Depression and Diabetes in Filipino Women

By
Tamar Chukrun

Senior Honors Thesis
BSPH Nutrition
University of North Carolina at Chapel Hill

April 2, 2017

Approved:

_____
(Name), Thesis Advisor

_____
(Name), Reader

Introduction

Type 2 Diabetes prevalence is increasing worldwide. According to the WHO 2016 Report on Diabetes, from 1980 to 2014 the total estimated number of people with diabetes increased from 108 to 422 million (1). The prevalence of diabetes nearly doubled during this time period- increasing from 4.7 to 8.5% of the world's population (1). Although previous research deemed diabetes a disease of developed nations, new studies demonstrate this is no longer the case. The WHO reported that diabetes prevalence has increased faster in lower and middle income countries, and that the Southeast Asia and Western Pacific regions are accountable for half of the diabetes cases in the world (1).

Diabetes is not only more prevalent in these regions- it is also increasing in its deadliness. The WHO estimates that from 1980 to 2014, the western Pacific experienced the largest rise in deaths attributable to high blood glucose (1). Apart from its impact on life expectancy, the complications associated with diabetes, such as kidney failure, blindness and heart disease serve to negatively impact the economic productivity of individuals, thereby affecting societies as a whole (2).

Understanding the causes and risks associated with type 2 diabetes onset is imperative in engineering better prevention and intervention methods that will decrease diabetes prevalence and mitigate its harmful complications. A variety of factors have been identified and are widely accepted as risk factors for type 2 diabetes, including obesity, physical inactivity and family history (2). The study of depression as a novel risk factor for type 2 diabetes has been a point of interest in a growing body of research, which has found that depressive symptoms are associated with an increased risk for type 2 diabetes (3).

Studying depression as a risk factor for type 2 diabetes is crucial because depression is becoming increasingly prevalent worldwide. According to the WHO Global Burden of Diseases 2004 Update, depression is the third leading cause of disability, with an estimated 98.7 million individuals affected worldwide (4). In 2004, depression was the leading cause of years lost to disability (YLDs) in both males and females, although for females the burden was 50% higher (4). Previous

assumptions that depression is limited to the developed world are incorrect. The WHO reports that unipolar depressive disorders account for 55.3 million YLDs in lower and middle-income countries, and only for 10.0 YLDs in high-income countries (4).

The body of evidence supporting an association between depression and type 2 diabetes onset is increasing. Research supports a bi-directional relationship between the two illnesses (3). A meta analysis of this relationship found that depression is associated with a 60% increased risk of developing type 2 diabetes; a modest increased risk was noted when type 2 diabetes was used as a predictor of depression onset (3). However, this meta-analysis was based on 13 studies that relied on self-reports, and not formalized diagnostic criteria. Other studies have used a retrospective cohort design to assess relative risk based on depression status. In a cohort of 4,803 Spanish older adults, it was found that clinically significant depression was associated with 65% increased risk of diabetes mellitus (5). This study used a standardized method to measure depression, the Geriatric Mental State Schedule, and AGECAT criteria (diagnostic for depression in older adults). However, the study population was limited to a high-income country (Spain). Other studies that have used standardized measures to quantify depressive symptoms have also found an increased risk of type 2 diabetes associated with depression; but their populations have also been limited to high-income countries (6–11).

As both depression and type 2 diabetes are becoming recognized problems beyond the developed world, it is imperative that more research be focused on the populations of low and middle-income countries. An understanding of depression and its comorbidities could have considerable implications for the health of such populations.

The Cebu Longitudinal Health and Nutrition Survey (CLHNS) provides a unique opportunity to test for an association between depressive symptoms and type 2 diabetes incidence in the less studied setting of a middle income country. The large sample size and robust longitudinal data allow for establishment of temporality and a sequential analysis of the two illnesses. The survey measured

depressive symptoms and type 2 diabetes using standardized measures in a large cohort of middle to older aged Filipino women, followed from 2005-2012. Since both depression and diabetes were measured using standardized measures (CES-D derived depression scale and blood glucose/HbA1c), the cohort allows for precision that has not been consistently possible in other previous studies. We conducted prospective analysis of depressive symptoms in 2005 as predictors of type 2 diabetes incidence in 2012. Because the survey included measurements of socioeconomic factors, weight, adiposity, education, we were able to explore these factors as possible confounders.

