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# Negative Emotions and Risk for Type 2 Diabetes among Korean Immigrants

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## Abstract

**Purpose—**The purpose of this study is to examine the relationship between negative emotions and bio-behavioral risk factors among Korean immigrants at risk for type 2 diabetes (T2DM).

**Methods—**Data were collected from 148 Korean immigrant adults who are “at risk” for T2DM as defined by having family history of T2DM in first degree relatives, body mass index greater than 23, or history of gestational diabetes in women. Participants completed questionnaires and underwent biological measures. Negative emotions included feeling nervous, hopeless, restless, anxious, and stressed as well as depressive symptoms.

**Results—**High percentages of participants had T2DM risk factors including overweight, greater than normal waist to hip ratio, and blood glucose readings that are indicative of T2DM. Feeling stressed was the most commonly reported negative emotion (66%), followed by feeling anxious (51%), restless (38%), nervous (30%), and hopeless (13%). Experience of negative emotions was significantly related to behavioral risk factors; higher levels of experiencing negative emotions were related to increased soda intake and a decreased likelihood of doing at least 10 minutes of moderate exercise. Stress and anxiety were each negatively related to moderate exercise and depressive symptoms were negatively related to both moderate and vigorous exercise. No significant relationship was found between negative emotions and biological risk factors.

**Conclusions—**Findings suggest that negative emotions, individually and taken together, may be related to T2DM risk behaviors in high-risk Korean immigrants. Behavioral interventions to prevent T2DM in this population should consider assessing and addressing negative emotions.

### Keywords

type 2 diabetes; prevention; negative emotions; risk behaviors; Korean immigrants

The prevalence of type 2 diabetes (T2DM) continues to rise in the U.S., particularly among racial/ethnic minorities.[1] Asian Americans have an increased risk of developing diabetes compared to Caucasians[1-4] and Korean immigrants, the 4th largest and one of the fastest-growing Asian subgroups in the U.S.,[5] have one of the highest risks of developing diabetes among Asians.[6]

Prevention of T2DM is primarily behavioral in nature,[7] such as modifying diet and engaging in exercise to prevent obesity, the primary risk factor for T2DM.[8, 9] Evidence shows that lifestyle behavior interventions focusing on diet and physical activity are more effective in

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decreasing the incidence of T2DM than pharmacological therapy.[10] However, individuals' ability to engage in and adhere to risk-reducing and health-promoting behaviors such as diet and exercise may be influenced by psychological factors such as experiencing negative emotions.[11-14] Depressive symptoms and/or negative emotions can induce or exacerbate unhealthy eating behavior or physical inactivity,[15-17] and the experience of depressive symptoms and negative emotions, such as anxiety, stress, and restlessness may make certain chronic illnesses, including T2DM, worse.[18]

Depression has often been studied as a psychological factor impacting health behaviors such as diet,[19] exercise,[20] smoking,[21, 22] alcohol use[23] and self-management of chronic health conditions such as T2DM,[13, 24, 25] and its role is quite well understood. However, other negative emotions have not been well-examined in terms of their relationships with health behaviors and risk of T2DM for non- or pre-diabetic individuals. Among those studies that did examine other negative emotions, findings are inconclusive, and no studies have focused on Asians specifically. One population-based study showed that more symptoms of anxiety and depression were associated with onset of T2DM at 10 years follow-up,[26] suggesting that these negative emotions may be related to risk factors. However, in a study of individuals presenting for diabetes screening, investigators found that anxiety levels at baseline, but not at twelve months follow-up, were weakly but significantly negatively correlated with overall risk for diabetes, whereas depression was weakly but significantly positively correlated with risk at both time points.[27] Researchers exploring the evidence for a relationship between depression, anxiety, and glucose levels in non- or pre-diabetic individuals found that though a larger proportion of individuals with T2DM had high anxiety levels than did those with impaired glucose metabolism, or those with normal glucose metabolism, the difference in anxiety scores between groups was not significant.[28] A study of perceived stress and dietary and activity patterns among Latino adults showed that individuals reporting greater stress levels reported consuming significantly more sweets, more salty snacks, more carbohydrates overall, and less protein than did those reporting less perceived stress, indicating a possible pathway between stress and health behaviors that may lead to the development of T2DM.[29] On the other hand, Daniels and colleagues[30] noted that although there were trends toward associations between increased psychological distress (SF-36) and higher body mass index (BMI), and between higher distress and impaired glucose tolerance in a sample of American Indian adults, no evidence was found that psychological distress had an impact on incidence of diabetes four years later.

To date, little is known about anxiety, stress, or other negative emotions and health behaviors and risks among Korean immigrants at risk for T2DM. However, Korean immigrants are reported to have higher prevalence of psychological distress, including depression and anxiety, than other racial/ethnic groups,[31-33] and negative emotions may be related to diabetes risk behaviors and biological risk factors in this group. Given the paucity of information on the psychological factors involved in T2DM risk among Korean immigrants, and given the abundance of information on the relationship between psychological factors and health behaviors and outcomes in the literature, the present study sought 1) to describe psychological environment of Korean immigrants at risk for T2DM as measured by frequency of experiencing negative emotions; and 2) to examine the relationship between immigrants' negative emotions and bio-behavioral T2DM risk factors. In addition, gender differences were examined in bio-behavioral risk factors and negative emotions since these differences may influence relationships between negative emotions and health outcomes.

