

Factors Affecting Clinical Depression in Diabetic Geriatric Population

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Abstract

Introduction: Diabetes mellitus is a common metabolic disorder affecting about 10% - 25% of the elderly population. The mechanisms, linking diabetes and major depressive disorders are unknown. Obesity is the risk factor for both diabetes mellitus and depression. The goal of this study was to explore if BMI of elderly diabetic patients with depression differed from BMI of the diabetic individuals without depression. Further, we aimed to explore the association of age, gender, health insurance status, ethnicity influence and systolic blood pressure (SBP) and diastolic blood pressure (DBP) with clinical depression in geriatric diabetics. **Methods:** Nursing home residents were recruited from an outpatient internal medicine clinic in a teaching university setting. After given written consent, patients received Public Health Questionnaire-9 (PHQ-9) in either English or Spanish language. **Results:** While the clinically depressed diabetic participants did not differ from that of the non-depressed diabetic participants with respect to age (70.6 ± 6.1 vs. 72.1 ± 4.8 ; $p = 0.111$), gender (47.2% of males vs. 57.1% of females; $p = 0.754$), or ethnicity (69% explain vs. 71%, $p = 1.000$), race did appear to differ in depression status: Caucasian, African-American, and others were respectively 37%, 48%, and 15% vs. 32%, 16%, 52%, $p = 0.0003$). Neither the BMI ($p > 0.499$) nor Hemoglobin A1c ($p > 0.839$) differed between the clinically depressed and non-depressed participants when controlled for these race differences. **Conclusion:** In our sample, diabetic African Americans are three times more likely to be depressed. Diabetic Caucasians also experience higher rates of clinical depression. However, diabetics with depression did not differ from diabetics without depression with regard to their age, gender, BMI, HbA1C, health insurance status, systolic blood pressure or diastolic blood pressure.

Keywords

Geriatric Depression, Diabetes Mellitus, Ethnicity, BMI

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1. Introduction

Diabetes mellitus—a common metabolic disorder affecting about 10% - 25% of the elderly population [1] is frequently associated with psychiatric disturbances [2]. Patients with diabetes mellitus are 2 - 4 times more likely to be diagnosed with major depressive disorder [3]. In elderly diabetic patients the risk of depressive mood symptoms is increased by 30 % (HR 1.31 (95% CI: 1.07 - 1.61)) [4]. The adjusted odds ratio (OR) for functional disability is 7.9 per subject with diabetes and depression, whereas OR is 2.4 for subjects with diabetes alone and three for subjects who have major depression alone [5]. The mechanisms, linking diabetes and major depressive disorders are unknown. Obesity is the risk factor for both diabetes mellitus and depression. However, data-exploring association of body mass index (BMI) in diabetic patients, suffering from depression, is sparse.

Background: people with diabetes have an increased risk of developing depressive symptoms and people with depression also have an increased risk of developing diabetes [6]. It is estimated that about one third of diabetics suffer from clinical depression [3] [6]. The prognosis of both diabetes and depression in terms of severity of disease, complications, treatment resistance and mortality is worse for either diseases when they are comorbid than when they occur separately [6] [7]. Besides clinical depression, diabetes mellitus has also been an established risk factor for cardiovascular diseases [8], metabolic syndrome, stroke, retinopathy and obesity [9] [10].

However, the epidemiological data-linking diabetes with such risk factors, including obesity, smoking, and perceived burden of diabetes treatment, particularly in the genetic population, remains sparse.

