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DIET QUALITY AND SOCIAL SUPPORT: FACTORS ASSOCIATED WITH SERUM CAROTENOID CONCENTRATIONS AMONG OLDER DISABLED WOMEN (THE WOMEN'S HEALTH AND AGING STUDY)

E.J. NICKLETT¹, R.D. SEMBA¹, E.M. SIMONSICK², S. SZANTON¹, K. BANDEEN-ROCHE¹, L. FERRUCCI², J.M. GURALNIK, and L.P. FRIED³

¹Johns Hopkins University, Baltimore, MD USA

²National Institutes of Health

³Mailman School of Public Health, Columbia University Medical Center

Abstract

Purpose—This study investigated the relationship between social support (including instrumental support, emotional support, social interaction, social space, and family networks) and diet quality, as indicated by serum carotenoid levels.

Design and Methods—The sample consisted of participants in the Women's Health and Aging Study with longitudinal carotenoid data (n=325). We performed regression analyses using baseline indicators of social support and changes in social support to determine whether baseline levels and/or change in levels of social support predict changes in serum carotenoid levels. Social support changes were measured over 1 year from baseline to follow-up round 1. Carotenoid level changes were established from follow-up round 1 to round 2. To determine whether or not regression to the mean was driving these results, we performed an analysis that included baseline and change levels of social support indicators.

Results—At baseline, the frequency of leaving one's home was associated with a decrease in carotenoid levels. Leaving one's home more frequently predicted an increase in carotenoid levels and attending fewer activities predicted a decrease in carotenoid levels.

Implications—In older, community-resident disabled women, baseline levels of social support did not consistently predict diet quality. However, change in social support predicted both positive and negative change in diet quality and thus provides supportive evidence that social activity and family interaction may play meaningful roles in the maintenance of diet quality among functionally compromised older women. Further research is necessary to more fully understand the impact of multiple forms of social supports on the diet quality of older adults.

Keywords

Social support; carotenoids; aging; diet quality

Introduction

Diet quality is an important determinant of morbidity, mortality, and quality of life among older adults (1). Upwards of 40 percent of community-dwelling adults over the age of 65 experience inadequate nutrition (2), with the likelihood of inadequate nutrition increasing with lower levels of social engagement and support (3–6). Barriers to food choices increase into late adulthood (7). With increasing numbers of elderly, many of whom live alone, further research is needed to identify the social conditions that both facilitate and threaten adequate nutrition among older adults in the community.

Sociological and public health research have long addressed the connections between social support and positive health outcomes, as well as social isolation and heightened vulnerability (8, 9). Numerous studies have examined the relationship between social support and dimensions of health (e.g., 10–17). Multiple domains of social promote health among older adults, including illness-related support (18–21), emotional support (17), social interaction (22), social space (9, 23), and family networks (24, 25).

Research on the connections between social support and diet quality has gained increasing momentum. Studies have found relationships between diet quality and instrumental support (26), emotional support (3, 5, 27), social interaction (4, 27, 28), and social space (27). A relationship has also been found between diet quality and a combined social support scale (29). Despite these findings, a number of studies have provided results that challenge these relationships. For example, while previous studies have found social isolation to strongly predict dietary risk (28, 30), one study found that having close friends and frequent social contact did not predict dietary quality among the elderly (31).

Of the studies investigating the relationship between social support and dietary status, few have examined how multiple forms of social support relate to nutrition (e.g. 27, 31). Studies instead tend to examine one scale or measure of social support, which overlooks how different types of support could predict diet quality among older adults. Further, studies use self-reported measures of nutrition, which can be influenced by recall or actor-observer bias. Total serum carotenoids is a reliable biomarker for fruit and vegetable intake and are strong predictors of survival among older adults (32–35). Carotenoids are major dietary antioxidants found in foods and have been shown to be protective of health in older adults (36, 37). Serum carotenoids are considered the best indicator of fruit and vegetable intake available (38). Research that examined the relationship between carotenoid levels and health outcomes among older adults indicates carotenoids are protective against negative health events such as coronary heart disease (39) and mortality (35, 40–42).

