Original Research

Factors Associated with Diabetes Risk in South Texas College Students

JORDAN W. STACK†[1], SARA E. MAHONEY‡[2], and CHRISTOPHER M. HEARON‡[1]

[1]Department of Health & Kinesiology, Texas A&M University-Kingsville, Kingsville, TX, USA; [2]Department of Exercise Science, Bellarmine University, Louisville, KY, USA

†Denotes graduate student author, ‡Denotes professional author

ABSTRACT

International Journal of Exercise Science 7(2) : 110-118, 2014. South Texas has a high prevalence of diabetes and college students may be particularly at risk. While increased BMI, sedentary activity and depression have been associated with diabetes progression in the general population, it has not been established whether these factors contribute to increased diabetes risk in college students. The purpose of this study was to assess diabetes risk and determine whether depressive symptoms or physical activity patterns are associated with increased diabetes risk in college students. Sixty-nine college students were assessed for diabetes risk using the Finnish Diabetes Risk Score (FINDRISC) . Each participant completed the International Physical Activity Questionnaire (IPAQ) which included a sitting subscale, the Zung Self-Rated Depression Scale, and had anthropometric measures taken. Of the participants, 21.7% reported elevated risk (FINDRISC score 7-11), and 4.3% of participants had a moderate-to-high risk of developing diabetes (FINDRISC >12). On average, the sample was overweight (BMI = 26.81±0.75 $kg \cdot m^{-2}$), and BMI was associated with diabetes risk (r = 0.626, p < 0.001). While diabetes risk was not correlated with IPAQ total physical activity score (r = 0.019, p = 0.874), it was modestly correlated with time spent sitting (r = 0.295, p = 0.015). There was no association between self-reported depressive symptoms and diabetes risk (r =0.078, p = 0.525). Although diabetes risk was not associated with total activity and depressive symptoms, it was associated with time spent sitting and BMI. These results suggest that in this population, sitting less and reducing weight may help lower the risk of developing diabetes.

KEY WORDS: BMI, FINDRISC, IPAQ, depression, Hispanic, physical activity, sitting time

INTRODUCTION

Type-II diabetes, also known as non-insulin dependent diabetes mellitus (NIDDM), affects approximately 17 million Americans over the age of 20 years, and over 135 million adults worldwide with a projected number of 300 million affected by 2025 (3, 7, 12). In 2002, the American Diabetes Association (ADA) estimated that approximately $92 billion were the direct medical costs attributed to diabetes, with another $40 billion in indirect costs due to disability, work loss, and premature mortality (10). Close to one million deaths worldwide occurred in 2002 as a result of diabetes, and is the seventh leading cause of death among U.S. adults where a substantial increase in risk of cardiovascular morbidity and mortality is evident (6, 9, 20). NIDDM affects both small and large blood vessels resulting in micro vascular and macro vascular conditions such as atherosclerosis, ischemic heart disease, stroke, and peripheral vascular disease (1). Moreover, diabetes is a chronic disease which cannot be cured and where management plays an important role, which includes: patient education, diabetic support, well-planned exercise regimens, and both short-term and long-term glycemic control (13).

With the prevalence of diabetes on the rise, prevention and early detection are key to reducing the incidence of diabetes. The strongest known influencing factors for NIDDM are obesity and a non-modifiable family history of diabetes (7, 12). Assessing one's risk for diabetes is an important first step in preventative care, but further research is needed to fully understand the risk factors involved. There is evidence that risk factors such as sedentary lifestyle and depression are associated with diabetes, but this relationship has not been fully elucidated (3, 11, 16). Additionally, it is increasingly relevant to assess diabetes risk in younger populations. In 2009, 13.2% of youth in Texas aged 0-17 and 9.2% of young adults aged 18-29 were diagnosed as either type 1 or type 2 diabetic. In South Texas, with its large Hispanic population, the prevalence of adult diabetes is approximately 26.5% higher than the rest of Texas (17).

Another component of diabetes risk is physical activity. The International Physical Activity Questionnaire (IPAQ) was developed by an international group of experts that received support from the World Health Organization and the Center for Disease Control (2). Many different surveys and questionnaires can be used to measure self-reported physical activity, and the IPAQ is one that has seen frequent use over the last decade (2). As a result of physical inactivity, skeletal muscle mitochondria face reduction in size and limited activity of the electron transport chain with a concomitant decrease in oxidative phosphorylation activation by insulin and, as a result, are a major site of insulin resistance in diabetes (12, 18). The aforementioned consequences of diabetes may increase the difficulty of performing physical activity, cause a lack of motivation to partake in physical activity, and may ultimately deter consistent participation in physical activity in those individuals suffering from diabetes.