A number of studies have reported prevalence rates of depression markedly and inconsistently high in people with type II diabetes compared to those without type II diabetes [11] [12]. Such rates have varied between 17.8% and 39%. However, certain European and Canadian studies have reported lower prevalence rates of depression in people with type II diabetes [13] [14]. Other studies, including that of Holt *et al.* (2009), have reported lower rates of depression in both people with and without type II diabetes (5% versus 3.8%) but they find a statistically significant association between depression and diabetes. Icks *et al.* [15] have suggested that there is no significant association between diabetes and depressive symptoms in women after controlling for comorbidities. For diabetes mellitus type I, the prevalence of clinical depression and controlled studies was 12% (5.8% - 43.3%) for people with diabetes compared with 3.2% (2.7% - 11.4%) for control subjects [16]. In contrast, other studies [17] reported significant high prevalence rates of depressive symptoms in both men and women with type I diabetes compared to individuals without diabetes (men: 25.5 versus 11.6%; women: 37.9 versus 20.5%). Through a more recent cross-sectional study involving out-patients with diabetes in the Netherlands, it was observed that about one third of the sample reported elevated depression scores, and that eight—24% were diagnosed with a depressive disorder [10].

Most studies considering race or ethnicity only analyzed ethnicity as an associate variable of depression and/or diabetes. Studies with African-American participants have shown a mixed picture in terms of rates of diabetes and depression [12] [18]. Katon *et al.* [19] reported that depressed individuals were less likely to be African-American, and were more likely to be Hispanic (African-American 13%; Asian American 15.2%; white Americans 15.5%; Hispanic 21.8%). However, Lin *et al.* [20] found no difference in rates between White Americans and non-White Americans for either minor depression or a major depression. European studies have reported higher levels of depressive symptoms or depressive effects in non-Dutch patients with type II diabetes compared with Dutch patients. However, they found no ethnic differences in depression in patients with type I diabetes [10]. Ali *et al.* [11] have found that the United Kingdom reports lower levels of diagnosed depressive disorder than their White European counterparts.

A number of studies have found diabetic women to have higher rates of depression than their men counterparts with similar findings in type I diabetes mellitus and type II diabetes mellitus [16] [21] [20]. However, Holt *et al.* [22] found diabetic men to have more depression rates than diabetic women.

In regards to age, a number of community-based studies in the US have reported an increase prevalence of psychological morbidity in younger adults with type II diabetes. Most studies have reported age as a risk factor for depression. However, depression has been found to be less common in older cohorts would depression [23]. Collins *et al.* [9] have reported lower rates of depression in older individuals with type I diabetes mellitus, suggesting that age may have a protective effect.

The goal of this study was to explore if BMI of elderly patients with diabetes differed from BMI of the individuals without depression. Further, we aimed to explore the association of age, gender, health insurance status, ethnicity influence and systolic blood pressure (SBP) and diastolic blood pressure (DBP) with clinical depression in geriatric diabetics.

2. Methods

2.1. Study Design

This was a cross-sectional analytic comparative non-interventional study.

2.2. Subjects' Recruitment and Characteristics

Nursing home residents were recruited from outpatient internal medicine clinics at the Texas Tech Health Science Center at Permian Basin between 2012 and 2013. All consenting diabetics with duration of diagnoses more than one year, irrespective of type I or type II over the age of 65 were eligible for the study. Relevant information was collected including independent variables: age, gender, ethnicity, Systolic and Diastolic blood pressure, BMI and latest HbA1c. The dependent variable was assessed with Patients received Public Health Questionnaire-9 (PHQ-9) in either English or Spanish language. The PHQ is based on DSM-IV (Diagnostic and statistical Manual -IV) criteria and has a 88% sensitivity and 88% specificity for diagnosis of major depression (PHQ score ≥ 10) in comparison to interview by mental health professionals.

2.3. Statistical Method

Univariate analysis was conducted to compare depressed and non-depressed nursing home residents with respect to the primary outcome measures of BMI and HgA1c along with secondary outcomes of SBP and DBP. In the absence of any statistical significance ($\alpha = 0.05$) between primary outcomes of the two groups, the age, race, ethnicity, gender, and insurance status between groups were compared in a similar fashion to probe for confounding. A post-hoc analysis was conducted comparing HgA1c and BMI between the depressed and non-depressed groups after adjusting for significant race differences between the two groups.