## Methods

### Design

This study employed a cross-sectional survey design. This was an appropriate design to address the aims of the study: to describe characteristics of the sample and to examine the relationships among the variables of interest.

### Participants

Individuals eligible for this study included Korean-born adults between 21 and 79 years of age who were at risk for developing T2DM. “At risk” was defined as endorsement of having at least one of the following risk factors[34]: 1) a family history of diabetes in first degree relatives, 2) a body mass index (BMI) greater than 23,[35] and/or 3) a history of gestational diabetes in women. Participants were recruited from a variety of community sites in a West Coast Korea town using flyers and newspaper advertisements in both English and Korean. Individuals interested in participating in the study contacted research assistants via telephone, at which time their “at risk” status was determined. Those who were eligible for the study were then invited to participate in the study and provided with additional information about the study and directed to the community site for data collection.

### Procedures

At the center, participants completed a battery of psychosocial instruments and a trained research assistant took biological assessments. All self-report instruments were available in both English and Korean; all participants chose to complete the survey in Korean, which was translated from the English version according to Brislin's methods of double translation.[36] That is, the English versions of the survey instruments were first translated into Korean by the bilingual lead author and then back-translated into English by a bilingual graduate student. The two English versions were then checked for discrepancies in translations. Any discrepancies were resolved by the consensus of three bilingual Korean immigrants: two health care professionals and a volunteer at a community health information center. Once the survey packet was completed, a trained, bilingual research assistant took participants' biological measurements, including their resting blood pressure, height, weight, and waist and hip circumferences, and fasting/random blood glucose. All study data were identified using an anonymous, random number assigned to each enrolled participant. As compensation for their time and effort, participating individuals were given a $10 gift certificate to a local community ethnic market. All measures and procedures were approved by the university Institutional Review Board.

### Measures

**Demographic information—**Socio-demographic data included age, gender, education, income, marital status, and health history. English proficiency was assessed by a four-item scale that asks respondents to report, on a 5-point Likert-type scale, the extent to which they speak, understand, read, and write in English. Higher scores on the scale indicate better English language proficiency. The scale, based on the Interagency Language Roundtable Scale,[37] has demonstrated excellent validity and reliability.[38]

**Behavioral risk factors—**Participants completed a survey of their dietary behaviors, based on the 2009 California Health Interview Survey (CHIS) Adult Questionnaire.[39] Respondents were asked to think about everything they had consumed over the past week, and report the number of times each day they ate fruit, vegetables, carbohydrates, such as rice, noodles, or bread, proteins, such as beef, chicken, or pork, snacks, including chips and crackers, and soda. Using the items from the CHIS adult health behaviors questionnaire,

participants were also asked to report whether or not they engaged in moderate (i.e., walking, bicycling, gardening) or vigorous (i.e., running, soccer, fast swimming) physical activity in past week and, if so, how many days and for how many minutes they had engaged in each type of physical activity. Participants were also asked to report on their lifetime tobacco use, their current smoking status, and how often and how much they consumed alcohol in the last 12 months.

**Biological risk factors—**Each participant's height was measured, without shoes, in centimeters (cm) to the top of the head using a non-stretching measuring tape secured to the wall. A professional body weight scale (Health O Meter Professional scale) was used to measure participants' weight in kilograms (kg), with the participants in no shoes and light clothing. BMI was computed for each participant using the following formula: BMI = kg/$m^2$. Waist size was measured in centimeters (cm) using a non-stretching measuring tape around participants' abdomen at the top of the iliac crest after expiration. Hip size was measured in centimeters (cm) over the buttocks at the point of maximum circumference, with the measuring tape touching the surface of participants' clothing but not indenting the skin. The waist to hip ratio (WHR) was calculated by dividing each participant's waist circumference by their hip circumference. An electronic blood pressure monitor (A&D Medical, LifeSource UA-767PV) was used to assess participants' resting blood pressure at two time points two minutes apart after resting for at least 5 minutes. Each participant's mean resting blood pressure value was computed by taking the average of the two blood pressure readings. Fasting or random blood glucose was measured using a finger-stick sample of whole blood and analyzed using a blood glucose meter (Accu-Chek glucose monitoring system) according to standardized procedures. Such finger-stick procedures have been validated as having accuracy comparable to venipuncture and are widely used in both clinical and home settings.[34]

**Psychological indicators—**Participants completed the 20-item Center for Epidemiologic Studies-Depression scale (CESD).[40] The CESD is a valid, reliable, assessment of overall psychological functioning as well as depressive symptoms, and has been validated for use in Korean individuals.[41-43] Participants indicated how often in the past week they had experienced each feeling on a 4-point Likert-type scale (0 = *rarely or none of the time (less than 1 day)*; 3 = *most of the time (5-7 days*)). Sample items included “I felt depressed”, “I had crying spells”, and “I felt that people disliked me”. Participants also completed a brief survey of the extent to which they had experienced negative emotions in the past 30 days by indicating frequency of these emotions. This single item questions are from the mental health section of the CHIS survey.[39] Respondents reported how often they felt nervous, hopeless, restless, anxious, and stressed on a 5-point scale ranging from “Never” to “All the time” (never, a little, some of the time, most of the time, all the time). Scores across the five negative emotions were averaged to create a scale score. Higher scores indicated higher frequency of negative emotions.

