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The Interplay of Diabetes, and Health Self Efficacy, Cognition and Compliance

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Globesity has partially been responsible for an outbreak of diabetes which affects 340 million people in the world today[1]. Severe diabetes, which would have killed a patient fifty years ago, can now be managed for decades longer. So the number of diabetics is increasing both among the obese young and the elderly who live longer. Amongst diabetic adults, the cardiovascular disease (CVD) death rate has declined by 40% (95% CI 23–54), while the death rate from all other causes declined by 23% over a ten year period from 1997 to 2006. Not surprisingly therefore, the rate of diabetes and the concomitant disorders continues to grow. Diabetes can also lead to significant cognitive decline which leads to interference with compliance, socialization and quality of life. Diabetes causes an increase in cognitive impairment in vascular dementia. Type 2 Diabetes may act as a partial causal agent of some dementias, and the link between diabetes and Alzheimer's has led a number of researchers to claim Alzheimer's is in reality a Type 3 diabetes. A clear and statistically significant relationship exists between HbA1c levels and the duration of diabetes mellitus and cognitive dysfunction. While the causal mechanism remains unknown Type 2 Diabetes clearly causes cognitive impairment. This genetic predisposition to diabetes may be greatest amongst South Asian Indians, and Hispanics. While genetics is certainly not the sole determinant of diabetes, genetics likely plays a key role. Some type of brief cognitive screening battery needs to be developed to screen for Mild Cognitive Impairment, and Health Self Efficacy, both of which affect compiance. This information could be used to make treatment decisions, both in terms of compliance and in terms of recommendations which may affect an individual's Quality of Life. With cognitive impairment and low Health Self Efficacy due to diabetes, screening can be a key tool in evaluating educational techniques which would aid patients, their communities and their families as to the type of interventions which may prove useful.

OBESITY AND DIABETES: A GLOBAL HEALTH PROBLEM

Type 2 Diabetes currently affects over a third of a billion people worldwide according to the World Health Organization

estimates[1]. Estimates are that Diabetes rates will continue to increase at a rapid pace[2]. Diabetes, long characterized as a chronic disease, has become more in recent times and has become even more chronic, due to improvements in medication and management; people with diabetes are living longer, extending the time that cognitive impairments will affect their functioning. The excessive CVD mortality rate associated with diabetes decreased by 60% as compared to the rate found in non-diabetic patients with the mortality rate from all causes having declined by 44% within the same period[3]. While these statistics are a reason for optimism, much needs to be done to address the social and individual effects on the long-term survival of diabetics with neurodegenerative diseases and cognitive impairments, whether related to their diabetes or caused by other factors.

Unsurprisingly, cognitive impairment has been shown to be more prevalent in countries with a large population of elderly people. In a 2004 study, Gregg *et al* found that diabetes led to significant cognitive decline in older women[4]. Women with diabetes were found to have between 57 and 114 percent greater chance of having cognitive impairments[4]. MacKnight and colleagues found that diabetes caused an increase in cognitive impairment in vascular Dementia[5]. Countries including China having 365 million elderly people in 2005, India with 81 million elderly, and Indonesia with 8.5% of their 240 million people being 60 years or older, are examples of countries experiencing this problem[6]. Studies predict that there will be a likely rise in the prevalence of cognitive impairments.

In China, Pei and Wan found a relationship between cognitive function and glucose tolerance[7]. In a six-nation study, which included South American countries, China and India, and with over 15,000 subjects assessed, Sosa and colleagues[8] found a statistically significant difference in dementia rates, with Peru and India having much higher rates of amnesic mild cognitive impairment (MCI), more than double prevalence of the others in the study. Anjana *et al* also found much higher rates of diabetes in India[9]. South Asians seem particularly susceptible to cognitive problems.

While Diabetes and Alzheimer's have been determined to be two of the most common causes of dementia in the world, medical personnel do not routinely screen diabetic patients for cognitive impairment. In a five-year longitudinal study, patients without baseline cognitive impairment were assessed for the association of diabetes and incident dementia. Even though those patients with diabetes at base line showed a higher incidence of vascular cognitive impairment and dementia[5]. Novak *et al* found that diabetics had exaggerated brain vasoconstriction reactivity and more atrophy than nondiabetic patients[10]. In addition, these diabetic brain impairments were related to depression and slower walking. Regional brain analysis showed that elevated levels of the endothelial integrity markers sVCAM (soluble vascular cell adhesion molecule) and sICAM (soluble intracellular cell adhesion molecule) were linked to exaggerated vasoconstriction, blunted vasodilation, and increased cortical atrophy in the frontal, temporal, and parietal lobes. These results indicate a potential causative relationship between cognitive impairment and brain functionality of diabetics.

Ohara *et al* conducted a study of community-dwelling, dementia-free subjects aged 60 or older who underwent an oral glucose tolerance test (OGTT) to ascertain a diabetic diagnosis and were followed for 15 years[11]. Using detailed neuroimaging and autopsies, the association between glucose tolerance levels and the development of dementia

could be measured at the statistically significant level. In summary, it was determined that the incidence of all-cause dementia, AD and vascular disease (VaD) was significantly higher with diabetes than in those within the community that had normal glucose tolerance, lending support to the theory that diabetes serves as a risk factor for some subtypes of dementia[11].