3. Results

There was no statistical difference between the depressed ($n = 67$) and non-depressed ($n = 32$) participants in their assessment of primary outcomes of HbA1C (7.5 ± 1.6 vs. 7.4 ± 1.4 ; $p = 0.447$) or BMI (31.4 ± 5.8 vs. 32.8 ± 5.3 ; $p = 0.254$), nor did the secondary outcomes: systolic blood pressure (142 ± 18.4 vs. 143 ± 25.8 ; $p = 0.823$) or diastolic blood pressure (77.6 ± 9.4 , 75.1 ± 11.1 ; $p = 0.240$) differ by depression status (**Table 1** and **Table 2**). While the clinically depressed diabetic participants did not differ to that of the non-depressed diabetic participants with respect to age (70.6 ± 6.1 vs. 72.1 ± 4.8 ; $p = 0.111$); gender (47.2% of males vs. 57.1% of females; $p = 0.754$), or ethnicity (69% explain vs. 71%, $p = 1.000$), race did appear to differ by depression status: Caucasian, African-American, and other were respectively 37%, 48%, and 15% vs. 32%, 16%, 52%, $p = 0.0003$). Neither the BMI ($p > 0.499$) nor Hemoglobin A1c ($p > 0.839$) differed between the clinically depressed and non-depressed participants when controlled for these race differences (**Figure 1**).

4. Discussion

In our sample, diabetic African Americans are three times more likely to be depressed. Diabetic Caucasians also experience higher rates of clinical depression. However, diabetics with depression did not differ from diabetics without depression with regards to their age, gender, BMI, HbA1C, health insurance status, systolic blood pressure or diastolic blood pressure.

Diabetes is a risk factor for high prevalence of depression [24]. It is possible that stress-associated hypothalamic-pituitary adrenal axis reaction with lowered hippocampal volume, upregulation of serotonin receptors (5 HT-2A receptors), decreased BDNF (Brain Derived Neurotropic Factor) and elevated inflammatory cytokines in diabetes may be directly related to the depression in diabetes. Our findings are in agreement with data, reporting higher incidence of depression in African American patients with diabetes [25] [26]. However, unlike the previous studies [27] [28], presence of clinical depression did not influence HbA1C levels. Similar to Munshi *et al.* [29], Engum [30] and Lin *et al.* [20] we did not find an association between the presence of depression and glycemic control. Knol *et al.* [8] in the cross-sectional study also demonstrated that impaired fasting glucose was not associated with depression in people with diabetes. Only one longitudinal study observed a significant association between elevated mean HbA1c values and a history of depression among participants with diabetes [31]. In a more recent cross-sectional study involving outpatients with any form of diabetes, Pouwer *et al.* [32] found that

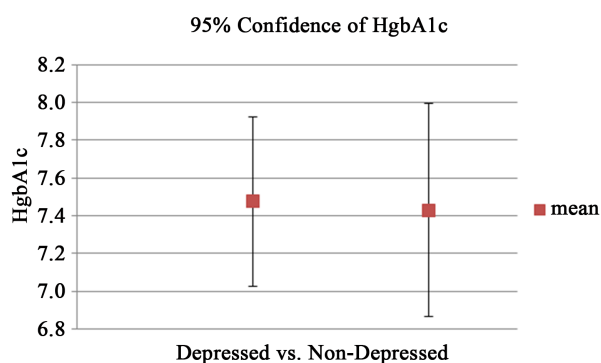


Figure 1. Difference between mean hemoglobin A1c levels between depressed and non-depressed diabetics.

Table 1. Association of confounding factors (BMI, age, ethnicity, gender, race and health insurance status) for depressed and non-depressed diabetics.