## Statistical Analyses

All statistical analyses were completed using the SPSS 20 (SPSS; Chicago, IL) statistical package. Data were stratified by gender. Frequencies and descriptive statistics were used to examine sample characteristics. *T*-tests were used to assess gender differences in health behaviors, biological risk factors, and negative emotion variables. Finally, in order to examine associations between health behaviors, biological risk factors, and negative emotions, partial correlations were used. These allowed the exploration of correlations among the variables of interest while controlling for participant gender because several variables were found to differ by gender. Sample sizes (*N*s) vary slightly across analyses due to some participants missing data on some demographic and health behavior variables.

# Results

## Sample Characteristics

A total of 153 Korean immigrant adults participated in the study. However, 5 participants were excluded due to missing data on key variables, thus the final sample size was 148. Table 1 presents demographic characteristics of the sample. Mean age was 49.4 [*SD* = 12.4] and gender was equally represented with 73 (49.3%) males and 75 (50.7%) females. For "at-risk" eligibility, 110 (76.7%) of participants met overweight criteria (BMI ≥ 23)[35]; one woman had experienced gestational diabetes; and 87 (58.8%) participants indicated that they had a family history of diabetes. Descriptive statistics for the sample can be found in Table 1. The majority of the sample (70.6%) had 4-year college or higher education, and income was distributed fairly evenly across 5 categories: <$20,000 (10.8%), $20,000 - $39,999 (27.0%), $40,000 - $59,999 (24.3%), $60,000 - $79,999 (11.5%), $80,000+ (21.6%), 4.8% refused to report.

## Bio-behavioral Risk Factors

Many participants displayed biological risk factors for diabetes as identified by practice guidelines,[34] including glucose levels that meets the criteria for the diagnosis of diabetes (27.9%), BMI indicative of overweight or obesity (76.4%), higher than normal waist-hip ratio (88.2%), and higher than normal systolic (62.2%) and diastolic (62.8%) blood pressure. Frequencies of overweight, higher than normal waist-hip ratio, high systolic blood pressure, and high diastolic blood pressure significantly differed by gender (all $\chi^2$s > 4.38, *p*s < .05). Biological risk factors are presented in Table 2.

For behavioral risk factors, dietary risk factors were present in more than half of this sample. Eighty-seven (59.2%) participants reported eating one serving or less of fruit and 83 (56.5%) reported eating one serving or less of vegetables per day over the past week. A significant gender difference was observed for soda intake ($t = 4.14$, $p < .001$). Women reported drinking fewer sodas per day than men. Frequencies of fruit, vegetable, carbohydrate, protein, snack, and soda consumption are presented in Table 2. For physical activity engagement in this sample, 109 (74.1%) participants reported engaging in moderate physical activity and 73 (50.7%) reported engaging in vigorous physical activity for at least 10 minutes on at least one day in the past week. A significant gender difference in vigorous physical activity was observed ($\chi^2(1) = 6.32$, $p < .05$). Men were more likely to report engaging in vigorous activity at least one day for at least 10 minutes in the past week. Smoking and drinking (not shown in table) were relatively uncommon in this sample; although 41 (27.7%) participants were smokers at some point in their life, only four (2.7%) of participants were current smokers. Thirty-eight (25.7%) participants reported consuming alcohol in the past 12 months; 22 (14.9%) participants reported consuming more than five alcoholic drinks in a single day at any time in the past year.

## Negative Emotions

Participants were asked to report how often during the past 30 days they experienced feelings of nervousness, hopelessness, restlessness, anxiety, and stress. About a third (29.7%) of participants reported feeling nervous at least "some of the time" (the midpoint of the scale) in the past 30 days. Fewer participants (12.9%) reported feeling hopeless at least some of the time, while considerably more participants reported feeling restless (37.9%), anxious (51.4%) and stressed (65.5%) at least some of the time. Women reported higher levels of all negative emotions than men but significant mean differences were only observed for hopelessness and stress (*t*s < -1.30, *p*s < .05). Women also had higher summary scores across the negative emotions variables and higher scores on the CES-D than men (*t*s < -2.05, *p*s < .05).

### Relationship between Negative Emotions, Health Behaviors, and Biological Risk Factors

Of particular interest were relationships between the frequency of experience of negative emotions, health behaviors (Table 3), and biological risk factors (Table 4). Bivariate correlations were conducted to examine these relationships. However, because many of the variables of interest differed by gender, partial correlations were computed in order to examine relationships between variables while simultaneously controlling for gender. Age and years in the U.S. were also considered as covariates because previous studies of Asian immigrants suggest that the experience of negative emotions such as anxiety may vary as a function of age and time spent in the U.S.[44, 45]; however, in the present sample, these variables were not consistently associated with psychological, behavioral, or biological variables, and therefore we controlled for gender only. Fruit intake was negatively associated with anxiousness ($r$ = -.18, $p$ < .05), indicating that participants who reported eating more fruit tended to report less anxiety. Carbohydrate and vegetable intake were positively associated with hopelessness ($r$s =.18, $p$s < .05), indicating that participants who reported eating more carbohydrates and vegetables tended to report more feelings of hopelessness. Soda intake was positively associated with nervousness, hopelessness, stress, and the overall negative emotion scale score ($r$s > .16, $p$s < .05), indicating that participants who reported drinking more soda tended to report more negative emotions across several scales.. Reporting at least 10 minutes of moderate exercise in the last week was negatively associated with anxiety, stress, negative emotion scale score, and CES-D score ($r$s < -.19, $p$s < .05). Vigorous exercise was negatively associated with CES-D score ($r$ = -.19, $p$ < .05). Together, these two findings indicate that exercise was generally associated with reduced negative emotions and/or depressive symptoms. The significant correlations were all fairly small in size. No significant associations emerged between negative emotions and biological risk factors.