Methods

Study Population

The cohort was selected using a cluster sampling method; 33 communities or barangays (17 urban, 16 rural) from the Metropolitan Cebu area were randomly selected for the baseline survey in late 1982 and again in early 1983. All women who gave birth from May 1, 1983 to April 30, 1984 were included in the initial sample; 3,327 women were enrolled. The women were followed for two years postpartum and follow up surveys were conducted in 1991-92, 1994-95, 1998-99, 2002, 2005, 2007, and 2012. Biomarkers were added to the CLHNS in 2005. Informed consent was obtained from all CLHNS subjects, and the University of North Carolina Institutional Review Board for the Protection of Human Subjects approved the study protocol.

Exposure

Depression symptoms were measured using a survey based on the WHO recommended 20-item Center for Epidemiological Studies Depression Scale (CES-D)(12). The local research team discarded certain questions and added ones that were deemed more culturally appropriate (13). The survey consisted of 16 questions, each asking how often the respondent experienced a certain symptom (difficulty falling asleep, feeling lonely, etc.) during the past 4 weeks. Possible

responses were none of the time (1), occasionally (2), and most of the time (3). 12 items were dichotomized, with 0= none of the time and 1=occasionally or most of the time (figure 1). Then, an index score was created by summing the 12 variables. The index showed a high degree of reliability (Cronbach α=0.80) (14). The 12 item score was used for consistency with prior work in the Cebu study (14). We analyzed depression scores and depression change scores from 2005 to 2012, to see if a change in depression was also a significant predictor of incident type 2 diabetes. Change score was calculated as depression score in 2012 minus depression score in 2005. A negative score indicates a decrease in depressive symptoms from 2005 to 2012. All variables were standardized using Z scores for easier interpretation and were analyzed as continuous variables.

Figure 1: Items used in depression score

How frequently in the past 4 weeks did you experience these common feelings or problems?
You had headaches?
You had poor digestion?
You were worried?
You felt lonely?
You felt people disliked you?
You had difficulty falling asleep?
People were unfriendly?
You felt you couldn't overcome difficulties?
You thought of yourself as worthless?
You felt life isn't worth living?
You wished you were dead?
You had the idea of taking your own life?

Footnote: Response options were none of the time, occasionally, and most of the time.

Outcome

In 2005, Individuals were classified as having type 2 diabetes if they listed "type 2 diabetes" when asked "Did you have any of the following illnesses since 2002 (or last visit)?", or if they had a fasting blood glucose greater than or equal to 126 mg/dl. A fasting blood sample was obtained by the research team at the homes of participants. The fasting venous whole-blood sample was analyzed using a

glucometer (OneTouch, Johnson & Johnson Ltd.)(15). To approximate plasma glucose, a correction factor of 0.97 mmol/L (17.5 mg/dL) was subtracted from the venous blood glucose values (16).

In 2012, individuals were classified as having type 2 diabetes using the same survey question as in 2005, or if they had an HbA1c greater than or equal to 6.5% (NycoCard® READER II). In both 2005 and 2012, participants were asked to list all medications they were taking at the time. Responses were categorized into the MIMS classification index, and respondents reporting use of Insulin preparations (MIMS index 1101) or Antidiabetic agents (MIMS index 1102) were classified as having diabetes.

A three level diabetes incidence variable was generated and used as the main outcome variable. Participants were classified as either never having diabetes if they had no diabetes in 2005 or 2012 (0), having chronic diabetes if they were diabetic in both 2005 and 2012, and having incident diabetes if they were not diabetic in 2005, but were diabetic in 2012. Those who were classified diabetic in 2005 and non-diabetic in 2012 were excluded from the analysis.

