the baseline visit, which were used to calculate BMI ($kg/m^2$).

***Physical activity*.** Typical weekly engagement in strenuous, moderate, or mild exercise was assessed by the four item Godin-Shepard Leisure Time Physical Activity Questionnaire [17]. An index score for physical activity was calculated in accordance with published standard. A score of 24 or higher is considered sufficiently active for health benefit according to national guidelines [17-20].

***Dietary intake*.** Eating patterns of study participants were indexed using the 8-item "Starting the Conversation" Brief Dietary Assessment screening tool designed to detect dietary behaviors within the context of diabetes self-management [21]. This measure assesses frequency of consumption of fast food, fruits and vegetables, sugar sweetened beverages, lean protein, and foods high in fat, sugar and salt, corresponds well with more in-depth food frequency questionnaires, and is supported in the assessment of overall healthiness of an individual's dietary behaviors [22]. Lower dietary intake scores indicate a healthier diet than higher scores.

**Statistical analysis.** All models were estimated using full information robust maximum likelihood estimation using Mplus 7.11 [23]. Significance of relations between variables ($p < .05$) was assessed using critical z-scores (parameter estimate/SE).

***Confirmatory factor analyses*.** An iterative process was used to assess factorial validity by comparing increasingly complex model specifications using confirmatory factor analysis (CFA). The simplest model specification was the null model, which reflected the absence of systematic relationships between item responses which, if supported, would suggest that covariance observed between items is random. It was expected that the null model would demonstrate worse model fit than all other model specifications. Next, a single-factor model was specified to test the possibility that items reflect a single underlying factor of perceived social provisions. If supported, this model would suggest that the scale measures social provisions without distinguishing between the factors intended in scale development (i.e. Guidance, Reassurance of Worth, Social Integration, Attachment, Nurturance, and Reliable Alliance). Support for the single-factor model would suggest that items supposed to measure provisions for different social needs (e.g., Guidance and Reassurance of Worth) covary just as strongly with items across scales as they do with items within scales. An orthogonal six-factor model was specified to distinguish between the six social provisions subscales as intended, but in opposition of the postulate that social provision factors are related – rather correlations between factors were restricted to zero to reflect the absence of association between factors. A correlated six-factor model was specified in alignment with the expectation that the six social provision factors are significantly correlated. In extension, a hierarchical model was specified such that items loaded onto their respective first-order factors, and those first-order factors loaded onto a single second-order factor for total perceived social provision. This model aligns with the intended structure of

the scale as it was developed [13], and reflects both the specificity of social provision factors, as well as their generalizability to overall perceived social support. Finally, a four-factor model reflective of the factor structure supported by Mancini & Bleiszner [15] was fit to the data. Support for this model would indicate that the scales for Guidance, Attachment, and Reliable Alliance in fact capture variance from a single common construct, previously labeled "Intimacy". It was not possible to estimate a bi factor model with these data.

***Measurement equivalence/invariance.*** Measurement invariance was also tested iteratively beginning with an omnibus test of invariance of covariance matrices. Should equivalence of covariance matrices not have been supported, levels of invariance would have been tested in decreasing order of restrictiveness to identify the highest level of measurement equivalence/invariance reflected in these data [24]. Tests of invariance were conducted for the following grouping variables: gender, age, education level, and BMI status. Insufficient cell sizes for race prohibited a corresponding test of measurement invariance. Age groups were stratified as follows: 1) those $\geq$ 1 SD below the sample mean, 2) those < 1 SD from the mean, and 3) those $\geq$ 1 SD above the mean. Education level was categorized as 1) those with less than a 4-year college degree, 2) those with a 4-year college degree, and 3) those with postgraduate education. Finally, participants obesity status was classified as 'obese class 1' (BMI of 30.0-34.9), 'obese class 2' (BMI of 35.0-39.9), or 'obese class 3' (BMI$\geq$40).

***Model fit.*** Several fit indices were examined to evaluate model fit. Absolute and relative model fit were assessed using the chi-square ($\chi^2$) statistic, comparative fit index (CFI), root mean square error of approximation (RMSEA) and its 90% confidence interval, and standardized root mean square residual (SRMR) [25, 26]. Concurrent values $\geq$0.95 for CFI and $\leq$0.08 for SRMR reportedly provide optimal protection from type I and type II error rates [25]. Values of CFI

approximating 0.90 are judged to be acceptable, while values > 0.95 indicate good fit, and values of the RMSEA ≤ 0.06 and ≤ 0.08 are commonly interpreted as indicating close and acceptable fit, respectively. The Bayesian Information Criterion (BIC), which is a relative fit statistic which approximates the Bayes factor and is conservative for comparing complex models, was also used to compare CFA models [27]. In the case of a non-positive definite covariance matrix, factor correlations and residual variances were scrutinized for specification problems. Modification indices were then examined for multicollinearity and/or cross-loading of problematic items. The item which demonstrated extreme inter-item collinearity and cross-loading was removed from the factor model specification and model fit was re-assessed. Modification indices were further examined for item multicollinearity or cross-loadings when model estimation properly converged but model fit was observed to be marginal.

***Bivariate associations.*** Bivariate correlations between SPS-WM scale scores and the physical activity index score, dietary intake score, and body weight were assessed. Summary scores for the SPS-WM component scales were calculated by averaging all four items on each scale. In the case of item removal from any of the component scales during the preceding assessment of factor structure of the survey, scale scores were recalculated as the average of the retained items for the respective scale, and bivariate correlations were recalculated and reported herein.