## Discussion

With growing evidence for links between psychological distress and T2DM risk behaviors and outcomes,[46, 47] this study examined negative emotions of Korean immigrants at risk for T2DM and whether these negative emotions are related to behavioral and biological risk factors among this group. The study found that ratings of stress were highest in both genders followed by ratings of feeling anxious, restless, and nervous, with hopeless being the least frequently reported negative emotion. The study also found that women's ratings were higher than men's across several emotions as well as depressive symptoms and the overall emotional scale, suggesting that women may experience these emotions more frequently. The overall high ratings of negative emotions are consistent with previous studies that showed that Korean immigrants have high prevalence of depressive symptoms[48, 49] and high levels of stress[50] and anxiety[44]. However, findings on gender differences were mixed; one study with Korean immigrants reported negligible gender differences in ratings of depressed symptoms (Hurh and colleagues), while another study reported that women fared better than men (Kuo and colleagues).

The sample in the current study had high proportion of bio-behavioral T2DM risk factors. Being overweight or obese was the most common risk factor and the majority of the sample also showed large WHR, an indicator for abdominal/central obesity and a risk factor Asian population are particularly prone to.[51, 52] Therefore, T2DM prevention efforts in Korean immigrants should consider targeting weight management. The most alarming finding was that more than a quarter of the sample (27.9%) showed glucose levels that meet the criteria for the diagnosis of diabetes. While this finding may be due to our sample being already “at risk,” it is consistent with a national report that 27% of patients affected by diabetes are undiagnosed.[1] For behavioral risk factors, more than half of our sample had fruit and vegetable consumption frequency lower than that recommended by the U.S. Department of

Health and Human Services.[53] However, the proportion of physical activity engagement in our sample was higher than that of Korean immigrants in previous epidemiological studies, which reported 31% -42% physical inactivity.[5, 50] A potential explanation for the differences may be related to our sample's higher percentage of college or higher level education compared to the previous studies (70% vs. 51.8% - 56.4%).

The present study was especially interested in relationships between particular negative emotions and behavioral and biological risk factors. Hopelessness was the emotion significantly related to the most behaviors (positively with all diet related behaviors), followed by feeling anxious and stressed. Soda intake and moderate exercise, behaviors directly related to obesity, were the two behaviors associated with the most number of negative emotions (higher soda intake was related to higher frequency of nervousness, hopelessness, feeling stressed, and scale score; decreased moderate exercise was related to higher frequency of feeling anxious, stressed, depressed). These findings suggest that various negative emotions may be related to different T2DM risk behaviors. CES-D scores were only related to moderate and vigorous exercise in our study, which is consistent with previous studies that have linked depression and decreased physical activity.[54, 55] The current study also suggests that for T2DM risk behaviors, specific negative emotions may need to be assessed (e.g., for exercise, depressive symptoms and for diet-related, hopelessness). It is also noteworthy that the sample in this study reported feeling stressed and anxious more frequently than any other negative emotions, and both of these emotions are associated with decreased engagement in moderate exercise. It may be that endorsing stress and anxiety are more acceptable than endorsing other negative emotions, including depressive symptoms, in Korean culture. If these two emotions are related to exercise in a similar way to depressive symptoms as seems to be the case in the present study, asking patients about feeling stressed or anxious may be a more culturally appropriate approach than asking about symptoms of depression when assessing the psychological factors related to exercise behavior among Korean immigrants at risk for T2DM. Future studies to confirm this will be needed.

Interestingly, no significant relationships were observed between negative emotions and biological T2DM risk factors. However, negative emotions may have an influence on biological risk factors indirectly through poor health behaviors. In analyses not presented here, the current study did not find evidence for interactive effects of negative emotion variables and health behaviors on biological risk factors. However, health behavior data in this study were all based on self-report. Future research including more detailed and objective measures of health behaviors should seek to clarify the relationship between negative emotions and behavioral risk factors and explore how these variables may interact to predict biological risk factors for T2DM. Understanding which emotion has the most influence on which behavior and subsequently impact which biological health outcomes may allow clinicians and researchers to target specific negative emotion(s) in screening “at risk” Korean immigrant population to improve diabetes health behaviors, and develop interventions to address those particular negative emotions.