Covariates

Waist circumference was measured three times using a plastic measuring tape to the nearest centimeter about two inches above the navel (17). The mean of the three measurements was used as a continuous variable. Height (cm) and weight (kg) were measured using a portable stadiometer and scale, respectively, using standard techniques (17). Education was measured as years of schooling, and was categorized as no completion of primary school (1), completion of primary but not high school (2), and high school graduate or more (3). Because of its non-linear association with the outcome variable, age was categorized into three groups based on trends (Table 1).

Urbanicity was measured as a continuous, community level variable. The scale used allows for a more nuanced analysis of the ways that living environment impacts health. The variable was constructed using 7 components: population size; population density; communications (availability of mail, telephone, internet, cable

TV, and newspaper services); transportation (paved road density and public transportation services); markets (presence of gas stations, drug stores, grocery stores, and the number of small commercial kiosks); educational facilities; and health services. Each component response ranged from 1-10, giving a total variable range of 0-70. The urbanicity variable measures a latent quality imperfectly captured by each of these components independently, and is an estimation of economic development. Higher urbanicity scores are associated with more urban barangays, while lower scores are associated with more rural barangays. (18).

A continuous household assets variable was used to approximate respondents' socioeconomic statuses. The assets score was created using principle factor analysis, including a comprehensive list of household possessions.

Statistical Analysis

By 2005, 1,309 respondents were lost to follow up giving a sample size of 2,018. By 2012, the cohort size was 1,815. For this study, we limited our analysis to women with complete depressive symptoms and biomarker data from 2005 and 2012. In 2005, 1 respondent did not complete the depression questions, 131 respondents did not give blood samples for fasting glucose, and 205 did not answer the diabetes self report section of the questionnaire. This resulted in a 2005 sample of 1,887. In 2012, 43 respondents refused the HbA1c test, 1 had too low hemoglobin, and for 17 the test was not administered- as a result, the final 2012 sample size was 1,811. The final sample size for our analysis was 1,651.

(Table 1). Participants lost to follow up were more likely to have higher income, more education, and live in more urban settings, and assumed to have a high degree of (economic) mobility. Participants who were lost to follow up due to death were more likely to be of lower income. Other work using the CLHNS has not found evidence of significant attrition bias (19).

Table 1: Comparison of Study Sample and Baseline Sample Characteristics

Variable	Baseline Sample	Study Sample	Pr(|T|>|t|)
Assets score	2.609*	2.380*	0.0006
Value of Household	11808.61	10393.85	0.3696

Assets			
Total Household income	306.234*	260.021*	0.0115
Highest grade of schooling completed	7.469*	6.777*	0.0000
Urbanicity score	32.553*	28.871*	0.0000
Age (years)	25.951	26.121	0.4140

Footnote: Two-sample t test for means was used to analyze differences, and the 2-tailed p-value is displayed. Starred values are significantly different with 95% confidence.

Models were estimated, using multinomial logistic regression in Stata 14(20). In the first model, the non-diabetic group (group 0) was the referent, and the likelihood of being in the chronic or incident diabetes groups vs the healthy was estimated, controlling for age, urbanicity, assets, and education. Waist circumference and BMI were also controlled for in alternate analyses in order to account for their different associations with type 2 diabetes risks. The second model estimates the likelihood of incident vs chronic diabetes, using the latter as the referent group. This second analysis was done in order to compare the risk differences of prevalent and incident diabetes.

Results

Participant Characteristics

Characteristics of participants in 2005 are summarized by outcome group in Table 2. The mean depression score of the sample in 2005 was 17.20 ± 3.32, and remained approximately the same in 2012, as indicated by the mean change score close to zero (-0.20 ± 3.84). Type 2 diabetes prevalence increased from 9.38% in 2005 to 16.99% in 2012.