Depression has also been linked to a potential increase in risk for type-II diabetes due to unhealthy behaviors or characteristics that may include sedentary lifestyle, obesity, or smoking (8). The direct negative effects of depression on glucose metabolism consist of increased counter regulatory hormone release and action, changes in glucose transport function, and increased immuno-inflammatory activation; these factors lead to increased insulin resistance and reduced glucose uptake that play direct roles in increasing one's risk for developing diabetes (16). The Zung Self-Rating Depression Scale (ZDS) was designed to assess one's level of depression in patients suffering from depressive disorders and has a reported split-half reliability of 0.73 (21). Depressive symptoms associated with increased diabetes risk may lessen one's response to antidepressant treatment, including decreased glycemic control, poor metabolic control, and functional impairment (11).

Determining if a relationship exists between diabetes risk and depression or diabetes and sedentary lifestyle in college students will allow for better preventative care, especially in high risk regions such as South Texas. The Finnish Diabetes Risk Score (FINDRISC) is a standardized diabetes risk questionnaire that includes family history, diet, and physical activity (19). By utilizing the IPAQ and ZDS in conjunction with the FINDRISC we can better determine if whether a relationship exists between diabetes risk and depression or a sedentary lifestyle in college-aged individuals. Therefore, the purpose of this study was to assess diabetes risk and determine whether depressive symptoms or physical activity patterns are associated with increased diabetes risk in college students.

METHODS

Participants

All participants provided informed consent prior to participation. No participants withdrew during data collection resulting in the final sample size (n = 69). Sixty-nine college-age (23.58 ± 2.13) volunteers (n = 69, Hispanic/non-Hispanic = 42/27, male/female = 34/35) were recruited by means of convenience from the undergraduate student population at Texas A&M University-Kingsville. All participants were Health and Kinesiology majors and the study was approved by the Institutional Review Board (Human Subjects).

Protocol

Participation was restricted to individuals not having been previously diagnosed by a physician as either a type 1 or type 2 diabetic. Each participant was assigned an ID number for the purposes of anonymity. Due to the novel nature of each of the three questionnaires to each participant, a brief but in-depth tutorial was provided to each participant prior to the answering of any questions. They were instructed to answer truthfully and to the best of their ability, and that they could withdraw from participation at any time.

All data were collected at the Human Performance Laboratory at Texas A&M University-Kingsville. Participants were measured for body mass (kg) utilizing a standard physician's scale (Model: Health o Meter 400KL; Manuf: Jarden Corporation; City: Boca Raton, FL), body stature (m) utilizing a stadiometer (Model: Stadi O Meter 1; Manuf: Novel Products; City: Rockton, IL), and waist circumference (cm) using a Gulick II anthropometric tape measure. Participants were then asked to complete the following questionnaires:

IPAQ (Physical Activity) (2): The IPAQ comprises a set of four questionnaires and 27 total questions in the long version that also includes a sitting subscale (4). The purpose of the questionnaires is to provide common instruments that can be used to obtain standardized internationally comparable data on health–related physical activity for use with young and middle-aged adults spanning 15-69 years of age (4). The four categories comprising the questionnaires are: leisure time physical activity, domestic and gardening activity, work-related physical activity, and transport-related physical activity. Activity is estimated by summing the reported minutes (product of duration and number of days) for each of these activities; vigorous activity receives double weight over non-vigorous to reflect its greater intensity (METs). Activity level is expressed in weekly MET-min·wk^{-1}. The metabolic equivalent (MET) is a physiological measure representing the energy cost of physical activity that is expressed as a ratio of metabolic rate during specific physical activities into reference metabolic rates; a MET-minute represents the metabolic equivalent of energy expended while at rest for one minute (14).

ZDS (Depression) (5): The ZDS is a 20 question survey that rates the affective, psychological, and somatic symptoms associated with depression and assigns a score between 20 and 80 to estimate one's depression level. The ZDS consists of 10 positive and 10 negative questions with each question ranging in value from 1-4 for answers falling between "a little of the time" and "most of the time." There are four score ranges where scores falling between 20-49 is within a normal range and represents low risk for depression; scores from 50-69 represent mild depression, scores of 60-69 show moderate depression, and >70 shows severe depression. Most people suffering from depression score between 50 and 69 (19).