The current study has limitations. First, due to the cross-sectional study design, causal relationships cannot be established. Second, we used single-item measures for both emotion and behavioral variables. While these items are from the CHIS questionnaire, which was administrated to Korean immigrants, the single items may not have captured the constructs to their full extent and thus may have limited validity. Third, due to the geographic location of the study, generalizability may be limited to Korean immigrants with similar demographics. Fourth, due to the community-based study design, fasting blood glucose could not be obtained for all participants and the blood test was done with finger stick method. However, the study followed American Diabetes Association (ADA) standardized

practice guidelines to determine risk factor level of fasting and random blood glucose and finger stick method is widely used for public health research with accuracy equivalent to venous drawing. Fifth, emotions can be difficult to separate as they can overlap. Patients may not have been able to differentiate clearly between some emotions. Additionally, socially desirable responding on psychosocial instruments may have occurred in this study as has been observed in previous studies with Korean immigrants.[31, 33, 45]

Despite these limitations, to authors' knowledge, this study is the first to examine negative emotions and bio-behavioral risk factor of T2DM among at-risk Korean immigrants by gender. The study showed that the experience of various negative emotions may be related to T2DM risk behaviors and thus deserve more attention from clinicians and researchers. These emotions individually or collectively may be helpful to better assess “at risk” individuals' T2DM risk behaviors. Future studies should investigate emotions beyond depression in relation to T2DM risk behaviors and outcomes.

### Implications/Relevance for Diabetes Educators

For the prevention of T2DM, effective lifestyle behavior interventions will be needed. A growing body of literature suggests the influence of psychological factors on diabetes health behaviors such as diet and exercise and outcomes. The present study showed that negative emotions as well as depressive symptoms may be related to T2DM risk behaviors in high risk Korean immigrants. Asking about negative emotions, especially stress and anxiety, may provide clues to underlying unhealthy behaviors contributing to the increased risk for T2DM. Gender differences should be considered in the assessment of negative emotions and bio-behavioral risk factors of T2DM among this population. The findings from this study can be translated and applied to the practice of diabetes education for this high-risk ethnic group – i.e., incorporating the assessment of negative emotions when evaluating behavioral T2DM risk factors and designing interventions to modify diabetes risk behaviors. Ethnicity/culture-specific information on experiences of negative emotions can also be applied to tailoring diabetes education for Korean immigrants at risk for T2DM.

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## References

1. Centers for Disease Control and Prevention. National Diabetes Fact Sheet: national estimates and general information on diabetes and prediabetes in the United States. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2011.
2. McNeely MJ, Boyko EJ. Type 2 diabetes prevalence in Asian Americans: results of a national health survey. Diabetes Care. Jan; 2004 27(1):66–69. [PubMed: 14693968]
3. Rajpathak SN, Gupta LS, Waddell EN, et al. Elevated risk of type 2 diabetes and metabolic syndrome among Asians and south Asians: results from the 2004 New York City HANES. Ethn Dis. Summer;2010 20(3):225–230. [PubMed: 20828094]
4. Shai I, Jiang R, Manson JE, et al. Ethnicity, obesity, and risk of type 2 diabetes in women: a 20-year follow-up study. Diabetes Care. Jul; 2006 29(7):1585–1590. [PubMed: 16801583]
5. Barnes, PM.; Adams, PF.; Powell-Griner, E. Health characteristics of the Asian adult population: United States, 2004-2006. Hyattsville, Maryland: National Center for Health Statistics; 2008.
6. Choi SE, Chow VH, Chung SJ, Wong ND. Do Risk Factors Explain the Increased Prevalence of Type 2 Diabetes Among California Asian Adults? J Immigr Minor Health. Oct 9.2011