Table 2: General Characteristics in 2005 by 2012 diabetes status (n=1,655)

2005	Nondiabetic	Prevalent Diabetic	Incident Diabetic	Total
Number of women	1,392 (84.11%)	112 (7.37%)	151 (9.12%)	1,655
Depression Score (mean ± sd)	17.23 ± 3.35	17.37 ± 3.24	16.94 ± 3.21	17.20 ± 3.32
Change in Depression				

Score (mean)	-0.25 ± 3.83	0.43 ± 4.10	0.38 ± 3.85	-0.20 ± 3.84
Age				
mean	48.16 ± 6.01	49.11 ± 5.83	48.54 ± 5.49	48.27 ± 5.95
ranges:				
35-40	67 (85.90%)	6 (7.69%)	5 (6.41%)	78
40-50	851 (85.19%)	56 (5.61%)	92 (9.21%)	999
50+	474 (82.01%)	50 (8.65%)	54 (9.34%)	578
Education				
Mean years	6.92 ± 3.51	8.60 ± 3.99	8.60 ± 4.26	7.17 ± 3.66
Did not complete primary	491 (88.79%)	27 (4.88%)	35 (6.33%)	553
Completed primary, but not high school	639 (85.54%)	46 (6.61%)	62 (8.30%)	747
High school graduate or more	262 (73.80%)	39 (10.99%)	54 (15.21%)	355
Assets Score	6.47 ± 5.63	9.12 ± 7.02	9.34 ± 7.27	6.91 ± 5.97
Urban index	39.66 ± 14.01	44.79 ± 10.90	44.19 ± 11.81	40.20 ± 13.69
Body Mass Index (mean ± sd	23.96 ± 4.18	26.35 ± 4.23	26.11 ± 4.69	24.33 ± 4.30
Waist Circumference (mean ± sd)	79.87 ± 10.29	88.62 ± 9.82	85.49 ± 11.43	81.01 ± 10.69

Depressive Symptoms and Diabetes Incidence

Depressive symptoms were positively associated with increased risk of type 2 diabetes prevalence (Table 3). When compared with the nondiabetic group, for every standard deviation away from the mean depressive score, the likelihood of diabetes prevalence increased by 35.7% (p=0.010) with waist circumference, and by 41.9% (p=0.003) with BMI. For every positive change in depression score from 2005 to 2012, there was a 42.5 (p=0.003) increased likelihood of diabetes prevalence with waist circumference, and a 41.6% (p=0.003) increased likelihood of diabetes prevalence with BMI. No significant association was found between depressive symptoms or change in depressive symptoms and diabetes incidence in either model.

Table 3 Panel a: Relative Risk Ratio (Prevalent versus nondiabetic, n=1,651)

	Model 1 (Waist Circumference)			Model 2 (BMI)		
	RRR	***95%***	***P-***	***RRR***	***Interval***	***P-Value***

		Confidence Interval	*Value*			
Standardized Depression Score	**1.357**	**(1.075, 1.713)**	**0.010**	**1.419**	**(1.127, 1.786)**	**0.003**
Standardized Change Score	**1.425**	**(1.132, 1.794)**	**0.003**	**1.416**	**(1.128, 1.778)**	**0.003**
Age						
2	0.604	(0.243, 1.500)	0.278	0.625	(0.253, 1.543)	0.308
3	1.017	(0.405, 2.553)	0.971	1.220	(0.480, 2.989)	0.671
Education						
2	1.177	(0.695, 1.994)	0.544	1.184	(0.702, 1.996)	0.758
3	1.778	(0.960, 3.259)	0.063	1.817	(0.995, 3.317)	0.052
Urbanicity	1.019	(1.000, 1.037)	0.045	1.021	(1.003, 1.040)	0.021
Assets						
F1	1.034	(0.100, 1.069)	0.134	1.038	(1.004, 1.073)	0.029
Waist/BMI	1.070	(1.050, 1.091)	0.000	1.122	(1.072, 1.175)	0.000

Table 3 Panel b: Relative Risk Ratio (Incident versus nondiabetic, n=1,651)