FINDRISC (Diabetes Risk): The FINDRISC is an eight question survey that estimates one's risk for developing type 2 diabetes within the next ten years using lifestyle, family history, and other health parameters. The FINDRISC provides a summed score between 0-26; the higher the score, the higher one's likelihood is to develop diabetes. However, it cannot tell with any specific certainty whether one definitely will or will not develop diabetes, but rather, is a non-laboratorial and non-invasive survey that can be quickly administered to persons of all ages.

Statistical Analysis

All data reduction and analyses were conducted using IBM SPSS Statistics (Version 19, Armonk, NY). Pearson product-moment correlation was used to determine the relationships between diabetes risk (FINDRISC score) and each of the following: body composition (BMI, kg·m^{-2}), weekly physical activity (IPAQ, MET-min·wk^{-1}), weekly time spent sitting (IPAQ, min·wk^{-1}), and depression rating (ZDS score). For each measure, statistical significance was determined using α=0.05. Data were reported as mean $\pm$ standard error.

RESULTS

The participants had an average FINDRISC score of 4.91 ± 0.43 where 21.7% (15 of 69) of students were found to have an elevated diabetes risk (FINDRISC score = 7-11) and 4.3% (3 of 69) of participants had a moderate-to- high risk of developing diabetes (FINDRISC > 12). The sample of students were overweight (BMI = 26.81 ± 0.75 kg·m^{-2}) and BMI was significantly associated with diabetes risk (Figure 1, r = 0.626, p < 0.001). The cut-off point used for determining overweight individuals was a BMI ≥ 25 kg·m^{-2} and is based on observational studies in both Europe and the USA; obesity is characterized as a BMI ≥ 30 kg·m^{-2} in the same studies (5). Table 1 shows the average value ± the standard error of all measures taken. Average total activity was equal to 10,331 ± 820 MET-

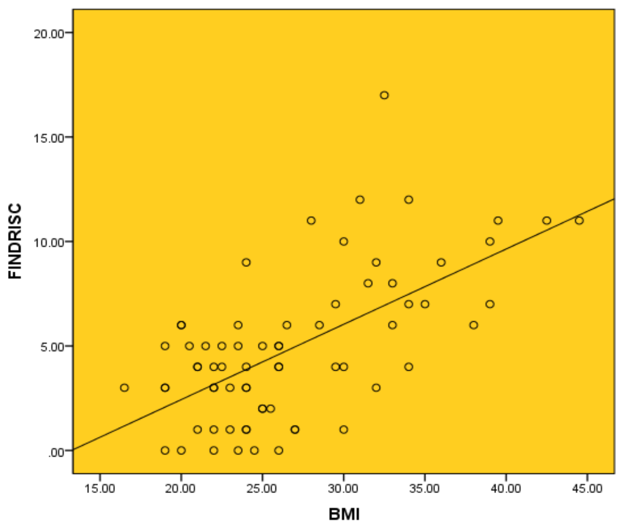

Figure 1. Relationship between Finnish Diabetes Risk Score (FINDRISC) and body mass index (BMI). Predictive equation: y = 1.0871x + 21.536.

Table 1. Assessment summary.

Assessment	**Mean ± SE**
BMI ($kg{\cdot}m^{-2}$)	26.81 ± 0.75
FINDRISC[a]	4.91 ± 0.43
Occupational Physical Activity ($MET\text{-}min{\cdot}wk^{-1}$)[b]	2555 ± 531
Transportation Physical Activity ($MET\text{-}min{\cdot}wk^{-1}$)[b]	1603 ± 230
Housework Physical Activity ($MET\text{-}min{\cdot}wk^{-1}$)[b]	1931 ± 387
Leisure Physical Activity ($MET\text{-}min{\cdot}wk^{-1}$)[b]	4221 ± 434
Total Physical Activity ($MET\text{-}min{\cdot}wk^{-1}$)[b]	10331 ± 820
Sitting Time ($min{\cdot}wk^{-1}$)[b]	317 ± 20
Depression Rating[c]	34.49 ± 0.76

[a] Finnish Diabetes Risk Score (19); [b]data from the International Physical Activity Questionnaire (2); [c]Zung Self-Rating Depression Score (21).