7. Prochaska JJ, Prochaska JO. A Review of Multiple Health Behavior Change Interventions for Primary Prevention. Am J Lifestyle Med. May-Jun;2011 5(3):208–221.
8. Chan JM, Rimm EB, Colditz GA, Stampfer MJ, Willett WC. Obesity, fat distribution, and weight gain as risk factors for clinical diabetes in men. Diabetes Care. Sep; 1994 17(9):961–969. [PubMed: 7988316]
9. Colditz GA, Willett WC, Rotnitzky A, Manson JE. Weight gain as a risk factor for clinical diabetes mellitus in women. Ann Intern Med. Apr 1; 1995 122(7):481–486. [PubMed: 7872581]
10. The Diabetes Prevention Program (DPP): description of lifestyle intervention. Diabetes Care. Dec; 2002 25(12):2165–2171. [PubMed: 12453955]
11. Gaitan-Sierra C, Hyland ME. Nonspecific mechanisms that enhance well-being in health-promoting behaviors. Health Psychol. Nov; 2011 30(6):793–796. [PubMed: 21942748]
12. Perna FM, Craft L, Carver CS, Antoni MH. Negative affect and barriers to exercise among early stage breast cancer patients. Health Psychol. Mar; 2008 27(2):275–279. [PubMed: 18377147]
13. Skaff MM, Mullan JT, Almeida DM, et al. Daily negative mood affects fasting glucose in type 2 diabetes. Health Psychol. May; 2009 28(3):265–272. [PubMed: 19450031]
14. Steptoe A, Dockray S, Wardle J. Positive affect and psychobiological processes relevant to health. J Pers. Dec; 2009 77(6):1747–1776. [PubMed: 19796062]
15. Al-Amer RM, Sobeh MM, Zayed AA, Al-Domi HA. Depression among adults with diabetes in Jordan: risk factors and relationship to blood sugar control. J Diabetes Complications. Jul-Aug; 2011 25(4):247–252. [PubMed: 21601482]
16. Franks MM, Hemphill RC, Seidel AJ, Stephens MA, Rook KS, Salem JK. Setbacks in diet adherence and emotional distress: A study of older patients with type 2 diabetes and their spouses. Aging Ment Health. Sep; 2012 16(7):902–910. [PubMed: 22533446]
17. Sepulveda A, Carrobles JA, Gandarillas AM. Associated factors of unhealthy eating patterns among Spanish university students by gender. Span J Psychol. May; 2010 13(1):364–375. [PubMed: 20480703]
18. Kiecolt-Glaser JK, McGuire L, Robles TF, Glaser R. Emotions, morbidity, and mortality: new perspectives from psychoneuroimmunology. Annu Rev Psychol. 2002; 53:83–107. [PubMed: 11752480]
19. Yeomans MR, Coughlan E. Mood-induced eating. Interactive effects of restraint and tendency to overeat. Appetite. Apr; 2009 52(2):290–298. [PubMed: 19022307]
20. Schwerdtfeger A, Eberhardt R, Chmitorz A, Schaller E. Momentary affect predicts bodily movement in daily life: an ambulatory monitoring study. J Sport Exerc Psychol. Oct; 2010 32(5): 674–693. [PubMed: 20980710]
21. Lasser K, Boyd JW, Woolhandler S, Himmelstein DU, McCormick D, Bor DH. Smoking and mental illness: A population-based prevalence study. JAMA. Nov 22-29; 2000 284(20):2606–2610. [PubMed: 11086367]
22. Yun WJ, Shin MH, Kweon SS, Ryu SY, Rhee JA. Association of smoking status, cumulative smoking, duration of smoking cessation, age of starting smoking, and depression in Korean adults. BMC Public Health. Aug 31.2012 12(1):724. [PubMed: 22938088]
23. Bailey RC, Baillie AJ. The relationship between placebo alcohol and affect: Motives for drinking. Drug Alcohol Rev. Sep 20.2012
24. Gonzalez JS, Safren SA, Delahanty LM, et al. Symptoms of depression prospectively predict poorer self-care in patients with Type 2 diabetes. Diabet Med. Sep; 2008 25(9):1102–1107. [PubMed: 19183315]
25. Katon WJ, Russo JE, Heckbert SR, et al. The relationship between changes in depression symptoms and changes in health risk behaviors in patients with diabetes. Int J Geriatr Psychiatry. May; 2010 25(5):466–475. [PubMed: 19711303]
26. Engum A. The role of depression and anxiety in onset of diabetes in a large population-based study. J Psychosom Res. Jan; 2007 62(1):31–38. [PubMed: 17188118]
27. Paddison CA, Eborall HC, French DP, et al. Predictors of anxiety and depression among people attending diabetes screening: a prospective cohort study embedded in the ADDITION (Cambridge) randomized control trial. Br J Health Psychol. Feb; 2011 16(Pt 1):213–226. [PubMed: 21226792]

28. Bouwman V, Adriaanse MC, van 't Riet E, Snoek FJ, Dekker JM, Nijpels G. Depression, anxiety and glucose metabolism in the general dutch population: the new Hoorn study. PLoS One. 2010; 5(4):e9971. [PubMed: 20376307]
29. Laugero KD, Falcon LM, Tucker KL. Relationship between perceived stress and dietary and activity patterns in older adults participating in the Boston Puerto Rican Health Study. Appetite. Feb; 2010 56(1):194–204. [PubMed: 21070827]
30. Daniels MC, Goldberg J, Jacobsen C, Welty TK. Is Psychological Distress a Risk Factor for the Incidence of Diabetes Among American Indians? The Strong Heart Study. J Appl Gerontol. Feb 1; 2006 25(1 suppl):60S–72S.
31. Kim MT, Han HR, Shin HS, Kim KB, Lee HB. Factors associated with depression experience of immigrant populations: a study of Korean immigrants. Arch Psychiatr Nurs. Oct; 2005 19(5):217–225. [PubMed: 16226673]
32. Park SY, Bernstein KS. Depression and Korean American immigrants. Arch Psychiatr Nurs. Feb; 2008 22(1):12–19. [PubMed: 18207052]
33. Shin HS, Han HR, Kim MT. Predictors of psychological well-being amongst Korean immigrants to the United States: a structured interview survey. Int J Nurs Stud. Mar; 2007 44(3):415–426. [PubMed: 16806219]
34. American Diabetes Association. Standards of medical care in diabetes--2012. Diabetes Care. Jan; 2012 35(Suppl 1):S11–63. [PubMed: 22187469]
35. World Health Organization. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. Jan 10; 2004 363(9403):157–163. [PubMed: 14726171]
36. Brislin RW. Back-translation for cross-cultural research. J Cross Cult Psychol. 1970; 1(3):185–216.
37. Clark JL, Clifford RT. The FSI/ILR/ACTFL Proficiency Scales and Testing Techniques: Development, Current Status, and Needed Research. Studies in Second Language Acquisition. 1988; 10(2):129–147.
38. Choi SE, Reed PL. Psychometric validation of a short acculturation scale for Korean immigrants. Nurs Res. Jul-Aug;2011 60(4):240–246. [PubMed: 21677595]
39. California Health Interview Survey. CHIS 2005 adult public use file, release 1 [computer file]: UCLA center for health policy research. 2009
40. Radloff LS. The CES-D Scale: A self-report depression scale for research in the general population. Appl Psychol Meas. 1977; 1(3):385–401.
41. Cho MJ, Kim KH. Use of the Center for Epidemiologic Studies Depression (CES-D) Scale in Korea. J Nerv Ment Dis. May; 1998 186(5):304–310. [PubMed: 9612448]
42. Cho MJ, Nam JJ, Suh GH. Prevalence of symptoms of depression in a nationwide sample of Korean adults. Psychiatry Res. Dec 14; 1998 81(3):341–352. [PubMed: 9925185]
43. Noh S, Kasper V, Chen X. Measuring depression in Korean Immigrants: Assessing validity of the translated Korean version of the CES-D scale. Cross-Cultural Research: The Journal of Comparative Social Science. Nov; 1998 32(4):358–377.
44. Breslau J, Chang DF. Psychiatric disorders among foreign-born and US-born Asian-Americans in a US national survey. Soc Psychiatry Psychiatr Epidemiol. Dec; 2006 41(12):943–950. [PubMed: 16988789]
45. Han H, Kim MT, Weinert C. The psychometric evaluation of Korean translation of the personal resource questionnaire 85-Part 2. Nurs Res. Sep-Oct;2002 51(5):309–316. [PubMed: 12352779]
46. Fisher L, Skaff MM, Mullan JT, Arean P, Glasgow R, Masharani U. A longitudinal study of affective and anxiety disorders, depressive affect and diabetes distress in adults with Type 2 diabetes. Diabet Med. Sep; 2008 25(9):1096–1101. [PubMed: 19183314]
47. Fisher L, Skaff MM, Mullan JT, et al. Clinical depression versus distress among patients with type 2 diabetes: not just a question of semantics. Diabetes Care. Mar; 2007 30(3):542–548. [PubMed: 17327318]
48. Hurh WM, Kim KC. Correlates of Korean immigrants' mental health. J Nerv Ment Dis. Nov; 1990 178(11):703–711. [PubMed: 2230758]