## Results

Descriptive statistics for demographic variables are reported in Table 1. The sample of adults with prediabetes enrolled in a digital diabetes prevention program were predominantly non-Hispanic (96.3%) white (90.5%) females (61.3%) with a mean(sd) age of 55.8(12.6) years,

most of whom were classified as Obese category 1 (i.e. BMI between 30 to 34.9 kg/m$^2$; 41.7%) and had less than a four-year college education (43.9%). Additional sample details are available elsewhere [28].

**Confirmatory factor analyses.** Table 2 displays model fit statistics for all confirmatory factor analyses. Generally, model fit improved with increasing model complexity. As expected, the single-factor model demonstrated improved fit compared to the null model, and the six orthogonal factor model demonstrated improved fit compared to the single-factor model. The model specifying six correlated factors demonstrated a non-positive definite covariance matrix resulting from a correlation of greater than one between latent factors for Guidance and Reliable Alliance. Item correlations revealed collinearity between several items from differing subscales. Modification indices highlighted item 3 of the Guidance subscale (i.e. "There is no one I can turn to for guidance on managing my weight in times of stress") as the greatest contributor to model misspecification. Upon re-specification of the model with removal of item 3, the model converged successfully and demonstrated marginal model fit. Re-examination of modification indices supported the removal of survey item 1 of the Reliable Alliance subscale (i.e. "There are people I know who will help me with managing my weight if I really need it."). A second model re-specification removing item 1 resulted in acceptable model fit.

The hierarchical model and the four-factor model demonstrated poor model fit, though fit was better than that of the single-factor and null models. Unlike the correlated six-factor model, the hierarchical model and four-factor model converged without removing any subscale items. To assess comparative fit, these models were re-specified with the removal of item 3, then again with the removal of item 1. As was observed in the correlated six-factor model, model fit improved very slightly with each re-specification. Nonetheless, model fit was best for the

correlated six-factor model after removal of items 3 and 1. In fact, model fit of the correlated six-factor model after removing just item 3 was superior to that of the hierarchical model and four-factor model after removal of items 3 and 1.

The final model parameter estimates for the correlated six-factor model, the hierarchical model, and the four-factor model after removing items 1 and 3 are illustrated in Figures 1, 2, and 3 respectively. Item numbers are reflective of their presentation in Appendix A, which aligns with that of the original scale publication [see appendix of 13], and parameter estimates reflect the standardized solution. Parameter estimates of models not displayed are available upon request to the corresponding author. Mean(sd) subscale scores, computed from raw data are presented in Table 3 for full subscales as well as subscales after removal of items 3 and 1. Further, Cronbach's alpha for the scales prior to item removal, and composite factor reliabilities for all six factors after removal of items 3 and 1 are also presented in Table 3.

**Measurement equivalence/invariance.** Equivalence of the covariance matrices was supported for all subgroup analyses (i.e., between genders, age groups, education, and BMI status) for the full survey as well as after removing items 3 and 1. Model fit statistics for each test of measurement invariance of the covariance matrices are reported in Table 4.

**Bivariate associations.** Bivariate correlations between component scale scores and weight, physical activity score, and dietary intake score are displayed in Table 5. Associations between component scores as well as between component scores and relevant outcomes did not meaningfully differ depending on whether component scores were calculated with or without items 3 and 1. As was observed in the factor models, all component scores were significantly related to each other. Notably, Worth Reassurance was the only component score significantly

related to all three outcomes of interest (weight $r = -.21$, $p < .01$; physical activity $r = .20$, $p < .01$; dietary intake $r = -.23$, $p < .01$). Physical activity and dietary intake were also significantly related to Social Integration ($r$'s = .10 and -.12, respectively) and Nurturance ($r$'s = .10 and -.15, respectively), while weight was related to Attachment ($r = .10$) and Reliable Alliance ($r = .10$ to .12, for the full and trimmed scale scores, respectively). Guidance was not significantly related to any of the outcomes of interest.

**Discussion**

This study provides evidence on the factor structure of the Social Provisions Scale adapted to focus on social provisions related to weight management in a clinical diabetes prevention trial. Our results indicate that, after removing two items with extreme collinearity, the expected structure with six correlated first-order factors was supported with these data. Model fit was best when allowing the six first order factors to correlate freely, and was only slightly reduced when specifying a hierarchical, second-order factor structure. Further, a four-factor structure collapsing scales for Guidance, Reliable Alliance, and Attachment demonstrated comparable fit to the hierarchical model. Nonetheless, model fit was still inferior to the six-factor model even after corresponding item removal. This study also provides support for the measurement equivalence/invariance of the scales according to gender, age, education level and BMI status in a large sample of adults with prediabetes participating in a hybrid effectiveness/implementation diabetes prevention trial. Bivariate correlations provide support that component scores from this scale relate to concurrently measured weight management related outcomes (i.e., body weight, physical activity and dietary behavior).

Factor analyses were conducted to replicate and compare the expected factor structure with alternative model specifications observed for the original scale in previous literature [13, 15]. As expected, the worst fitting model was the null model, which specified no interitem covariance. Model fit improved when testing a single-factor model which specified that all 24 survey items covaried as a result of a single underlying factor in contrast of the theoretical postulate of multidimensional components of social support [29]. However, model fit was still poor for this specification.