<i>Confounders</i>				
BMI	Mean	SD	<i>p</i> -value	
Depressed	31.4	5.8	0.254	
Not depressed	32.8	5.3		
Age	Mean	SD	<i>p</i> -value	
Depressed	70.6	6.1	0.111	
Not depressed	72.1	4.8		
Ethnicity	Non-hispanic	Hispanic	<i>p</i> -value	
Depressed	29	37	1.000	
Non-depressed	13	15		
Total	42	52		
Percentage	45%	55%		
Gender	Male	Female	<i>p</i> -value	
Depressed	29	30	0.665	
Non-depressed	14	18		
Total	43	48		
Percentage	47%	53%		
Race	White	Black	Other	<i>p</i> -value
Depressed	25	32	10	0.0003
Non-depressed	10	5	16	
Total	35	37	26	
Percentage	36%	38%	27%	
Insurance	Medicaid	Medicare	Self	<i>p</i> -value
Depressed	4	7	2	0.600
Non-depressed	31	30	16	
Total	35	37	18	
Percentage	39%	41%	20%	

Table 2. Showing outcome measures for Hemoglobin A1c (HA1c), Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) for diabetics with and without depressive symptoms.

<i>Outcome measures</i>			
HA1c	Mean	SD	<i>p</i> -value
Depressed	7.5	1.6	0.447
Not depressed	7.4	1.4	
SBP	Mean	SD	<i>p</i> -value
Depressed	142.0	18.4	0.823
Not depressed	143.2	25.8	
DBP	Mean	SD	<i>p</i> -value
Depressed	77.6	9.4	0.240
Not depressed	75.1	11.1	

depressive effect was associated with poor glycaemic control for type 1 DM only.

Depressed diabetic patients in our study did not differ in their BMI compared to non-depressed diabetic participants. This is contrast to other studies [33] who found increased BMI in the patients with diabetes and depression.

The gender has been reported to play an important role in the psychiatric disorders. Women with diabetes have consistently shown higher rates of depression than men [9] [31] [34] [35]. However, in our study we did not find any gender difference in diabetic patients with or without clinical depression. Our results are in line with the findings of one study [36] where, when controlled for BMI, age, race, there was no gender difference in presence of clinical depression, in diabetic patients

Age is associated with the clinical symptoms of depression. Studies found that younger patients with diabetic tend to experience more clinical depression than elderly population with diabetes [7] [20] [23]. In fact, Collins *et al.* [9] have reported lower rates of depression in older individuals, suggesting that age might be a protective factor.

It has been argued that diabetes precedes depression and leads to depression either through a direct effect of hyper glycaemia, possibly leading to altered glucose transport in the brain, or as a result of the psychological stress resulting from the knowledge of the diagnosis or from the rigorous treatment, through the both–lifestyle corrections and pharmacological interventions [3] [30] [37]. However, this assumption has been challenged by several recent cohort studies that have suggested that depression may be a risk factor for diabetes [30] [12] [36] while diabetes does not necessarily predict depression or is associated with only a modest risk of development of depression [30].

There are a number of **limitations** of this study. The design of the study gives only a snap shot of the symptoms experiencing by the participants in the previous two weeks. A prospective case controlled study would have been informative. We took one-year duration of diabetes as a cut off point for inclusion in this study. Hence this study does not provide information about effect of new onset of diabetes on mood symptoms. We also did not take into consideration if the diabetics had any comorbid complications of diabetes such as diabetic retinopathy or neuropathy, which can cause severe limitations and hence influence mood symptoms. Most importantly, we had assessment of depressive symptoms through one time evaluation through PHQ-9 in lieu of a comprehensive clinical depression assessment. However in spite of the limitations as this is first study in our knowledge that has tried to assess the effect of such confounding factors (age, gender, ethnicity, race, health insurance status, SBP/DBP, BMI and HbA1c) on development of depression in geriatric population.

Future studies may need further exploration of the association of such factors in a prospective case controlled design.

5. Conclusion

In summary, despite being cross-sectional, our study is significant for its unexpected findings.

Addendum

CRI contributed to the collection and analysis of the data.