	Model 1 (Waist Circumference)			Model 2 (BMI)		
	RRR	***95% Confidence Interval***	***P-Value***	***RRR***	***Interval***	***P-Value***
Standardized Depression Score	**0.969**	**(0.781, 1.203)**	**0.778**	**0.996**	**(0.801, 1.237)**	**0.968**
Standardized Change Score	**0.952**	**(0.765, 1.186)**	**0.663**	**0.943**	**(0.757, 1.174)**	**0.599**
Age						
2	1.273	(0.490, 3.305)	0.620	1.303	(0.502, 3.380)	0.587
3	1.355	(0.511, 3.588)	0.542	1.524	(0.575, 4.038)	0.397
Education						
2	1.183	(0.753, 1.860)	0.759	1.187	(0.756, 1.865)	0.457
3	1.912	(1.133, 3.225)	0.015	1.946	(1.154, 3.282)	0.013
Urbanicity	0.995	(0.981, 1.008)	0.440	0.995	(0.982, 1.009)	0.521
Assets						
F1	1.040	(0.010, 1.070)	0.008	1.039	(1.009, 1.069)	0.010
Waist/BMI	1.046	(1.029, 1.064)	0.000	1.107	(1.0632, 1.153)	0.000

We also analyzed the likelihood of incident type 2 diabetes in comparison to prevalent diabetes (Table 4). In both models, every sd in depression score was associated with a significant likelihood of type 2 diabetes prevalence. With waist circumference, the likelihood was estimated to be 40.0% (p=0.027), while with BMI

that likelihood was 42.5% (p=0.020). An increase in sd change in depression score was also associated with a likelihood of diabetes prevalence (Table 4). This suggests depressive symptoms are more predictive of diabetes prevalence, and do not predict type 2 diabetes incidence in this cohort.

Table 4: Relative Risk Ratio (prevalent versus incident diabetic, n=1,651)

	Model 1 (Waist Circumference)			Model 2 (BMI)		
	RRR	***Interval***	***P-Value***	***RRR***	***Interval***	***P-Value***
Depression Z-Score	**1.400**	**(1.040, 1.884)**	**0.027**	**1.425**	**(1.058 1.918)**	**0.020**
Change Z-Score	**1.496**	**(1.111, 2.014)**	**0.008**	**1.502**	**(1.116, 2.022)**	**0.007**
Age						
2	0.475	(0.137, 1.647)	0.240	0.480	(0.139, 1.662)	0.247
3	0.751	(0.213, 2.652)	0.656	0.786	(0.223 2.775)	0.708
Education						
2	0.995	(0.513, 1.930)	0.988	0.997	(0.515, 1.932)	0.776
3	0.930	(0.439, 1.970)	0.850	0.934	(0.441, 1.978)	0.858
Urbanicity	1.024	(1.002, 1.047)	0.030	1.026	(1.004, 1.049)	0.994
Assets						
F1	0.994	(0.955, 1.035)	0.777	0.999	(0.959, 1.040)	0.953
Waist/BMI	1.024	(1.000, 1.047)	0.050	1.014	(0.958, 1.073)	0.634

Discussion

That high depressive symptoms were associated with increased likelihood of type 2 diabetes prevalence, but not incidence, is inconsistent with previous studies of high-income country populations (3, 6–11). The findings are not consistent with cohort studies, which have found depression to be positively associated with increased risk of incident type 2 diabetes (6–11). Since a significant association was found between depressive symptoms and type 2 diabetes prevalence, our data suggests reverse causality- that type 2 diabetes might be a risk factor for depressive symptoms in middle-income countries. This would be somewhat consistent with the bi-directional model supported in a recent meta-analysis, which looked at 7 studies that investigated the relationship from this direction. However, this meta-analysis found only modest evidence for an association, while our study suggests the association to be more considerable in the Filipino population (3). The findings are

also consistent with a more recent cohort study, which found that while the relationship between depression and type 2 diabetes is bi-directional, the positive association between treated type 2 diabetes and depressive symptoms is stronger than that of baseline depressive symptoms and incident type 2 diabetes (21).

That type 2 diabetes is more predictive of depressive symptoms in the Philippines than it has been in studies of high-income countries could speak to the negative implications and fear of the disease in the developing setting. Such fears are warranted- diabetes is associated with more severe complications and higher mortality in the developing setting, where it is less often diagnosed, and less effectively managed (22–24). Serious complications may spur from the lack of knowledge about the disease and the importance of treatment (25). But this lack of knowledge may also lead to depressive symptoms, if those who are diagnosed do not know about treatment options or perceive treatment options to be too difficult given available resources. More research is needed to discern the perception and knowledge of diabetes in the Philippines. In settings like the Philippines, where diabetes health outcomes are poorer, the illness experience may play a larger part in the development of depressive symptoms. This would explain why depression is a more significant predictor of type 2 diabetes in high-income countries, but not in the Philippines.