The first model to test the multidimensional structure of social provisions was the orthogonal six-factor model, which, if supported, would have indicated that Guidance, Reliable Alliance, Reassurance of Worth, Social Integration, Nurturance, and Attachment are independent and unrelated constructs. Model fit worsened compared to the single-factor model, though fit did remain superior to the null model. Considering the expectation that the unique components of social provision are related to one another, this observation makes sense. That is, the single-factor model aligns with this expectation in that all items are free to covary, as they are specified to be reflective of a single underlying factor. This is not the case in the orthogonal six-factor model; item covariances are restricted to zero for items that belong to different subscales (i.e. items on the Guidance subscale are restricted from covarying with items on any of the other five subscales, and so on for all item covariances across subscales). Only one fit statistic of the orthogonal six-factor model was improved compared to the single-factor model. The CFI, or comparative fit index, reflects the relative improvement in fit of the specified model compared to the null model [30]. The slight improvement in the CFI for this model compared to the single-factor model therefore suggests that the orthogonal six-factor model specification is a better approximation of the covariance observed in these data than that of the single-factor model with

respect to a model in which no item covariances were present. This observation favors the multidimensional nature of social provisions, but the improvement in this fit index is negligible, and overall model fit remained poor.

The specification of a correlated, six-factor model revealed a non-positive definite covariance matrix. Inspection of factor and item correlations revealed collinearity between items for the Guidance and Reliable Alliance scales. The items "There is no one I can turn to for guidance on managing my weight in times of stress" and "There are people I know who will help me with managing my weight if I really need it" demonstrated collinearity across subscales and were highlighted by modification indices as contributing heavily to model misspecification. Removal of these items resolved the misspecification and revealed acceptable model fit across indices. Mancini and Blieszner [15] also reported collinearity between items of these component scales in the original survey. Perera [14] reported strong inter factor correlations and cross factor item collinearity for Guidance and Reliable Alliance calling into question the discriminant validity of these two factors. In both cases, structural changes were applied rather than attempting to identify whether a single item or two might be responsible for model misspecification or extreme inter-factor correlations. Mancini & Blieszner respecified their model to collapse items from three scales into a single factor for "Intimacy" (as reflected in our specification of the four-factor model). On the other hand, Perera noted that despite strong inter-factor correlations and item-cross loadings, there are items from each scale that have substantial loadings per factor, supporting the scientific utility of retaining the intended factor structure of the survey. Our approach corresponds to this goal by iteratively eliminating items identified as strong contributors to model misspecification, rather than immediately exploring the possibility of alternative factor structures to accommodate cross-loading and item collinearity. Removal of

items 1 & 3 from our six-factor model specification supported the presence of six unique factors for social support, as intended by the survey.

Our observations corroborate earlier results questioning the presence of a salient second-order factor accounting for first-order factor correlations. Cutrona and Russell (1987) reported significant factor loadings of the six first-order factors of the original scale onto a general factor reflective of overall social support. They noted, however, that a substantial proportion of factor variance for most factors is not accounted for by a global, second-order factor of social support, suggesting that first-order factors are distinct and highly correlated beyond the influence of a general level of support available to the person. Though factor loadings did indicate a substantial amount of variance ($R^2$ ranged from 32% to 94%) from each first order factor being accounted for by a global social support construct in the current investigation, model fit for six correlated factors remained superior, albeit marginally, to that of the hierarchical model and the four-factor model proposed by Mancini & Blieszner (even after corresponding item removal).

In contrast, Chiu, Motl, & Ditchman [31] found close fit of their data to the hierarchical model in a sample of 292 individuals with multiple sclerosis (MS). Extreme inter-factor correlations and multicollinearity previously reported for the original scale [13-15] were not observed in this sample. Other investigations have produced mixed results. Motl & colleagues found additional support for the hierarchical model tested here among a sample of White adolescent females, but only after specifying an orthogonal method factor to account for variance related to positive vs negative worded items within and between first order factors of the original scale [32]. On the other hand, in the same investigation, factor structure differed significantly for a sample of Black adolescent girls such that a hierarchical model with four first-order factors (one factor generated by collapsing items from Attachment, Social Integration, and Reliable

Alliance subscales), a single second-order factor and an orthogonal method factor [32]. We did not consider the specification of an orthogonal method factor, which may have improved model fit of across models tested.

Perera [14] conducted a bi-factor analysis of the original scale which parsed out common item variance prior to allowing items to load on their respective scale factors. This model would suggest that there is some general source of common variance beyond that which is shared between items within factors. Perera conceptualized this as a global factor for social support, reflected by common variance across all items, leaving residual variance reflective of their unique factors. We were unable to fit a bi-factor model to our data as the model failed to converge, even after allowing up to 10,000 iterations of the model specification.