The identification of specific forms of social support that predict change in diet quality is necessary for planning policy and practice interventions. To our knowledge, the relationship between change in different forms of social support and change in serum carotenoids has not been characterized in a population-based sample. Certain aspects of social support could be underlying factors contributing to different carotenoid levels. These relationships could be predictive of health in older adults through change in diet quality over time.

Hypotheses

We hypothesized that higher levels of each social support item are positively associated with subsequent carotenoid levels. We also hypothesized that increases in levels of social support are associated with increases in carotenoid levels, while decreases in levels of social support are associated with decreases in carotenoid levels over time.

Design and Methods

The study population consisted of women aged 65 and older who participated in the baseline and two follow-up rounds of the Women's Health and Aging Study (WHAS) I. WHAS I is a population-based study that evaluates physical disability among older community-dwelling women. Participants were recruited from an age-stratified random sample of female Medicare enrollees 65 years and older who lived in 12 contiguous zip code regions in Baltimore, MD (43). WHAS I recruited enrollees who reported difficulty in at least two functional domains during an in-home assessment of physical functioning in the following four areas: mobility and exercise tolerance, upper extremity function, higher or instrumental functioning and self-care. Of the 1,409 women who met eligibility criteria, 1002 consented to participate in the baseline examination conducted in 1992. There were no meaningful socio-demographic or reported health differences between eligible women who agreed to participate and those who did not (43).

Of the WHAS I baseline sample, 753 agreed to participate in a blood draw that provided serum nutrient measures. Participants consenting to the blood draw were younger (77.4 versus 80.7 years), but did not differ by race or body mass index from those who did not consent (37). The current analysis included respondents with blood draws at follow-up rounds 1 and 2 and excluded respondents with incomplete data on key variables (56 respondents). Only one respondent had an unchanged serum carotenoid measurement across rounds and was excluded from the analysis. The resultant analytic sample size was N=325.

Study Variables

Change in diet quality was measured by change in total serum carotenoid levels for a 1-year period between follow-up round 1 and round 2 (1993–1994). Changes in carotenoid levels were calculated as the difference between total carotenoid $\mu\text{mol/l}$ during this 1-year span. Total carotenoids were calculated as the sum of α -carotene, β -carotene, β -cryptoxanthin, lutein/zeaxanthin, and lycopene.

Carotenoid levels were measured from non-fasting blood samples, which were obtained by venipuncture. Processing, aliquoting, and freezing processes were carried out following a standardized protocol at the Core Genetics Laboratory of The Johns Hopkins University School of Medicine. Blood samples were analyzed for carotenoids by high performance liquid chromatography (44).

Four aspects of social support were examined: instrumental support, emotional support, social interaction, and social space. Included measures have been found to predict physical and emotional well-being among older adults. Variables were constructed based on previous literature. Instrumental support variables included reported level of satisfaction with help received from family and/or friends (from 0–10) and whether or not the respondent received help with preparing meals and/or shopping. Emotional support variables encompass whether or not the respondent had a person they could depend on or a confidant and whether or not they felt they needed more emotional support (if yes: a little bit more, some more, or a lot more). Social interaction included how frequently the respondent talked on the phone (never, less than once per week, about once per week, 2–3 times per week, 4–6 times per week, once per day, or more than once per day) and attended church functions and other activities (never, less than once per month, once per month, 2–3 times per month, once per week, or more than once per week). Attendance at church and other activities were combined into a single variable ranging from 0–10. Social space included how frequently the respondent left their home or neighborhood (never, less than once per week, about once per week, 2–3 times per week, 4–6 times per week, once per day, or more than once per day) and the household composition of the respondent at baseline (not married and lived alone,

married and 2 people in household, married and more than 2 people in household, or not married and more than 2 people in household). These characteristics capture a diversity of social support dimensions, many of which derive from validated scales (see 43).

Patterns were observed in social support characteristics for 1 year between baseline (1992) and follow-up round (1993). The majority of social support characteristics were compared and categorized as an increase, decrease, or as the same level of support. These “change variables” were constructed for each social support variable with the exception of household composition, due to the small proportion that experienced change.