One of the drawbacks of this study is that it took place in the midst of the survey's transition from fasting blood glucose to HbA1c as methods of diagnosing type 2 diabetes. As a result, two different methods of diagnosis were used in 2005 and 2012. Using two different metrics to diagnose diabetes in each respective year introduces risk of some misclassification. However, literature supports the assumption that HbA1c and fasting glucose are both accurate means of diagnosis. A cohort study assessing cardio-metabolic risk in China, which used multiple measurements including both HbA1c and fasting blood glucose to diagnose diabetes, found no significant difference in prevalence based on either method (26). This suggests that misclassification was likely too minor to affect the results from our model.

The use of a depression measurement instrument altered from the standard CES-D can also be seen as a weakness of this study. However, the research team stresses that the changes made were necessary in order to obtain a more accurate measurement tool, appropriate for Filipino culture. Furthermore, previous studies have run promax rotated exploratory factor analyses (EFA) and principal component analyses (PCA) of the 2005 depressive symptoms scale and found that the factors emerged were comparable to those found by Radloff's original 4-factor solution for the CES-D (13). These findings suggest that the CLHNS measure can be interpreted similarly to the CES-D in western populations (13). Another possible source of error was that the depression scale was administered via in person interviews. This may have caused a response bias because of stigma around mental health, and as a result led to underreporting of depressive symptoms.

This study is one of the first to look at the relationship between depression and type 2 diabetes incidence in a middle-income country- making the findings essential to establishing a more comprehensive picture of this relationship, inclusive of people from all backgrounds and settings. Aside from its unique population, the study provides many advantages. The availability of robust data from two different years allowed for the establishment of temporality which previous cross-sectional studies were unable to achieve. Furthermore, information on other risk factors and a large sample size allowed for a more complete analysis of this association within the web of other known risk factors for type 2 diabetes. Diagnosis of type 2 diabetes based on HbA1c and fasting blood glucose, and not simply self-report, further increased the accuracy of our results.

Depression and diabetes are serious problems in both middle and low-income countries. Our results demonstrate an association between these two illnesses- suggesting that more public health efforts should treat them in a coordinated fashion. Recognizing type 2 diabetes as a risk factor for depression also has important implications for early diagnosis and prevention of mental illness.

Mental health resources are sparse in the Philippines, posing a barrier to effective treatment and screening. According the WHO 2005 Mental Health Atlas, the Philippines allocate only 0.02% of the total health budget to mental health.

Furthermore, there are 0.9 psychologists per 100,000 people, and 0.4 psychiatrists per 100,000 people (27). Our study findings suggest that depression may be a sign of chronic metabolic disease, and that with increasing diabetes prevalence, perhaps an increase in mental health treatment resources may be necessary.

Furthermore, depression-diabetes comorbidity has been associated with increased risk of other diabetes related complications, increased rates of non-compliance, increased all-cause mortality and increased healthcare expenditures (28–30). Treating these two illnesses in a coordinated fashion could prove effective in improving the health of such patients. Such considerations are especially relevant in the context of middle-income countries like the Philippines, where funds and resources are already sparse. Coordinated care efforts have the potential to reduce healthcare costs in these settings.

In conclusion, this cohort study suggests that depression is not a significant risk factor for type 2 diabetes in the Philippines, and that type 2 diabetes is more likely to be causing depressive symptoms. More research is needed on the pathophysiological mechanisms that could explain why this association is different in middle-income settings. Furthermore, studies that incorporate coordinated care treatments of depression and diabetes have yet to be done. This study was the first to look at depression and type 2 diabetes in the context of a middle-income country: more studies should continue to investigate this association in diverse settings to establish universality. Understanding the relationship between depression and type 2 diabetes could have considerable implications for the prevention of both of these debilitating illnesses in countries where need is high and resources are low.