References

- [1] Fagot-Campagna, A., Bourdel-Marchasson, I. and Simon, D. (2005) Burden of Diabetes in an Aging Population: Prevalence, Incidence, Mortality, Characteristics and Quality of Care. *Diabetic Medicine*, **31**, 5S35-5S52.
- [2] Beeny, L.J., Bakry, A.A. and Dunn, S.M. (1996) Patient Psychological and Information Needs When the Diagnosis Is Diabetes. *Patient Education and Counseling*, **29**, 109-116. [http://dx.doi.org/10.1016/0738-3991\(96\)00939-1](http://dx.doi.org/10.1016/0738-3991(96)00939-1)
- [3] Anderson, R.J., Freedland, K.E., Clouse, R.E. and Lustman, P.J. (2001) The Prevalence of Comorbid Depression in Adults with Diabetes: A Meta-Analysis. *Diabetes Care*, **24**, 1069-1078. <http://dx.doi.org/10.2337/diacare.24.6.1069>
- [4] Maraldi, C., Volpato, S., Penninx, B.W., Yaffe, K., Simonsick, E.M., Strotmeyer, E.S., et al. (2007) Diabetes Mellitus, Glycemic Control, and Incident Depressive Symptoms among 70- to 79-Year-Old Persons: The Health, Aging, and Body Composition Study. *Archives of Internal Medicine*, **167**, 1137-1144. <http://dx.doi.org/10.1001/archinte.167.11.1137>
- [5] Egede, L.E. (2004) Effects of Depression on Work Loss and Disability Bed Days in Individuals with Diabetes. *Diabetes Care*, **27**, 1751-1753. <http://dx.doi.org/10.2337/diacare.27.7.1751>
- [6] Lloyd, C.E. (2010) Diabetes and Mental Health; the Problem of Co-Morbidity. *Diabetic Medicine*, **27**, 853-854. <http://dx.doi.org/10.1111/j.1464-5491.2010.03067.x>
- [7] Katon, W., Fan, M.Y., Unutzer, J., Taylor, J., Pincus, H. and Schoenbaum, M. (2008) Depression and Diabetes: A Potentially Lethal Combination. *Journal of General Internal Medicine*, **23**, 1571-1575. <http://dx.doi.org/10.1007/s11606-008-0731-9>
- [8] Knol, M.J., Geerlings, M.I., Egberts, A.C., Gorter, K.J., Grobbee, D.E. and Heerdink, E.R. (2007) No Increased Incidence of Diabetes in Antidepressant Users. *International Clinical Psychopharmacology*, **22**, 382-386. <http://dx.doi.org/10.1097/YIC.0b013e3282202c0e>
- [9] Collins, M.M., Corcoran, P. and Perry, I.J. (2009) Anxiety and Depression Symptoms in Patients with Diabetes. *Diabetic Medicine*, **26**, 153-161. <http://dx.doi.org/10.1111/j.1464-5491.2008.02648.x>
- [10] Pouwer, F., Geelhoed-Duijvestijn, P.H., Tack, C.J., Bazelmans, E., Beekman, A.J., Heine, R.J., et al. (2010) Prevalence of Comorbid Depression Is High in Out-Patients with Type 1 or Type 2 Diabetes Mellitus. Results from Three Out-Patient Clinics in the Netherlands. *Diabetic Medicine*, **27**, 217-224.
- [11] Ali, S., Stone, M.A., Peters, J.L., Davies, M.J. and Khunti, K. (2006) The Prevalence of Co-Morbid Depression in Adults with Type 2 Diabetes: A Systematic Review and Meta-Analysis. *Diabetic Medicine*, **23**, 1165-1173. <http://dx.doi.org/10.1111/j.1464-5491.2006.01943.x>
- [12] Golden, S.H. and Mezuk, B. (2009) The Association of Depressive Symptoms with Prediabetes versus Diagnosed Diabetes: Is Ignorance Really Bliss? *The Physician and Sportsmedicine*, **37**, 143-145. <http://dx.doi.org/10.3810/PSM.2009.04.1697>
- [13] Brown, L.C., Majumdar, S.R., Newman, S.C. and Johnson, J.A. (2006) Type 2 Diabetes Does Not Increase Risk of Depression. *Canadian Medical Association Journal*, **175**, 42-46. <http://dx.doi.org/10.1503/cmaj.051429>
- [14] Paddison, C.A., Eborall, H.C., French, D.P., Kinmonth, A.L., Prevost, A.T., Griffin, S.J., et al. (2011) Predictors of Anxiety and Depression among People Attending Diabetes Screening: A Prospective Cohort Study Embedded in the ADDITION (Cambridge) Randomized Control Trial. *British Journal of Health Psychology*, **16**, 213-226. <http://dx.doi.org/10.1348/135910710X495366>
- [15] Icks, A., Kruse, J., Dragano, N., Broecker-Preuss, M., Slomiany, U., Mann, K., et al. (2008) Are Symptoms of Depression More Common in Diabetes? Results from the Heinz Nixdorf Recall Study. *Diabetic Medicine*, **25**, 1330-1336.
- [16] Bernard, D.M., Banthin, J.S. and Encinosa, W.E. (2006) Health Care Expenditure Burdens among Adults with Diabetes in 2001. *Medical Care*, **44**, 210-215. <http://dx.doi.org/10.1097/01.mlr.0000199729.25503.60>
- [17] Gendelman, N., Snell-Bergeon, J.K., McFann, K., Kinney, G., Paul Wadwa, R., Bishop, F., et al. (2009) Prevalence and Correlates of Depression in Individuals with and without Type 1 Diabetes. *Diabetes Care*, **32**, 575-579. <http://dx.doi.org/10.2337/dc08-1835>
- [18] Knol, M.J., Heerdink, E.R., Egberts, A.C., Geerlings, M.I., Gorter, K.J., Numans, M.E., et al. (2007) Depressive Symp-