$min{\cdot}wk^{-1}$, and sitting time equal to 317 ± 20 $min{\cdot}wk^{-1}$. While diabetes risk was not significantly correlated with the IPAQ total physical activity scores (Figure 2, r = 0.019, p = 0.874), it had a modest correlation with time spent sitting (Figure 3, r = 0.295, p = 0.015). The average depression rating was 34.49 ± 0.76, indicating the students had low risk for depression while also having a low correlation with diabetes risk (Figure 4, r =0.078, p = 0.525). The relationship between sitting time and BMI was also examined but the results were found to be non-significant (r = .102, p = .200).

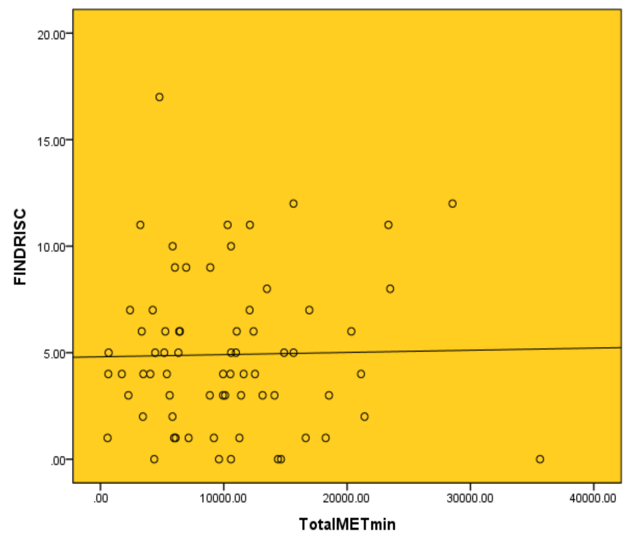

Figure 2. Relationship between FINDRISC and total weekly activity from the International Physical Activity Questionnaire (IPAQ). Predictive equation: y = 36.891x + 10,151.

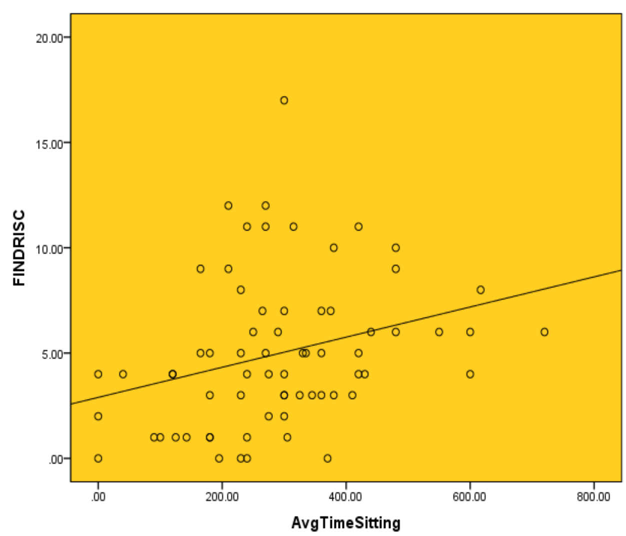

Figure 3. Relationship between FINDRISC and average weekly time spent sitting from the International Physical Activity Questionnaire (IPAQ). Predictive equation: y = 12.171x + 231.3.

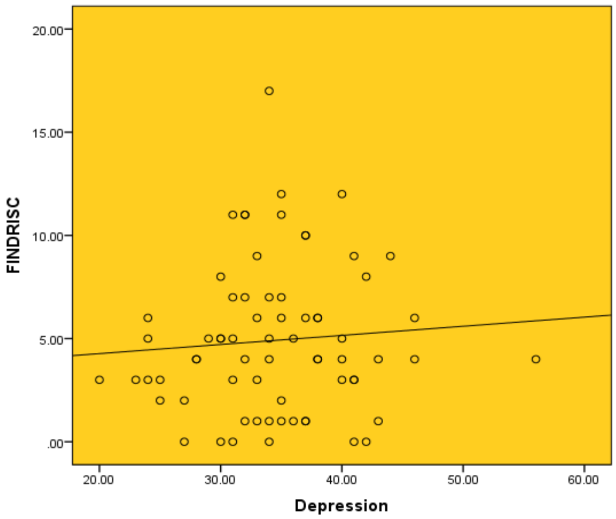

Figure 4. Relationship between FINDRISC and depression rating from the Zung Self-Rating Depression Scale (ZDS). Predictive equation: y = 0.137x + 33.82.