It remains unclear whether a global factor reflecting overall weight management related social support could be derived from this measure. The single-factor model tested here speaks against the presence of a global factor accounting for shared variance across all items. The hierarchical model we tested also did not demonstrate close fit to our data. The amount of variance of each first order factor that is accounted for by a second-order factor differs substantially in our samples compared to others. Second-order factor loadings of the original scale reported by Chui and colleagues [31] ranged from $\lambda$ = .65-.90, whereas in the current investigation factor loadings for the weight management specific scale ranged from $\lambda$ = .57-.97. Though this may seem negligible, the pattern of differences between samples with regard to specific factor loadings is a point of interest. For example, among adults with MS, Reassurance of Worth loaded onto the global factor for social support at $\lambda$ = .90 whereas in our sample this parameter was only $\lambda$ =.58. In the solution supported in the sample of White adolescent females second-order factor loadings ranged between $\lambda$ = .58-.94 [32]. Again, the range of factor loadings

is similar to those observed in our sample, but the weakest factor loading in this sample was for Nurturance ($\lambda$ = .58) which is consistent with observations by Cutrona & Russell [13]. Such a wide variability of second-order factor loadings between samples across these scales suggests that the use of a summary score for global social support derived from individual factor scores would require the application of a unique weighting coefficient to subscale scores. This is an impractical consideration, however, as factor analysis is beyond the scope of practice of many who would use this scale in smaller samples in applied settings. Due to the apparent need to derive weighting coefficients for each sample in which the scale is used, a reliable summary score reflective of overall perceptions of social support across diverse samples will remain elusive. Taken in the context of other factor analyses of the Social Provisions Scale, these analyses demonstrate the utility of using scale scores independently, rather than summing or averaging scale scores to reflect a global indicator for social support related to weight management.

Encouragingly, analyses of the measurement equivalence/invariance of this survey according to gender, age, education level, and BMI provide support for its use in similar samples of adults with prediabetes. Tests supported equivalence of covariance matrices provide the most rigorous assessment of measurement invariance [24] and indicate that subgroups interpret the survey items in similar ways. These results provide confidence that any between group differences in scale scores in this sample are free of bias resulting from to demographic characteristics. Generalizability to more diverse samples is limited, however, as our sample was relatively homogenous.

Composite factor reliabilities indicate that there may be some problems with some items on subscales for Reassurance of Worth, Social Integration, and possibly Nurturance (range .661-

.718). Similar deficits were observed by Perera [14] who reported internal consistency reliability of $\alpha$ = .710 for Nurturance, $\alpha$ = .641 for Reassurance of Worth, and $\alpha$ = .795 for Social Integration. Considering that items aligned very closely with the original publication, perhaps this is not surprising. Cutrona & Russell [13] reported internal consistency reliabilities between $\alpha$ = .653 - .760 for the scales in the Social Provisions Scale. Nonetheless, factor loadings from our sample were moderate to strong ($\lambda$ = |.365 - .839|) and statistically significant ($p$<.001). More work should be done to test the internal consistency of these scales; items should be scrutinized for content validity and amended to improve internal consistency of the scales.

**Conclusion**

Overall, analyses provided support for the intended first-order factor structure of the measure. The issue of whether a higher order factor reflective of global social support related to weight management can be derived from scores for the first order factors remains unclear. Factor loadings for the hierarchical model allow for a weighted solution for computing global social support in this sample but are not recommended for use more generally. More work is needed to assess the proper weighting of scale scores for the derivation of a global social support score in the general population. Measurement invariance was strongly supported for this survey in the sample of patients with prediabetes, extending support for this scale as being interpreted uniformly across demographic subgroups. Finally, bivariate correlations suggest that these scales are relevant for understanding behaviors related to weight management, and support continued use of this measure in clinical trials to assess predictive validity related to weight loss and management.

Evidence provided by this study supports the psychometric validity of these scales in people with prediabetes engaged in community-based weight-loss trials. Continued assessment of the psychometric performance of this survey in samples of adults with prediabetes of varying size and diversity is encouraged to confirm or refute these factorial observations and to corroborate the applicability of these scales across demographic subgroups. Tests of convergent and discriminant validity with other supported measures of social provisions in samples with prediabetes are recommended to assess whether this is the most appropriate measure to capture component factors of social support related to weight management in populations with prediabetes.

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**Figure 1.** *Illustration of the Six Correlated Factor Model after removing items 3 & 1.*
Item numbers are reflective of survey presentation in Appendix A which aligns with the original scale publication (Cutrona & Russell, 1987).

**Figure 2.** *Illustration of the Hierarchical Model after removing items 3 & 1.*
Item numbers are reflective of survey presentation in Appendix A which aligns with the original scale publication (Cutrona & Russell, 1987).

**Figure 3.** *Illustration of the Four-factor model after removing items 3 & 1.*
Item numbers are reflective of survey presentation in Appendix A which aligns with the original scale publication (Cutrona & Russell, 1987).

Figure 1.