49. Kuo WH. Prevalence of depression among Asian-Americans. J Nerv Ment Dis. Aug; 1984 172(8): 449–457. [PubMed: 6747614]
50. Wismer, B. Center for Family and Community Health. Korean American Community Health Survey: Alameda and Santa Clara Counties. Berkeley, CA: University of California School of Public Health; 1999.
51. Barzi F, Patel A, Woodward M, et al. A comparison of lipid variables as predictors of cardiovascular disease in the Asia Pacific region. Ann Epidemiol. May; 2005 15(5):405–413. [PubMed: 15840555]
52. Shiwaku K, Anuurad E, Enkhmaa B, et al. Predictive values of anthropometric measurements for multiple metabolic disorders in Asian populations. Diabetes Res Clin Pract. Jul; 2005 69(1):52–62. [PubMed: 15955387]
53. United States Department of Health and Human Services. Dietary Guidelines for Americans, 2010. Washington, D. C.: 2010.
54. Hawkley LC, Thisted RA, Cacioppo JT. Loneliness predicts reduced physical activity: cross-sectional & longitudinal analyses. Health Psychol. May; 2009 28(3):354–363. [PubMed: 19450042]
55. Simon GE, Ludman EJ, Linde JA, et al. Association between obesity and depression in middle-aged women. Gen Hosp Psychiatry. Jan-Feb;2008 30(1):32–39. [PubMed: 18164938]
56. Obesity in Asia Collaboration. Is central obesity a better discriminator of the risk of hypertension than body mass index in ethnically diverse populations? J Hypertens. Feb; 2008 26(2):169–177. [PubMed: 18192826]

## Table 1

### Sample Characteristics

| Demographics | Men | Women | Total | N |
|---|---|---|---|---|
| Age, M(SD) | 48.60 (12.61) | 50.21 (12.25) | 49.41 (12.41) | 145 |
| Years in the US, M(SD) | 18.01 (10.22) | 19.84 (9.91) | 18.93 (10.07) | 146 |
| Education, N(%) * | | | | 146 |
| High School or below | 8 (11.1) | 17 (23.0) | 25 (17.1) | |
| 2-year College | 5 (6.9) | 12 (16.2) | 17 (11.6) | |
| 4-year College | 36 (50.0) | 34 (45.9) | 70 (47.3) | |
| Post-Graduate Degree | 23 (31.9) | 11 (14.9) | 24 (23.3) | |
| Married, N(%) | 62 (86.1) | 54 (74.0) | 116 (80.0) | 145 |
| Health Insurance, N(%) | 45 (63.4) | 39 (53.4) | 84 (58.3) | 144 |
| English Proficiency, M(SD) | 2.01 (0.97) | 1.74 (0.87) | 1.88 (0.93) | 145 |

Note: Ns vary slightly across variables due to missed items. English proficiency scores ranged from 0 (lowest) to 4 (highest).