Covariates in the analysis included age (years greater than 65), level of satisfaction with income (from extremely dissatisfied to extremely satisfied, 0–10) from the Perceived Quality of Life Scale (45), and change in body mass index (BMI). Change in BMI is assessed by the absolute difference in body mass index from follow-up rounds 1 and 2. Sensitivity analyses were conducted to assure stability of the models.

Analysis

The relationships between social support and changes in support and subsequent carotenoid measures were tested in linear multivariate regression analyses. Cross-tabulations were conducted between the social support measures, covariates, and whether or not a carotenoid increase or decrease was observed between baseline and the first follow-up round.

Using multiple linear regression, the absolute difference in carotenoid values between follow-up rounds 1 and 2 (1993–1994) were regressed on the baseline social variables in each social support category (1992–1993). This resulted in 5 different models, with carotenoid level change regressed on social support variables in each case: Instrumental support (Model 1), Emotional support (Model 2), Social interaction (Model 3), and Social space (Model 4), each controlling for age, income satisfaction, and BMI change. Model 5 regressed carotenoid change on all social support variables (from Models 1–4) and covariates.

To investigate the hypotheses regarding changes in social support levels predicting changes in carotenoid levels, Models 1–4 and 5 were repeated with changes in carotenoid levels from follow-up rounds 1 to 2 (1993–1994) regressed on the changes in social support characteristics (same, increase, or decrease) from baseline to follow-up round 1 (1992–1993). Reference groups are indicated in the analyses tables.

Finally, Models 1–4 were repeated to include baseline and change measures of social support. These analyses were conducted to test whether or not regression to the mean was driving the results in the previous analyses.

Results

Descriptive Results: Sample Characteristics

Table 1 presents the cross-tabulations of the sample characteristics. Simple regression tested whether or not sample characteristics predicted serum carotenoid change. Participants' social support responses were categorized into whether the level of social support across the 4 categories remained the same, decreased, or increased from baseline to follow-up round 1. These categories are cross-tabulated with whether or not the participants experienced a subsequent increase or decrease in absolute carotenoid levels between follow-up round 1 to follow-up round 2.

Average serum carotenoid levels at follow-up round 1 are also shown. The covariates age group (65–74, 75–84, and 85+), level of satisfaction with income, and BMI change were cross-tabulated with whether or not respondents experienced an increase or decrease in carotenoid levels between follow-up round 1 and 2. The average serum carotenoid levels changed little from follow-up round 1 to round 2 (2.704 to 2.719 $\mu\text{mol/l}$). These levels are consistent with populations from other studies, including a mean of $2.272 \pm 1.294 \mu\text{mol/l}$ for breast cancer survivors (46). They did vary between groups and were relatively high, for example, in married participants and those with more than 2 people living in their household.

Multivariate Results: Social Support at Baseline

Change in carotenoids was regressed on the social support characteristics at baseline, controlling for age, BMI change and income satisfaction. Models had originally controlled for education, race/ethnicity, level of disability, and frailty (47), but these covariates were not associated with change in carotenoids in the final models or in 2-sample t-tests and were highly correlated with age and satisfaction with income. They were therefore omitted as covariates. All other variables were retained in the models even if they did not achieve significance. Full model results are shown in Table 2.

None of the baseline social support characteristics in Models 1–3 (instrumental support, emotional support, and social interaction, respectively) predicted carotenoid change. Model 4 evaluated social space characteristics. While living arrangement and frequency of leaving one's neighborhood did not predict carotenoid change, frequency of leaving one's house was associated with a decline in carotenoid levels of $0.051 \mu\text{mol/l}$ ($p < 0.05$).

In the final baseline model, which includes all forms of social support, the frequency of leaving one's home predicted a decline of $0.05 \mu\text{mol/l}$ ($p < 0.05$). Attending activities only marginally predicted carotenoid decline of $0.036 \mu\text{mol/l}$ ($p < 0.10$).

Multivariate Results: Changes in Social Support

Changes in total carotenoids were regressed on changes in social support measures, controlling for age, BMI change, and satisfaction with income. The results are shown in Table 3.