DISCUSSION

This study offers insight into the relationship between time spent sitting and diabetes risk in college students. While older adults are the usual population studied for NIDDM, the unique findings highlight the importance of early treatment and detection in younger adults. While this relationship is modest, it still provides relevant information for addressing diabetes risk. No relationship was found between total physical activity and diabetes risk. Average reported activity level in MET-min·wk^{-1} was very high (over 10,330), which is 6.89 times greater than the minimum activity level needed to be classified as highly active using IPAQ scoring (1,500 MET-min·wk^{-1}). Sixty-four participants were classified as being highly active, three as being moderately active, and two as having low activity levels. Given this, we anticipated a negligible appearance of diabetes risk, but according to individual FINDRISC scores 15 participants were at elevated risk for developing diabetes, three at moderate risk, and one at high risk. The average minutes of sitting per day was approximately 317 minutes, which is approximately 5.3 hours of sitting per day.

The findings of this study show a statistically significant relationship between time spent sitting and diabetes risk score from the FINDRISC. This is an important finding for college-aged individuals as it suggests that younger populations that engage in prolonged bouts of sitting may increase their risk for developing type 2 diabetes, independent of any other characteristic or risk factor. It also highlights the importance of avoiding a sedentary lifestyle, as those individuals who had a lower BMI and reduced sitting times had consistently lower diabetes risk scores. This finding is also in accordance with previous research where obesity and increases in body weight (BMI) are regarded as two of the most significant risk factors for type 2 diabetes (15). Increases in weight and BMI in early adulthood (25-40 yr) have been shown to yield higher relative risks and earlier onset of type 2 diabetes than is weight gain between 40 and 55 years of age, further strengthening the argument for early detection and prevention in college-aged individuals (15). BMI at ages 25, 35, and 45 are strongly associated with diabetes risk and weight gain over this time frame can strongly predict one's risk of type 2 diabetes within a latency period of 15-23 years (15). Individuals who are more physically active tend to have a lower BMI, as previous research has shown (7,10). Individuals should make conscious efforts to be more active and to reduce time spent sitting as both may play important roles in reducing

BMI and diabetes risk in younger age groups.

As there is not yet a standardized questionnaire for assessing time spent sitting, the creation of a more detailed questionnaire could provide additional validation of the aforementioned relationships. The IPAQ has only two questions pertaining to sitting time, and they are summed into total time spent sitting on week days and weekend days. It would be an important step in diabetes preventative care to design a questionnaire dealing solely with sitting time that includes many different facets of sitting. This could include the total time spent sitting on weekdays and weekend days as the IPAQ does, but also examines location (school, work, home, etc.), duration of sitting periods, and reasons for sitting (TV watching, class, work, etc.). Physical activity patterns and time spent sitting between different college majors, ethnic groups, and genders should also be explored in future research, while also examining larger sample sizes, different geographical areas, and longitudinal data to confirm these relationships.

A limitation of the present study lies in the nature of the participants. The homogeneity of the cohort created some unintentional bias as all of the participants were volunteer undergraduate health and kinesiology majors, which may have affected our data. As a result, the cohort used was not representative of the university population as a whole. The self-reported activity levels appeared to be uncharacteristically high amongst most of the participants. Also, questionnaires were the only instrument used to collect data in this study. In general, questionnaires are not regarded as the most accurate tools for assessing physical activity because of social desirability, recall bias, misinterpretation of the questions, and so forth. This may have led to the unexpected finding showing no significance between total physical activity and diabetes risk. The inaccuracy of BMI in active populations is another limitation of this study as no allowance is made in its calculation for the relative proportions of bone, muscle, and fat in the body. Therefore, a person with strong bones, good muscle tone and low fat may have a high BMI and may potentially be classified as overweight or even obese.

While increased BMI, sedentary activity and depression have been associated with diabetes progression in the general population, it has not been established whether these factors contribute to increased diabetes risk specifically in college students. The findings of this study suggest that reducing BMI and time spent sitting may reduce diabetes risk in South Texas college students and other Hispanic areas, where further research is necessary before the results can be extended as generalizable to the remainder of the young-adult population spanning the nation. There were no statistically significant differences found between gender or ethnicity, and the study did not yield the expected results between physical activity and diabetes risk, mainly attributed to a large overestimation of average physical activity. There was also no association found between self-reported depressive symptoms and diabetes risk. Ultimately, cost-effective strategies must be found for preventing and managing risk for diabetes around the world. It is recommended that such tactics should involve limiting the time one spends sitting, as the results herein suggest, as well as incorporating some form of physical activity into daily routines (7, 10).