- toms in Subjects with Diagnosed and Undiagnosed Type 2 Diabetes. *Psychosomatic Medicine*, **69**, 300-305. <http://dx.doi.org/10.1097/PSY.0b013e31805f48b9>
- [19] Katon, W.J. (2008) The Comorbidity of Diabetes Mellitus and Depression. *The American Journal of Medicine*, **121**, S8-S15. <http://dx.doi.org/10.1016/j.amjmed.2008.09.008>
- [20] Lin, E.H., Rutter, C.M., Katon, W., Heckbert, S.R., Ciechanowski, P., Oliver, M.M., et al. (2010) Depression and Advanced Complications of Diabetes: A Prospective Cohort Study. *Diabetes Care*, **33**, 264-269. <http://dx.doi.org/10.2337/dc09-1068>
- [21] de Jonge, P. and Rosmalen, J.G. (2006) Comment on: Knol, M.J., Twisk, J.W.R., Beekman, A.T.F., Heine, R.J., Snoek, F.J. and Pouwer, F. (2006) Depression as a Risk Factor for the Onset of Type 2 Diabetes Mellitus. A Meta-Analysis. *Diabetologia*, **49**, 837-845. *Diabetologia*, **49**, 2797-2798.
- [22] Holt, R.I., Phillips, D.I., Jameson, K.A., Cooper, C., Dennison, E.M., Peveler, R.C., et al. (2009) The Relationship between Depression and Diabetes Mellitus: Findings from the Hertfordshire Cohort Study. *Diabetic Medicine*, **26**, 641-648.
- [23] Fisher, L., Skaff, M.M., Mullan, J.T., Arean, P., Glasgow, R. and Masharani, U. (2008) A Longitudinal Study of Affective and Anxiety Disorders, Depressive Affect and Diabetes Distress in Adults with Type 2 Diabetes. *Diabetic Medicine*, **25**, 1096-1101. <http://dx.doi.org/10.1111/j.1464-5491.2008.02533.x>
- [24] Golden, S.H., Lazo, M., Carnethon, M., Bertoni, A.G., Schreiner, P.J., Diez Roux, A.V., et al. (2008) Examining a Bidirectional Association between Depressive Symptoms and Diabetes. *JAMA*, **299**, 2751-2759. <http://dx.doi.org/10.1001/jama.299.23.2751>
- [25] Porter, C., Wheatland, B., Gilles, M. and Greenfield, C. (2006) Missed Opportunities for Improving Health Outcomes of Patients with Diabetes. *Australian Family Physician*, **35**, 567.
- [26] Egan, B.M., Shaftman, S.R., Wagner, C.S., Bandyopadhyay, D. and Szymanski, K.A. (2012) Demographic Differences in the Treatment and Control of Glucose in Type 2 Diabetic Patients: Implications for Health Care Practice. *Ethnicity & Disease*, **22**, 29-37.
- [27] Markowitz, S.M., Gonzalez, J.S., Wilkinson, J.L. and Safren, S.A. (2011) A Review of Treating Depression in Diabetes: Emerging Findings. *Psychosomatics*, **52**, 1-18. <http://dx.doi.org/10.1016/j.psym.2010.11.007>