Model 1 examines the relationship between change in instrumental support and carotenoid level change. Respondents who perceived less help had an increased level of carotenoids by $0.249 \mu\text{mol/l}$ ($p < 0.05$). The emotional support variables did not predict carotenoid change. Talking more frequently on the phone predicted a decrease in carotenoid levels of $0.240 \mu\text{mol/l}$ ($p < 0.10$). Respondents with greater activities had marginally increased level of carotenoids by $0.197 \mu\text{mol/l}$ ($p < 0.10$). Leaving one's home less frequently predicted a decrease in carotenoid levels by $0.254 \mu\text{mol/l}$ ($p < 0.05$). In the full model that examined changes in social support measures and carotenoids, the majority of findings remained consistent. A decrease in satisfaction with perceived help continued to predict an increase in carotenoid levels, now of $0.308 \mu\text{mol/l}$ ($p < 0.05$). An increase in the frequency of talking on the phone also predicts a decrease in carotenoids, now by $0.256 \mu\text{mol/l}$ ($p < 0.05$). A decrease in the frequency of leaving home is associated with a decrease in carotenoid levels of $0.311 \mu\text{mol/l}$ ($p < 0.05$). Change in frequency of activities was no longer significant. The additional tested social support characteristics did not predict carotenoid change.

Finally, changes in total carotenoids were regressed on baseline levels of social support and on changes in social support measures, controlling for age, change in BMI, and satisfaction with income. The results are shown in Table 4.

The results were consistent in the combined model change measures of social support, but not for baseline measures. As shown in Table 2, leaving the home less frequently predicted a decline in carotenoid levels. As shown in Table 4, none of the baseline measures of social support—including frequency leaving the home—predicted changes in carotenoid measures. Changes in social support that predicted changes in carotenoids in Table 3 were consistent in Table 4. Less satisfaction with help predicted an increase in carotenoid levels of 0.247 $\mu\text{mol/l}$ ($p < 0.05$). Talking on the phone more predicted a decrease in carotenoid levels of 0.328 $\mu\text{mol/l}$ ($p < 0.05$). Leaving the home less frequently predicted a decrease in carotenoid levels of 0.226 $\mu\text{mol/l}$ ($p < 0.05$).

Discussion

In community-resident older disabled women, different dimensions of social support and 1-year changes in those dimensions were associated with 1-year improvements and declines in carotenoid levels. As carotenoid levels measure fruit and vegetable intake, which in turn is a strong indicator of diet quality, this suggests that declines in serum carotenoid levels and, hence, diet quality. We hypothesized that greater social support would be associated with better diet quality and less social support would be associated with poorer diet quality. The observed associations were not uniformly consistent with our hypotheses. Here, we discuss the findings with respect to each dimension of social support examined in the analysis.

Instrumental Support—The use of informal sources of support—such as family, home care services or senior companion visiting programs for assistance—for help with activities is widespread among older disabled women living in institutions and in the community (48). Previous studies have found that receiving assistance with meals protects against inadequate diet and is associated with eating more servings of fruits and vegetables per day in disabled elderly (26). In this study, however, help with shopping or preparing meals did not predict better/improved diet quality. Changes in the level of satisfaction with perceived help challenged the study's hypothesis. Respondents with increases or decreases in carotenoid levels began with similar levels of carotenoids at follow-up wave 1, so “ceiling effects” do not explain this finding (see Tables 1 and 4). This finding could be partially explained by participants seeking and obtaining foods as alternate forms of coping from decreased satisfaction. Further research is needed in this area.

Emotional Support—Reliance on close friends, neighbors, and family has been found to protect against nutritional risk factors for older adults (3, 5, 27). In a community sample, whether or not participants reported having close friends did not predict diet quality (31), while other studies have found loneliness predictive of lower diet quality (30). In this study, baseline or changes in emotional support characteristics measured (level of emotional support needed and whether or not the respondent reports having a confidant) did not predict change in diet quality.

Social Interaction—The relationship between carotenoid change and changes in frequency taking on the phone challenges the study's hypothesis. This is most likely not explained by a “ceiling effect”; respondents who reported engaging in more activities (and a subsequent increase in carotenoid levels) had lower mean carotenoid levels relative to those who decreased activities or reported the same level. The relationship between carotenoid change and changes in engaging in activities supports the study's hypotheses. Social contact has previously been found to predict diet quality (28). A longitudinal study of older adults found a positive association between social isolation and nutritional risk (27), while a community-based study found that the frequency of social contact did not predict diet quality in an elderly population (31). The extent to which initial levels of social interaction

and changes in social interaction predict dietary outcomes is likely contingent upon the extent to which social interactions help satisfy nutritional needs: Talking more frequently on the phone, for example, may not provide more opportunities to eat fruit and vegetables than other social activities.