REFERENCES

1. Boussageon R, Bejan-Angoulvant T, Saadatian-Elahi M, Lafont S, Bergeonneau C, Kassai B, Cornu C. Effect of intensive glucose lowering treatment on all-cause mortality, cardiovascular death, and microvascular events in type 2 diabetes: Meta-analysis of randomised controlled trials. Br Med J 343: 1-12, 2011.

2. Brown WJ, Trost SG, Bauman A, Mummery K, Owen N. Test-retest reliability of four physical activity measures used in population surveys. J Sci Med Sport 7(2): 205-215, 2004.

3. Cowie CC, Rust KF, Byrd-Holt D, Eberhardt MS, Saydah S, Geiss LS, Engelgau MM, Ford ES, Gregg EW. Prevalence of diabetes and impaired fasting glucose in adults—United States, 1999–2000. Morb Mortal Wkly Rep 52: 833-37, 2003.

4. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yngve A, Sallis JF, Oja P. International physical activity questionnaire: 12 country reliability and validity. Med Sci Sports Exerc 35(8): 1381-1395, 2003.

5. Deurenberg P. Universal cut-off BMI points for obesity are not appropriate. Br J Nutr 85: 135-36, 2001.

6. Grundy SM, Benjamin IJ, Burke GL, Chait A, Eckel RH, Howard BV, Mitch W, Smith SC, Sowers JR. Diabetes and cardiovascular disease: A statement for healthcare professionals from the American heart association. Circulation 100: 1134-46, 1999.

7. Helmrich SP, Ragland DR, Leung RW, Paffenbarger RS. Physical activity and reduced occurrence of non-insulin-dependent diabetes mellitus. N Engl J Med 325(3): 147-52, 1991.

8. Katon W, VonKorff M, Ciechanowski P. Behavioral and clinical factors associated with depression among individuals with diabetes. Diabetes Care 27: 914-920, 2004.

9. Kochanek KD, Murphy RN, Anderson C, Scott SL. Deaths: Final data for 2002. Hyattsville, MD: National Center for Health Statistics. Natl Vit Stat Rep 53(5): 2005.

10. LaMonte MJ, Blair SN, Church TS. Physical activity and diabetes prevention. J Appl Physiol 99: 1205-13, 2005.

11. Lustman PJ, Clouse RE. Depression in diabetic patients: the relationship between mood and glycemic control. J Diabetes Complications 19: 113-122, 2005.

12. Manson JE, Rimm EB, Stampfer MJ, Colditz GA, Willett WC, Krolewski AS, Rosner B, Hennekens CH, Speizer FE. Physical activity and incidence of non-insulin dependent diabetes mellitus in women. Lancet 338: 774-78, 1991.

13. Nathan DM, Cleary PA, Backlund JY, Genuth SM, Lachin JM, Orchard TJ, Zinman B. Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes. N Engl J Med 353(25): 2643-53, 2005.

14. Russell RP, Stevens J, Webber LS, Dowda M, Murray DM, Young DR, Going S. Age-related change in physical activity in adolescent girls. J Adolesc Health 44(3): 275-82, 2009.

15. Schienkiewich A, Schulze MB, Hoffmann K, Kroke A, Boeing H. Body mass index history and risk of type 2 diabetes: results from the european prospective investigation into cancer and nutrition (EPIC) - potsdam study1'2'3. Am J Clin Nutr 84(2): 427-33, 2006.

16. Talbot F, Nouwen A. A review of the relationship between depression and diabetes in adults. Diabetes Care 23: 1556-1562, 2000.

17. Texas diabetes prevention and control program: Diabetes status in Texas 2012 [Internet]. Austin, TX: Texas Department of State Health Services. Available from: http://www.dshs.state.tx.us/diabetes/tdcdata.shtm

18. Toledo FG, Menshikova EV, Ritov VB, Azuma K, Radikova Z, DeLany J, Kelley, D.E. Effects of physical activity and weight loss on skeletal muscle mitochondria and relationship with glucose control in type 2 diabetes. Diabetes 56: 2142-47, 2007.

19. Waddingham S. Making sense of the FINDRISC: The Finnish diabetes risk score and how to use it. Br J Prim Care Nurs 5(5): 243-245, 2008.

20. Yach D, Hawkes C, Gould CL, Hofman KJ. The global burden of chronic diseases: overcoming impediments to prevention and control. JAMA 291: 2616-22, 2004.

21. Zung WW. A self-rating depression scale. Arch Gen Psychiatry 12: 63-70, 1965.