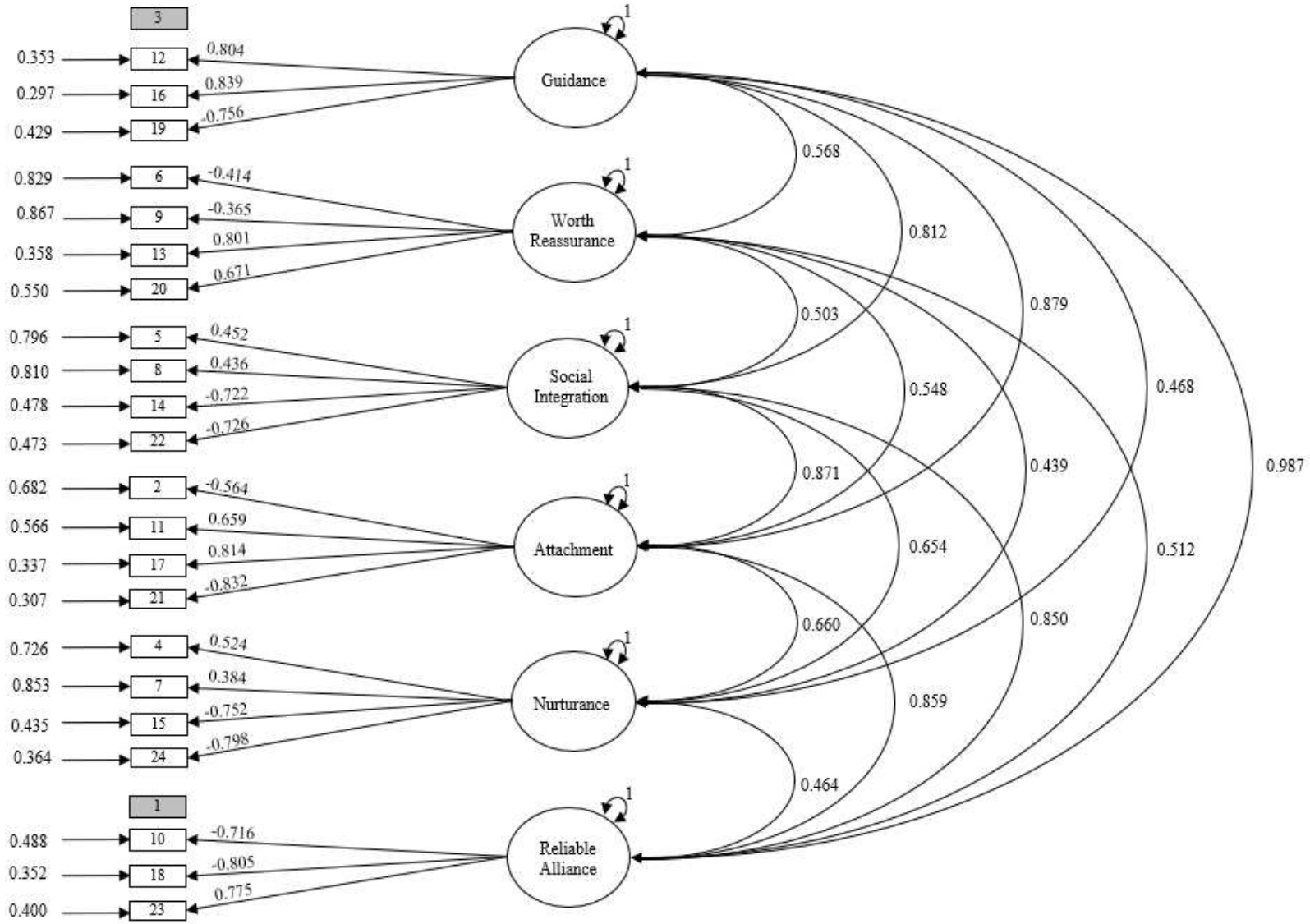
3
1
Guidance
Worth Reassurance
Social Integration
Attachment
Nurturance
Reliable Alliance
12
16
19
6
9
13
20
5
8
14
22
2
11
17
21
4
7
15
24
10
18
23
0.353
0.297
0.429
0.829
0.867
0.358
0.550
0.796
0.810
0.478
0.473
0.682
0.566
0.337
0.307
0.726
0.853
0.435
0.364
0.488
0.352
0.400
0.804
0.839
-0.756
-0.414
-0.365
0.801
0.671
0.452
0.436
-0.722
-0.726
-0.564
0.659
0.814
-0.832
0.524
0.384
-0.752
-0.798
-0.716
-0.805
0.775
0.568
0.812
0.879
0.503
0.548
0.468
0.871
0.439
0.987
0.654
0.512
0.660
0.850
0.859
0.464

Figure 2.