Social Space—The frequency of leaving one's home challenged the study's hypothesis at baseline but was supportive when change in these characteristics over time was examined. Further, engaging in more frequent activities—largely outside the home—were also found to be associated with increased carotenoid levels. This could be explained by the availability of food at events and increased opportunities to obtain food while outside the home.

Those who left their homes more frequently had higher mean levels of carotenoids (2.81 $\mu\text{mol/l}$) relative to those who left their homes the same amount (2.77 $\mu\text{mol/l}$) and to those who left their homes less frequently (2.54 $\mu\text{mol/l}$). At baseline, homebound disabled elderly could have been more likely to receive more nutrient-rich foods at home through friends, family, and community programs. Changes in whether or not one left their neighborhood could have occurred for the non-homebound population, offering support to our hypothesis. Leaving one's neighborhood was not predictive of increases in carotenoid levels. This is challenged by literature finding larger life-space to protect against dietary risk for older adults (27). Although the ability for one to leave one's neighborhood could relate strongly to one's ability to shop for foods with higher nutritional content, this is not supported by this study. Finally, living arrangement did not predict dietary quality in this analysis, although previous research on marriage and cohabitation has found that such factors improve diet quality and are associated with increased fruit and vegetable consumption in previous research (27). However, other studies have suggested that men are more likely to benefit from co-living situations or that the quality of relationships could be stronger predictors of nutrition (49, 50).

Higher levels of social support and positive changes in social support were often not predictive of higher levels of carotenoids among older disabled women. To the contrary, in some cases lower levels of social support or changes to lower levels were predictive of higher serum carotenoids. Previous literature has found strong linkages between social support and health outcomes, including diet quality among older adults. Our findings suggest that the levels of social support at baseline and over time do not independently predict diet quality.

This study has several limitations. First, change in social support characteristics are only evaluated over a 12 month period. The subsequent change in carotenoid levels is also only evaluated over a 12 month period. It is possible that a longer period is required to capture change due to this relationship. Different forms of social support could relate to individual carotenoid levels differently and the analysis of total carotenoid levels might overlook certain relationships.

Although a number of other social support characteristics could be evaluated, these are limited by availability of the data. Further, additional measures of social support were available in the WHAS study, but could not be included in the analysis to maintain a sufficient sample size. Social support measures that were highly correlated were excluded from the analysis. Sensitivity analyses of additional social support measures were conducted post-hoc to ensure that the final results did not change with the inclusion of additional measures.

Total serum carotenoid concentrations are an excellent indicator of fruit and vegetable intake; however, social support could be more strongly linked to other aspects of nutrition

and total diet quality. The number and types of meals eaten away from home might be an important factor (51, 52), as restaurants tend to have higher proportions of fat and larger portions (52). Further, relationship between social support, nutritional status, and loss of autonomy warrants further investigation. Loss of autonomy has been found to predict dietary problems among older adults (31), but might relate to some forms of social support differently than to others. As with many epidemiological studies, this analysis runs the risk of omitted variable bias. Additional data would be helpful for this analysis, such as the use of multivitamins. Certain changes in one's health or lifestyle could confound the relationship between social support and carotenoid change. Finally, further research should address the clinical significance of consumption of total carotenoids to better translate research into practice.

The study population was older disabled women who participated in the WHAS I study in Baltimore, MD. This sample survived to the point of data collection; therefore, respondents who did survive could have had different relationships to social support and carotenoids. Although the study is population-based, the extent to which these findings can be generalized to males or non-disabled women is not known. Therefore, the relationships between social support characteristics and carotenoid change could be different for males or for women who are not disabled. These relationships should ideally be further examined in a population with both men and women, diverse levels of functional status, and where social support and dietary trends can be evaluated with opportunities for longer follow-up.