- [28] Richardson, L.K., Egede, L.E., Mueller, M., Echols, C.L. and Gebregziabher, M. (2008) Longitudinal Effects of Depression on Glycemic Control in Veterans with Type 2 Diabetes. *General Hospital Psychiatry*, **30**, 509-514. <http://dx.doi.org/10.1016/j.genhosppsy.2008.07.001>
- [29] Munshi, M., Grande, L., Hayes, M., Ayres, D., Suhl, E., Capelson, R., et al. (2006) Cognitive Dysfunction Is Associated with Poor Diabetes Control in Older Adults. *Diabetes Care*, **29**, 1794-1799. <http://dx.doi.org/10.2337/dc06-0506>
- [30] Engum, A. (2007) The Role of Depression and Anxiety in Onset of Diabetes in a Large Population-Based Study. *Journal of Psychosomatic Research*, **62**, 31-38. <http://dx.doi.org/10.1016/j.jpsychores.2006.07.009>
- [31] Gendelman, N., Snell-Bergeon, J.K., McFann, K., Kinney, G., Paul Wadwa, R., Bishop, F., et al. (2009) Prevalence and Correlates of Depression in Individuals with and without Type 1 Diabetes. *Diabetes Care*, **32**, 575-579. <http://dx.doi.org/10.2337/dc08-1835>
- [32] Pouwer, F., Kupper, N. and Adriaanse, M.C. (2010) Does Emotional Stress Cause Type 2 Diabetes Mellitus? A Review from the European Depression in Diabetes (EDID) Research Consortium. *Discovery Medicine*, **9**, 112-118.
- [33] Chiu, C.J. and Wray, L.A. (2011) Physical Disability Trajectories in Older Americans with and without Diabetes: The Role of Age, Gender, Race or Ethnicity, and Education. *Gerontologist*, **51**, 51-63. <http://dx.doi.org/10.1093/geront/gnq069>
- [34] Roy, T. and Lloyd, C.E. (2012) Epidemiology of Depression and Diabetes: A Systematic Review. *Journal of Affective Disorders*, **142**, S8-S21. [http://dx.doi.org/10.1016/S0165-0327\(12\)70004-6](http://dx.doi.org/10.1016/S0165-0327(12)70004-6)
- [35] Barnard, K.D., Skinner, T.C. and Peveler, R. (2006) The Prevalence of Co-Morbid Depression in Adults with Type 1 Diabetes: Systematic Literature Review. *Diabetic Medicine*, **23**, 445-448. <http://dx.doi.org/10.1111/j.1464-5491.2006.01814.x>
- [36] Holt, R.I., Phillips, D.I., Jameson, K.A., Cooper, C., Dennison, E.M. and Peveler, R.C. (2009) The Relationship between Depression and Diabetes Mellitus: Findings from the Hertfordshire Cohort Study. *Diabetic Medicine*, **26**, 641-648. <http://dx.doi.org/10.1111/j.1464-5491.2009.02742.x>
- [37] Renn, B.N., Feliciano, L. and Segal, D.L. (2011) The Bidirectional Relationship of Depression and Diabetes: A Systematic Review. *Clinical Psychology Review*, **31**, 1239-1246. <http://dx.doi.org/10.1016/j.cpr.2011.08.001>