* $p < .05$

## Table 2
## Diabetes Risk Factors and Negative Emotions/Psychological Variables

| **Biological Health Markers, N (%) at risk** | **Men** | **Women** | **Total** | **N** |
|---|---|---|---|---|
| BMI ≥ 23kg/m2 *a | 63 (86.3) | 47 (66.2) | 110 (76.4) | 144 |
| Waist/Hip Ratio *b<br>Men > 0.9<br>Women> 0.8 | 60 (83.3) | 67 (93.1) | 127 (88.2) | 144 |
| Systolic Blood Pressure *c > 120mmHg | 55 (75.3) | 37 (49.3) | 92 (62.2) | 148 |
| Diastolic Blood Pressure *c >80mmHg | 52 (71.2) | 41 (54.7) | 93 (62.8) | 148 |
| Blood Glucose c<br>Fasting ≥126mg/dl or Random ≥ 200mg/dl | 24 (32.8) | 17 (23.0) | 41 (27.9) | 147 |
| **Dietary Behaviors: Mean (SD) per day** | | | | |
| Fruit intake | 1.68 (1.67) | 1.95 (1.63) | 1.81 (1.65) | 147 |
| Vegetable intake | 1.68 (1.31) | 2.23 (2.91) | 1.96 (2.27) | 147 |
| Soda Intake * | 0.85 (1.02) | 0.29 (0.56) | 0.56 (0.87) | 147 |
| Carbohydrate Intake | 2.84 (2.15) | 3.21 (2.76) | 3.03 (2.47) | 147 |
| Protein Intake | 1.71 (1.36) | 1.35 (1.38) | 1.53 (1.37) | 147 |
| Snack Intake | 0.96 (1.04) | 0.86 (1.27) | 0.91 (1.16) | 147 |
| **Exercise Behaviors: N(%)** | | | | |
| Moderate Exercise at least 1 day, N(%) | 53 (72.6) | 56 (75.7) | 109 (74.1) | 147 |
| Vigorous Exercise at least one day, N(%) * | 44 (60.3) | 29 (40.8) | 73 (50.7) | 144 |
| **Negative Emotions: Mean (SD) past month** | | | | |
| Nervous | 1.01 (0.77) | 1.23 (1.02) | 1.12 (0.91) | 148 |
| Hopeless * | 0.49 (0.63) | 0.89 (0.92) | 0.70 (0.81) | 148 |
| Restless | 1.16 (0.85) | 1.25 (0.97) | 1.21 (0.91) | 148 |
| Anxious | 1.36 (0.86) | 1.57 (0.95) | 1.47 (0.91) | 148 |
| Stressed * | 1.59 (0.96) | 1.97 (0.92) | 1.78 (0.95) | 148 |
| Emotion Scale Score * | 1.18 (0.76) | 1.49 (0.97) | 1.34 (0.89) | 148 |
| CES-D Score * | 11.57 (6.14) | 14.49 (8.60) | 13.05 (7.61) | 146 |

Note: Ns vary slightly across variables due to incomplete assessments or missed items.

[a]World Health Organization recommendation for Asians, 2002[35]

[b]The Obesity in Asia Collaboration, 2008 [56]

[c]American Diabetes Association Clinical Practice Recommendations, 2012 [34].

*p< .05

**Table 3**

**Partial Correlations between Psychological Variables and Behavioral DM Risk Factors**

| | Nervous | Hopeless | Restless | Anxious | Stressed | Scale Score | CES-D Score |
|---|---|---|---|---|---|---|---|
| Fruit Intake | -.100 | -.075 | -.106 | -.184* | -.090 | -.110 | .017 |
| Vegetable Intake | .107 | .180* | -.040 | -.124 | -.129 | -.006 | -.158 |
| Carbohydrate Intake | .118 | .180* | .041 | -.002 | .033 | .086 | -.054 |
| Protein Intake | -.076 | .018 | -.029 | -.123 | -.002 | -.045 | -.021 |
| Snack Intake | .032 | .119 | -.055 | .027 | .101 | .038 | -.016 |
| Soda Intake | .167* | .222** | .132 | .139 | .206* | .207* | .149 |
| Moderate Exercise | -.062 | -.120 | -.143 | -.202* | -.195* | -.192* | -.202* |
| Vigorous Exercise | -.041 | -.070 | -.135 | -.117 | -.151 | -.137 | -.193* |

Note: Correlations controlled for gender.

* $p < .05$

** $p < .01$

**Table 4**

**Partial Correlations between Psychological Variables and Biological DM Risk Factors**

| | Nervous | Hopeless | Restless | Anxious | Stressed | Scale Score | CES-D Score |
|---|---|---|---|---|---|---|---|
| Waist Circumference | -.111 | .007 | -.095 | -.089 | .017 | -.063 | -.074 |
| Body Mass Index | -.052 | .101 | -.098 | -.074 | .026 | -.036 | -.087 |
| Waist-Hip Ratio | -.140 | -.074 | -.098 | -.151 | -.129 | -.123 | -.106 |
| Systolic BP | .010 | .055 | .065 | -.038 | .071 | .048 | .005 |
| Diastolic BP | -.029 | .089 | .023 | -.023 | .099 | .044 | -.045 |
| Glucose Level | .048 | -.087 | -.041 | .053 | .058 | -.009 | -.083 |

Note: Correlations controlled for gender.

$^{*}p < .05$

$^{**}p < .01$

BP =blood pressure