Works Cited

1. Global Report on Diabetes. 2016.
2. Dagogo-jack S, editor. Diabetes Mellitus in Developing Countries and Underserved Communities. Springer International Publishing; 2017.
3. Mezuk B, Eaton WW, Albrecht S, Golden SH. Depression and Type 2 Diabetes Over the Lifespan. Diabetes Care. 2008;31(12):2383–90.
4. The global burden of disease 2004. 2004.
5. Campayo A, De Jonge P, Roy JF, Saz P, De la Cámara C, Quintanilla MA, et al. The Effect of Characteristics of Depression. Am J Phsychiatry. 2010;167(5):580–8.
6. Carnethon MR, Kinder LS, Fair JM, Stafford RS, Fortmann SP. Symptoms of Depression as a Risk Factor for Incident Diabetes: Findings from the National Health and Nutrition Examination Epidemiologic Follow-up Study, 1971–1992. Am J Epidemiol [Internet]. Oxford University Press; 2003 [cited 2017 Mar 27];158(5):416–23. Available from: https://academic.oup.com/aje/article/158/5/416/67773/Symptoms-of-Depression-as-a-Risk-Factor-for
7. Everson-Rose SA, Meyer PM, Powell LH, Pandey D, Torréns JI, Kravitz HM, et al. Depressive Symptoms, Insulin Resistance, and Risk of Diabetes in Women at Midlife. Diabetes Care [Internet]. 2004 [cited 2017 Mar 27];27(12):2856–62. Available from: http://care.diabetesjournals.org/content/diacare/27/12/2856.full.pdf
8. Kawakami N, Takatsuka N, Shimizu H, Ishibashi H. Depressive symptoms and occurrence of type 2 diabetes among Japanese men. Diabetes Care [Internet]. American Diabetes Association; 1999 Jul [cited 2017 Mar 27];22(7):1071–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10388970
9. Golden SH, Williams JE, Ford DE, Yeh H-C, Paton Sanford C, Nieto FJ, et al. Depressive symptoms and the risk of type 2 diabetes: the Atherosclerosis Risk in Communities study. Diabetes Care [Internet]. 2004;27(2):429–35. Available from: http://www.ncbi.nlm.nih.gov/pubmed/14747224
10. Eaton WW, Armenian H, Gallo J, Pratt L, Ford DE. Depression and risk for onset of type II diabetes. A prospective population-based study. Diabetes Care [Internet]. American Diabetes Association; 1996 Oct [cited 2017 Mar 27];19(10):1097–102. Available from: http://www.ncbi.nlm.nih.gov/pubmed/8886555
11. Engum A. The role of depression and anxiety in onset of diabetes in a large population-based study. J Psychosom Res [Internet]. 2007 Jan [cited 2017 Mar 27];62(1):31–8. Available from: http://linkinghub.elsevier.com/retrieve/pii/S002239990600331X
12. Radloff LS. The CES-D Scale: A Self-Report Depression Scale for Research in the General Population. Appl Psychol Meas [Internet]. Sage PublicationsSage CA: Thousand Oaks, CA; 1977 Jun 1 [cited 2017 Apr 18];1(3):385–401. Available from: http://apm.sagepub.com/cgi/doi/10.1177/014662167700100306
13. Hock RS, Mendelson T, Surkan PJ, Bass JK, Bradshaw C, Hindin MJ. Parenting