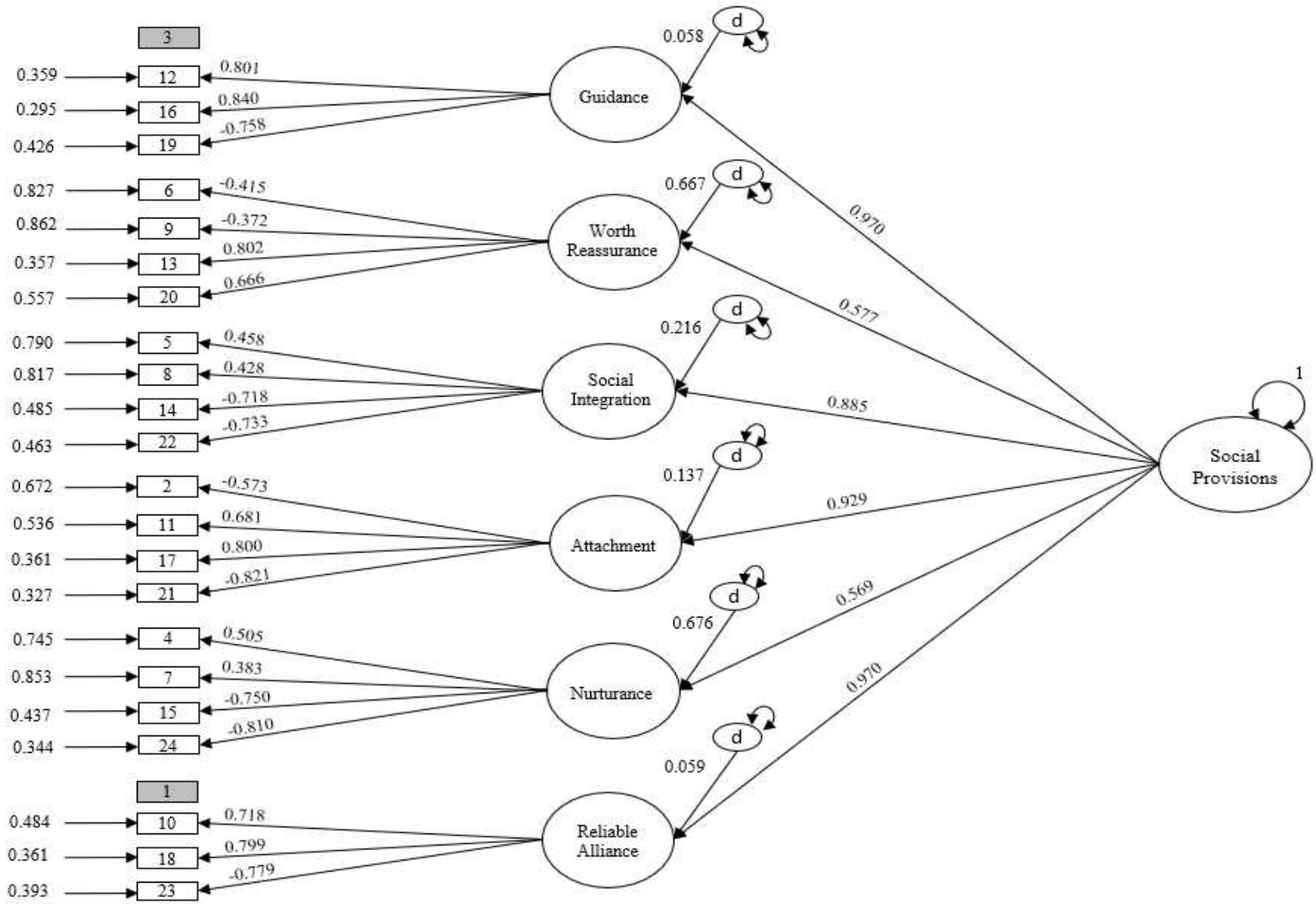
3
0.359
12
0.801
0.295
16
0.840
0.426
19
-0.758
0.827
6
-0.415
0.862
9
-0.372
0.357
13
0.802
0.557
20
0.666
0.790
5
0.458
0.817
8
0.428
0.485
14
-0.718
0.463
22
-0.733
0.672
2
-0.573
0.536
11
0.681
0.361
17
0.800
0.327
21
-0.821
0.745
4
0.505
0.853
7
0.383
0.437
15
-0.750
0.344
24
-0.810
1
0.484
10
0.718
0.361
18
0.799
0.393
23
-0.779
Guidance
Worth Reassurance
Social Integration
Attachment
Nurturance
Reliable Alliance
Social Provisions
d
0.058
0.667
0.216
0.137
0.676
0.059
0.970
0.577
0.885
0.929
0.569
0.970
1

Figure 3.

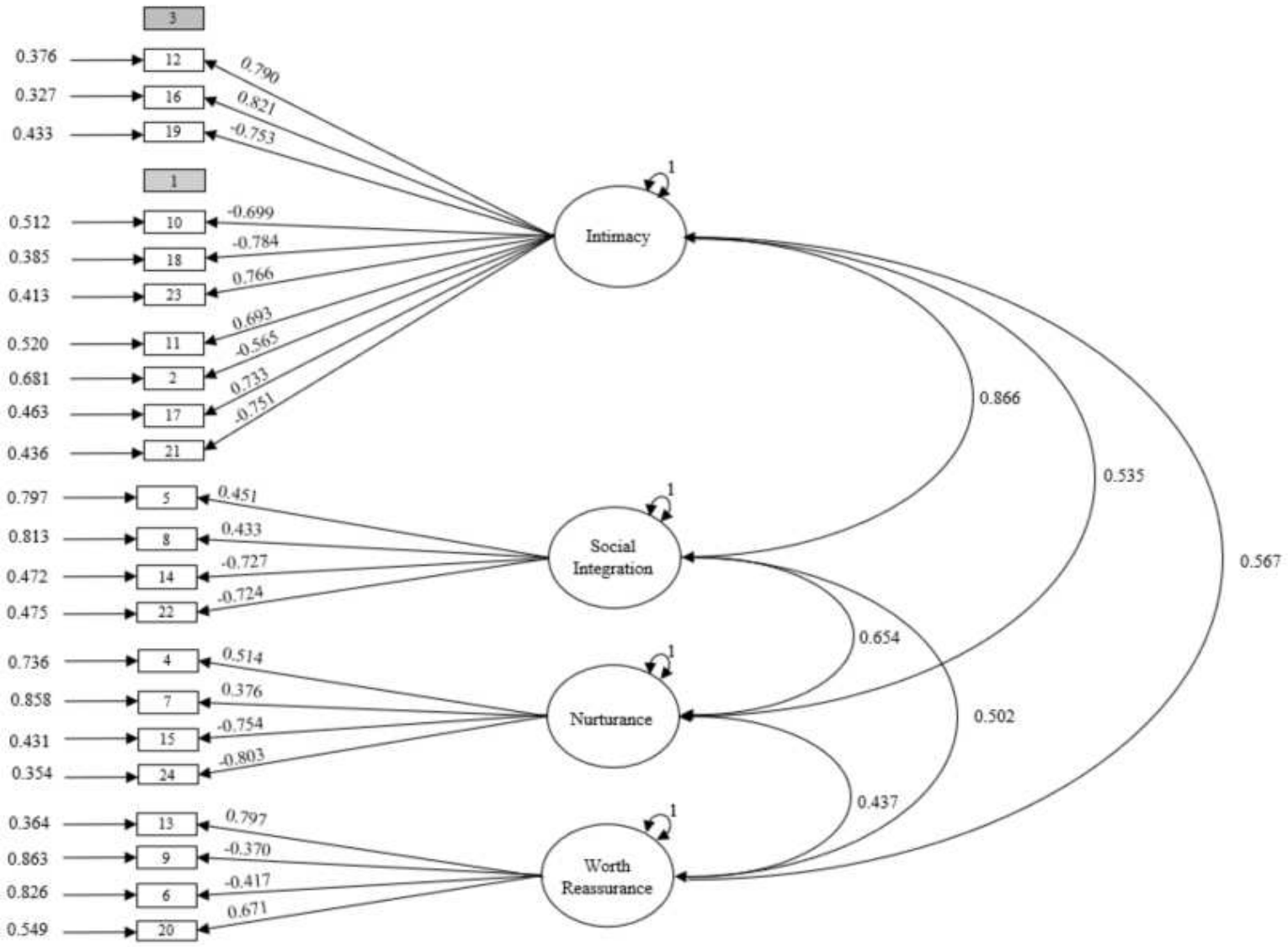
3
1
Intimacy
Social Integration
Nurturance
Worth Reassurance
0.866
0.535
0.567
0.654
0.502
0.437