This study found that baseline levels of social support and increases in support did not consistently predict improved diet quality, as measured by changes in levels of serum carotenoids. However, these findings do not suggest that support is inherently detrimental to the diet quality or nutritional status of older disabled women. The vast body of research on social support suggests social support can have an overall positive impact on health. Previous intervention studies found older adults in social groups such as church congregations to be amenable to increases in carotenoid levels (29, 52). Our study found that in community-resident older disabled women, most aspects of social support were not associated with improved dietary behaviors. The consumption of carotenoid-rich fruits and vegetables in social situations should be targeted, particularly among socially isolated populations.

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Table 1
Means or Percentages for Social Support and Control Variables for Respondents by Carotenoid Level Change

	Sample Statistics			Decrease			Increase		
	Mean	Percentage	n	Baseline	Sign	Mean	Percentage	n	Percentage
<i>Age Group</i>									
65–74 (reference)	49.2%		160			2.56	47.6%	78	50.9%
75–84	33.8		110	*		2.85	32.3	53	35.4
85+	16.9		55			2.83	20.1	33	13.7
Level of Satisfaction with Income	7.44		325			-	7.32	-	7.56
Change Body Mass Index	-0.38		325			-	-0.44	-	-0.32
<i>Change in Satisfaction with Perceived Help</i>									
Same (reference)	43.1		140			2.75	44.5	73	41.6
Decrease	27.1		88			2.70	23.8	39	30.4
Increase	29.8		97			2.70	31.7	52	28.0
<i>Change in Help Shopping/Preparing Meals</i>									
Same (reference)	45.2		147			2.74	43.3	71	47.2
Decrease	28.6		93			2.73	28.0	46	29.2
Increase	24.3		79			2.60	28.0	46	20.5
<i>Change in Confidant</i>									
Same (reference)	88.9		289			2.72	88.4	145	89.4
Increase	5.2		17			2.67	6.7	11	3.7
<i>Change in Emotional Support Needed</i>									
Same (reference)	45.5		148			2.76	44.5	73	46.6
Decrease	27.1		88	**		2.34	28.0	46	26.1
Increase	27.4		89			2.80	27.4	45	27.3
<i>Change in Freq. Taking on the Phone</i>									
Same (reference)	53.5		174			2.65	49.4	81	80.9
Decrease	20.6		67			2.64	18.3	30	32.2
Increase	25.8		84			2.87	32.3	53	27.0
<i>Change in Freq. Going to Activities</i>									
Same (reference)	47.1		153			2.61	50.0	82	62.5
Decrease	26.5		86	**		2.96	28.0	46	35.2

	Sample Statistics			Decrease			Increase		
	Mean	Percentage	n	Mean	Percentage	n	Mean	Percentage	n
Increase	26.5		86	2.61	22.0	36	44.0		50
<i>Change in Freq. Leaving Neighborhood</i>									
Same (reference)	46.5		151	2.67	48.8	80	61.8		71
Decrease	29.2		95	2.79	28.0	46	42.6		49
Increase	24.3		79	2.66	23.2	38	35.7		41
<i>Change in Freq. Leaving House</i>									
Same (reference)	29.2		95	2.77	25.6	42	46.1		53
Decrease	34.2		111	2.54	41.5	68	37.4		43
Increase	36.6		119	2.81	32.9	54	56.6		65
<i>Household Situation</i>									
Not Married, Live alone	47.4		154	2.85	48.2	79	66.0		75
Married, 2 people in home	18.2		59	2.69	16.5	27	28.2		32
Married, more than 2 people in home	7.7		25	3.11	9.1	15	6.2		10
Not Married, 2 or more people in home	26.8		87	2.34	26.2	43	27.3		44
n	325				164		161		

Note:

* p<0.01,

** p<0.05,

Freq. indicates Frequency

Table 2

Baseline Measures of Social Support as Predictors of Carotenoid Change

	Model 1				Model 2				Model 3				Model 4				Combined Model				
	Coef.	SE	t	P	Coef.	SE	t	P	Coef.	SE	t	P	Coef.	SE	t	P	Coef.	SE	t	P	
Age	0.00	0.01	-0.47	0.64	0.00	0.01	-0.43	0.67	0.00	0.01	-0.50	0.61	0.00	0.01	-0.48	0.63	0.00	0.01	-0.30	0.77	
Change in Body Mass Index	0.02	0.03	0.56	0.58	0.01	0.03	0.36	0.72	0.02	0.03	0.66	0.51	0.02	0.03	0.77	0.44	0.02	0.03	0.66	0.51	
Satisfaction with Income	0.01	0.02	0.75	0.45	0.01	0.02	0.77	0.44	0.02	0.02	1.06	0.29	0.02	0.02	0.86	0.39	0.02	0.02	1.05	0.30	
Satisfaction with Perceived																					
Help	0.00	0.02	0.14	0.89													0.00	0.02	0.21	0.84	
Has Help with Meals/Shopping	-0.02	0.10	-0.25	0.81													-0.04	0.10	-0.42	0.68	
Has Confidant					-0.25	0.18	-1.36	0.18									-0.24	0.19	-1.30	0.19	
Need Emotional Support (none)																					
A little more					0.00	0.21	0.01	0.99									0.04	0.22	0.18	0.86	
Some more					-0.05	0.17	-0.31	0.75									0.06	0.18	0.35	0.73	
A lot more					-0.24	0.15	-1.59	0.11									-0.21	0.16	-1.35	0.18	
Frequency Talking on Phone										0.01	0.03	0.42	0.68				0.01	0.03	0.41	0.68	
Frequency Going to Activities										-0.03	0.02	-1.42	0.16				-0.04	0.02	-1.80	0.07 *	
Frequency Leaving Neighborhood														0.02	0.03	0.86	0.39	0.05	0.03	1.48	0.14
Frequency Leaving House														-0.05	0.02	-2.26	0.02 **	-0.05	0.02	-2.20	0.03 **
Household Living Situation (Not Married, Live Alone)																					
Married, 2 people in home										0.16	0.14	1.16	0.25				0.15	0.14	1.10	0.27	
Married, more than 2 people in home										-0.16	0.19	-0.84	0.40				-0.19	0.20	-0.96	0.34	
Not Married, 2 or more people in home										0.05	0.12	0.44	0.66				0.05	0.12	0.43	0.67	

Note:

*
p<0.01,**
p<0.05

Table 3

Changes in Social Support as Predictors of Carotenoid Change

	Model 1				Model 2				Model 3				Model 4				Combined Model			
	Coef.	SE	t	P	Coef.	SE	t	P	Coef.	SE	t	P	Coef.	SE	t	P	Coef.	SE	t	P
Age	0.00	0.01	-0.29	0.77	0.00	0.01	-0.35	0.72	0.00	0.01	-0.19	0.85	0.00	0.01	-0.52	0.60	0.00	0.01	-0.21	0.84
Change in Body Mass Index	0.01	0.03	0.41	0.68	0.02	0.03	0.69	0.49	0.02	0.03	0.70	0.48	0.02	0.03	0.69	0.49	0.02	0.03	0.62	0.53
Satisfaction with Income	0.01	0.02	0.72	0.48	0.01	0.02	0.55	0.58	0.01	0.02	0.77	0.44	0.01	0.02	0.64	0.52	0.01	0.02	0.34	0.73
Change Sat. with Perceived Help (Same)																				
Decrease	0.25	0.12	2.12	0.04**													0.31	0.12	2.51	0.01**
Increase	-0.11	0.12	-0.91	0.36													-0.04	0.12	-0.31	0.76
Change Help Shopping/Meals (Same)																				
Decrease	-0.04	0.11	-0.40	0.69													-0.04	0.12	-0.35	0.73
Increase	-0.03	0.12	-0.25	0.80													0.04	0.13	0.28	0.78
Change have Confidant (Same)																				
Increase					-0.02	0.22	-0.10	0.92									0.01	0.22	0.04	0.97
Change Need Emotional Support (Same)																				
Decrease					0.03	0.15	0.21	0.83									0.04	0.15	0.27	0.78
Increase					-0.12	0.13	-0.89	0.38									-0.14	0.14	-1.00	0.32
Change Freq. Talking on Phone (Same)																				
Decrease									0.03	0.12	0.28	0.78					0.07	0.13	0.53	0.59
Increase									-0.24	0.11	-2.11	0.04**					-0.27	0.12	-2.26	0.03**
Change in Freq. of Activities (Same)																				
Decrease					-0.10	0.12	-0.89	0.38									-0.11	0.12	-0.95	0.34
Increase					0.20	0.12	1.71	0.09*									0.18	0.12	1.45	0.15
Change Freq. Leave Neighborhood (Same)																				
Decrease																	-0.03	0.11	-0.27	0.79
Increase																	-0.07	0.12	-0.61	0.54
Change Freq. Leave House (Same)																				
Decrease																	-0.25	0.12	-2.11	0.04**
Increase																	0.13	0.12	1.11	0.27
																	-0.31	0.12	-2.51	0.01**
																	0.13	0.12	1.07	0.29