styles and emerging adult depressive symptoms in Cebu, the Philippines. Transcult Psychiatry. 2017 in press.
14. Hindin MJ, Gultiano S. Associations Between Witnessing Parental Domestic Violence and Experiencing Depressive Symptoms in Filipino Adolescents. 2006;96(4):660–3.
15. Norris SA, Osmond C, Gigante D, Kuzawa CW, Ramakrishnan L, Lee NR, et al. Size at birth, weight gain in infancy and childhood, and adult diabetes risk in five low- or middle-income country birth cohorts. Diabetes Care. 2012;35(1):72–9.
16. Kumar G, Sng BL, Kumar S. Correlation of Capillary and Venous Blood Glucometry with Laboratory Determination. Prehospital Emerg Care. 2004;8(4):378–83.
17. Carba DB, Bas IN, Gultiano SA, Lee NR, Adair LS. Waist circumference and the risk of hypertension and prediabetes among Filipino women. Eur J Nutr. 2013;52(2):825–32.
18. Dahly DL, Adair LS. Quantifying the urban environment: A scale measure of urbanicity outperforms the urban-rural dichotomy. Soc Sci Med. 2007;64(7):1407–19.
19. Adair L, Perez T, Borja J. The life history of a cohort study. Attrition in the cebu longitudinal health and nutrition survey. Submitt Rev.
20. StataCorp. 2015. Stata Statistical Software: Release 14. College Station, TX: StataCorp LP.
21. Golden SH, Lazo M, Carnethon M, Bertoni AG, Schreiner PJ, Diez Roux A V, et al. Examining a Bidirectional Association Between Depressive Symptoms and Diabetes. JAMA [Internet]. 2008 Jun 18 [cited 2017 Apr 1];299(23):2751. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18560002
22. Hamid Zargar A, Iqbal Wani A, Rashid Masoodi S, Ahmad Laway B, Iftikhar Bashir M. Mortality in diabetes mellitus—data from a developing region of the world. Diabetes Res Clin Pract [Internet]. 1999 Jan [cited 2017 Apr 2];43(1):67–74. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0168822798001120
23. Hossain P, Kawar B, El Nahas M. Obesity and Diabetes in the Developing World — A Growing Challenge. N Engl J Med [Internet]. Massachusetts Medical Society ; 2007 Jan 18 [cited 2017 Apr 2];356(3):213–5. Available from: http://www.nejm.org/doi/abs/10.1056/NEJMp068177
24. Ruta LM, Magliano DJ, LeMesurier R, Taylor HR, Zimmet PZ, Shaw JE. Prevalence of diabetic retinopathy in Type 2 diabetes in developing and developed countries. Diabet Med [Internet]. 2013 Apr [cited 2017 Apr 2];30(4):387–98. Available from: http://doi.wiley.com/10.1111/dme.12119
25. Ardeña GJRA, Paz-Pacheco E, Jimeno CA, Lantion-Ang FL, Paterno E, Juban N. Knowledge, attitudes and practices of persons with type 2 diabetes in a rural community: Phase I of the community-based Diabetes Self-Management Education (DSME) Program in San Juan, Batangas, Philippines. Diabetes Res Clin Pract [Internet]. 2010 Nov [cited 2017 Apr 2];90(2):160–6. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0168822710003931
26. Yan S, Li J, Li S, Zhang B, Du S, Gordon-Larsen P, et al. The expanding burden of

cardiometabolic risk in China : the China Health and Nutrition Survey. Obes Rev. 2012;13(9):810–21.
27. Mental Health Atlas 2005 [Internet]. World Health Organization; 2005 [cited 2017 Mar 27]. 373-376 p. Available from: https://books.google.com/books?hl=en&lr=&id=2SXuXnlz3PgC&oi=fnd&pg=PA6&dq=WHO+2005+Mental+Health+Atlas&ots=KGPkdEJfno&sig=dEbNUHN4FsMEjxqBpZbil8lX24g#v=onepage&q=WHO 2005 Mental Health Atlas&f=false
28. Egede LE, Zheng D, Simpson K. Comorbid depression is associated with increased health care use and expenditures in individuals with diabetes. Diabetes Care. 2002;25(3):464–70.
29. Ciechanowski PS, Katon WJ, Russo JE. Depression and Diabetes. Arch Intern Med [Internet]. 2000 Nov 27 [cited 2017 Mar 27];160(21):3278–85. Available from: http://archinte.jamanetwork.com/article.aspx?doi=10.1001/archinte.160.21.3278
30. de Groot M, Anderson R, Freedland KE, Clouse RE, Lustman PJ. Association of depression and diabetes complications: a meta-analysis. Psychosom Med [Internet]. 2001;63(4):619–30. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11485116