**Table 1.**
*Descriptive statistics of the study sample.*

| | M(sd) |
|---|---|
| **Age (yrs)** | 55.5(12.7) |
| **BMI (kg/m$^2$)** | 36.0(6.4) |
| | **N(%)** |
| **Female** | 367(61.3) |
| **Age groups** | |
| <43 years old | 108(18.0) |
| 43-68 years old | 395(65.9) |
| >68 years old | 96(16.0) |
| **Education groups** | |
| <4 yr degree | 263(43.9) |
| 4 yr degree | 185(30.9) |
| Advanced degree | 149(24.9) |
| **BMI Status** | |
| Overweight | 73(12.2) |
| Obese class 1 | 250(41.7) |
| Obese class 2 | 141(23.5) |
| Obese class 3 | 135(22.5) |
| **Race** | |
| African American | 39(6.5) |
| American Indian/Native Hawaiian | 2(0.3) |
| Asian | 6(1.0) |
| Unknown | 10(1.7) |
| White | 542(90.5) |
| **Ethnicity** | |
| Hispanic | 19(3.2) |
| Non-Hispanic | 577(96.3) |
| Unknown | 3(0.5) |

Two participants did not report education level.

**Table 2.**
*Model fit statistics for all models.*

| | N | $\chi^2$ (df) | RMSEA (90% CI) | CFI | SRMR | BIC |
|---|---|---|---|---|---|---|
| **CFAs** | | | | | | |
| Null Model | 598 | 4993.430(276) | 0.169(0.165, 0.173) | <0.001 | 0.336 | 33283.249 |
| Single Factor | 598 | 1302.319(252) | 0.083(0.079, 0.088) | 0.777 | 0.073 | 28180.214 |
| Six Orthogonal Factors | 598 | 1385.526(242) | 0.089(0.084, 0.093) | 0.758 | 0.206 | 28355.091 |
| *Six Correlated Factors* | *598* | – | – | – | – | – |
| Six Correlated Factors [a] | 598 | 669.446(215) | 0.059(0.054, 0.065) | 0.896 | 0.062 | 26475.553 |
| Six Correlated Factors [b] | **598** | **603.978(194)** | **0.059(0.054, 0.065)** | **0.900** | **0.061** | **25258.044** |
| Hierarchical Model | 598 | 877.616(246) | 0.066(0.061, 0.070) | 0.866 | 0.067 | 27647.106 |
| Hierarchical Model [a] | 598 | 773.666(224) | 0.064(0.059, 0.069) | 0.874 | 0.066 | 26553.317 |
| Hierarchical Model [b] | 598 | 704.591(203) | 0.064(0.059, 0.070) | 0.878 | 0.066 | 25333.069 |
| Four Correlated Factors | 598 | 870.723(246) | 0.065(0.061, 0.070) | 0.868 | 0.064 | 27642.499 |
| Four Correlated Factors [a] | 598 | 776.946(224) | 0.064(0.059, 0.069) | 0.873 | 0.064 | 26562.233 |
| Four Correlated Factors [b] | 598 | 711.158(203) | 0.065(0.060, 0.070) | 0.876 | 0.064 | 25346.147 |

CFAs: Confirmatory Factor Analyses; df: degrees of freedom; RMSEA: Root Mean Squared Error of Approximation; CI: Confidence interval; CFI: Comparative Fit Index; SRMR: Standardized Root Mean Square Residual; BIC: Bayesian Information Criteria. Italics indicate model specifications with a non-positive definite covariance matrix. Bolded values reflect the model with the best fit to these data. [a] Item 3 removed. [b] Items 3 & 1 removed.

**Table 3.**
*Baseline values of social prevision scale scores from the full and trimmed scales.*

| | M(sd) | Composite Factor Reliability |
|---|---|---|
| Guidance | 12.65(2.52)/**9.39(1.92)** | .842 |
| Worth Reassurance | 10.10(2.12) | .661 |
| Social Integration | 11.61(2.05) | .681 |
| Attachment | 11.98(2.60) | .813 |
| Nurturance | 9.36(2.39) | .718 |
| Reliable Alliance | 12.62(2.40)/**9.40(1.87)** | .810 |

Bolded scale scores reflect the mean score of scales after item removal. Composite factor reliability was calculated for the scales after item removal.