	Model 1				Model 2				Model 3				Model 4				Combined Model			
	Coef.	SE	t	P	Coef.	SE	t	P	Coef.	SE	t	P	Coef.	SE	t	P	Coef.	SE	t	P
Household Living Situation (Not Married, Live Alone)																				
Married, 2 people in home																				
Married, more than 2 people in home																				
Not Married, 2 or more people in home																				

Note:

* p<0.01,

** p<0.05,

Freq. indicates "Frequency", Sat. indicates "Satisfaction"

Table 4
Baseline and Changes in Social Support Measures as Predictors of Carotenoid Change

	Model 1			Model 2			Model 3			Model 4		
	Coef.	SE	t	P	Coef.	SE	t	P	Coef.	SE	t	P
Age	0.00	0.01	-0.34	0.73	0.00	0.01	-0.21	0.83	0.00	0.01	-0.35	0.72
Change in Body Mass Index	0.01	0.03	0.31	0.76	0.01	0.03	0.30	0.76	0.03	0.03	0.85	0.40
Satisfaction with Income	0.02	0.02	0.96	0.34	0.01	0.02	0.73	0.46	0.02	0.02	1.04	0.30
Baseline Satisfaction with	-0.03	0.02	-1.14	0.26					0.01	0.02	0.58	0.57
Perceived Help												
Change Sat. with Perceived Help (Same)												
Decrease	0.25	0.12	2.08	0.04**								
Increase	-0.19	0.14	-1.36	0.17								
Baseline Help Shopping/Meals	0.05	0.14	0.34	0.74								
Baseline Help Shopping/Meals												
Decrease	-0.08	0.14	-0.53	0.60								
Increase	-0.02	0.13	-0.15	0.88								
Baseline Confidant					-0.64	0.36	-1.79	0.08*				
Change have Confidant (Same)												
Increase					-0.64	0.41	-1.55	0.12				
Baseline Need Emotional Support (none)												
A little more	0.01	0.26	0.04	0.97								
Some more	-0.11	0.24	-0.47	0.64								
A lot more	-0.35	0.21	-1.65	0.10								
Change Need Emotional Support (Same)												
Decrease	0.04	0.16	0.27	0.79								
Increase	0.05	0.22	0.22	0.83								
Baseline Freq Talking on Phone					-0.04	0.04	-1.16	0.25				
Change Freq. Talking on Phone (Same)												
Decrease					0.02	0.12	0.15	0.88				
Increase					-0.33	0.13	-2.48	0.01**				
Baseline Freq. of Activities					-0.02	0.02	-0.89	0.37				

	Model 1			Model 2			Model 3			Model 4		
	Coef.	SE	t	P	Coef.	SE	t	P	Coef.	SE	t	P
Change in Freq. of Activities (Same)												
Decrease												
Increase												
Baseline Freq. Leave Neighborhood												
Change Freq. Leave Neighborhood (Same)												
Decrease												
Increase												
Baseline Freq. Leave House												
Change Freq. Leave House (Same)												
Decrease												
Increase												
Household Living Situation (Not Married, Live Alone)												
Married, 2 people in home												
Married, more than 2 people in home												
Not Married, 2 or more people in home												

Note:

* p<0.01,

** p<0.05,

Freq. indicates "Frequency", Sat. indicates "Satisfaction"