**Table 4.**
*Model fit statistics for analyses of invariance of the covariance matrices according to demographic characteristics for the full scale and the trimmed scale.*

| | $X^2$(df) | RMSEA(90%CI) | CFI | SRMR |
|---|---|---|---|---|
| **Full Scale** | | | | |
| Gender | 359.676(300) | 0.026(0.013, 0.035) | 0.988 | 0.072 |
| Age | 896.894(600) | 0.050(0.043, 0.056) | 0.947 | 0.078 |
| Education | 818.117(600) | 0.043(0.035, 0.050) | 0.960 | 0.075 |
| BMI Status | 651.738(600) | 0.022(<0.001, 0.033) | 0.989 | 0.071 |
| **Trimmed Scale** | | | | |
| Gender | 306.067(253) | 0.027(0.013, 0.037) | 0.988 | 0.072 |
| Age | 745.738(506) | 0.049(0.041, 0.056) | 0.951 | 0.079 |
| Education | 685.269(506) | 0.042(0.034, 0.050) | 0.962 | 0.077 |
| BMI Status | 538.304(506) | 0.019(<0.001, 0.032) | 0.992 | 0.071 |

df: degrees of freedom; RMSEA: Root Mean Squared Error of Approximation; CI: Confidence interval; CFI: Comparative Fit Index; SRMR: Standardized Root Mean Square Residual; BMI: Body mass index. Trimmed scale reflects invariance of the covariance matrices after removing items 3 & 1.

**Table 5.**
*Bivariate correlations between social provision component scores from the full and trimmed scales and outcome variables.*

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. |
|---|---|---|---|---|---|---|---|---|---|
| 1. Guidance | **--** | .42** | .63** | .78** | .34** | .86** | .07 | .04 | -.04 |
| 2. Worth Reassurance | .42** | -- | .36** | .38** | .31** | .39** | -.21** | .20** | -.23** |
| 3. Social Integration | .60** | | -- | .66** | .42** | .60** | .03 | .10* | -.12** |
| 4. Attachment | .75** | | | -- | .48** | .74** | .10* | .03 | -.03 |
| 5. Nurturance | .33** | | | | -- | .33** | .00 | .10* | -.15** |
| 6. Reliable Alliance | .81** | | | | | -- | .12** | .03 | -.03 |
| 7. Weight | .06 | | | | | .10* | -- | -.15** | .17** |
| 8. PA Score | .03 | | | | | .03 | | -- | -.14** |
| 9. Dietary Intake | -.01 | | | | | -.01 | | | -- |

* $p \leq .05$; ** $p \leq .01$. PA: Physical activity. Correlations above the diagonal are correlations for the full scales, below the diagonal are correlations using the trimmed scales.

Appendix A. The Weight Management Related Social Provisions Scale

Instructions to participants: This questionnaire is about you and your relationships with other people. It is focused on weight management. Weight management is about either trying to lose weight or maintain a healthy weight. Please indicate how much you agree or disagree with each statement.

If you feel a statement is VERY TRUE you would mark Strongly Agree. If you feel a statement REALLY does not describe your relationships, you would answer Strongly Disagree.

Rating Scale:

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Strongly Disagree | Disagree | Agree | Strongly Agree |

1. There are people I know who will help me with managing my weight if I really need it.
2. I do not have close personal relationships with other people interested in my weight management goals.
3. There is no one I can turn to for guidance on managing my weight in times of stress.
4. There are people who call on me for help managing their weight.
5. There are people who watch their weight that enjoy the same social activities that I do.
6. Other people do not think I am good at managing my weight.
7. I feel responsible for taking care of someone else who is working on getting to a healthy weight.
8. I am with a group of people who think the same way I do about managing their weight.
9. I do not think other people respect how I work on managing my weight.
10. If something went wrong, no one would help me with my weight management goals.
11. I have close relationships that make me feel good about managing my weight.
12. I have someone to talk to about weight management decisions in my life.
13. There are people who value my weight management skills and abilities.
14. There is no one who has the same weight management interests and concerns as me.
15. There is no one who needs my help managing their weight.
16. I have a trustworthy person to turn to it I have problems with managing my weight.
17. I feel a strong emotional tie with at least on other person who is working on weight management.
18. There is no one I can count on for help with my weight management goals if I really need it.
19. There is no one I feel comfortable talking about weight management problems with.
20. There are people who admire my weight management talents and abilities.
21. I do not have a feeling of closeness with anyone working on weight management.

22. There is no one who likes to do the things that I like to do to manage my weight.
23. There are people I can count on when sticking with my weight management goals gets really tough.
24. No one needs me to help them with their weight management goals.

Scoring:

A summary score for each component is calculated such that a high score indicates that the individual is receiving that provision. Items that are asterisked should be reverse scored before summing. Sum the following items to derive the respective component score:

Guidance: 3*, 12, 16, 19*

Reassurance of Worth: 6*, 9*, 13, 20

Social Integration: 5, 8, 14*, 22*

Attachment: 2*, 11, 17, 21*

Nurturance: 4, 7, 15*, 24*

Reliable Alliance: 1, 10*, 18*, 23