IMPORTANCE OF DISCOVERING TRIGGERS OF BEHAVIORAL CHANGE

Successful diabetes interventions remain dependent upon patients being compliant with medication (insulin administration/taking oral medication), exercise and diet as recommended by the health care professionals. Owing to the chronic nature of illness, a patient diagnosed with diabetes is told to adhere and follow a highly regimented lifestyle for the remainder of their lifetime. A complex process of both behavioral self-regulation and ongoing-active complex decision making helps determine a patient's abilities to adhere or comply with regimens on the consistent basis, critical to success[12]. This expectation of multiple compliances (diet, lifestyle, medication) with complex tasks, made by health care professionals and family members, may grossly overestimate their abilities to comply for those who are also suffering from cognitive impairment, and doom them to repeated failures creating a learned helplessness regarding controlling their disorders.

THEORIES OF TRIGGERS OF BEHAVIORAL CHANGE & COMPLIANCE

Medication, lifestyle and diet compliances continue to be major concerns in fighting diabetes, but these compliances are based upon both cognition and Health Self Efficacy. In order for patients to comply consistently, they must believe that first that they are indeed ill, and secondly that these compliance behaviors, which can cost effectively, help them. By cost patients include, time needed, taste of food, the social consequences of eating separate diets and other factors which health care professionals typically do not think of when making their recommendations. Patients must have a strong sense of Health Self Efficacy, meaning simply their actions and sacrifices have a significant effect of their health outcomes[13]. It must be both a personal and daily fight. Research has demonstrated that belief in health self-efficacy regarding diet enables patients to better control their diabetes[14], exercise and glucose-testing[15-17]. Intervention programs using self-efficacy and with it the related theoretical construct of Locus of Control continue to play key roles in predicting behavioral change in Type 2 Diabetes and in instituting that change[18,19]. Since medication non-compliance has been shown to be related to Health Self Efficacy in patients with type II diabetes, perceived behavioral control could explain greater adherence to medication, exercise and dietary behaviors[20].

Another theoretical underpinning of compliance in diabetes is the The Theory of Planned Behavior (TPB). TPB which theorizes that behavior can be influenced by: (a) Attitude towards the behaviour (some behaviors are viewed as favorable and others unfavorable), (b) Subjective norm (perceived social pressure which affects diet particularly in social situations, and (c) Perceived behavioral control which is similar to Health Self Efficacy. In one study TPB model has accounted for 46% of variance in behavioral intention and a full 57% of variance in self-monitoring behavior done by patients. When a hierarchical regression analysis was conducted it showed that past behavior, and the difficulty experienced, were the strongest predictors of self-monitoring blood glucose levels in diabetics[21].

HEALTH SELF EFFICACY

Studies have also shown that, patients who believed in their ability to control diabetes demonstrated better self-care in the areas of diet[14], exercise and glucose-testing[15,22]. Treatment control perceptions have also been found to be associated with glycosylated haemoglobin levels (HbA1C)[15]. Hierarchical multiple linear regression analysis revealed illness representations accounted for 12% of the variance in glycosylated hemoglobin (HbA1c) levels of adult type 2 diabetic patients[23]. Intervention programs developed to assess health self-efficacy of diabetics, focus on the positive, desirable outcomes of adhering to diabetes management behaviors. The incorporation of the concept of self-efficacy into almost all major theories of behavior is further evidence of its important role in the behavior change process[18].

In patients with type II diabetes, perceived behavioral control could explain greater adherence to medication taking than to exercise and dietary behavior[16]. This finding indicates the need to consider a patient's, past behavior, what the patient is capable of and what is feasible for the patient in treatment customization. In fact, there is much similarity between Ajzen's perceived behavioral control (focus on ease and difficulty in performing behavior) and Bandura's construct of self-efficacy (belief in one's ability to perform the behavior).

COGNITIVE AND HEALTH SELF EFFICACY SCREENING

The ongoing need for a quality screening tool or battery to discover cognitive deficits and Health Self Efficacy cannot remain simply theoretical, since fully one third of adults with diabetes have shown evidence of mild cognitive impairment, and researchers are unsure as to what percentage have low Health Self Efficacy, but judging by compliance numbers it is not insignificant. Impairment in these areas interferes with a number of processes including their likelihood to participate in exercise programs, belief in ability to get better, Quality of Life, basic self-care, and medication along with diet compliance[24-27]. A Critchley *et al* study suggests that one way to get around these deficits in cognition and to increase changes in behavior is to use group activities[28]. Group activities likely better reinforce changes in those with cognitive impairment due to the multisensory and social stimulation of the group creating more useful behavioral changes[28]. And group activities may be a cost effective intervention, perhaps run by paraprofessionals who have had some success in managing their own diabetes. Obviously, other strategies need to be tested and success or failure measured.

Cognitive impairment related to cause by diabetes remains an under-addressed problem, by both clinicians and intervention researchers. The lack of recognition of the problem by primary care practitioners increases the chances that they will not perform the necessary evaluations for the condition. This lack of evaluation interferes not only with the ability of a clinician to monitor the condition in his or her patient, but also with his or her ability to judge what interventions are working and how to reevaluate the treatment of a patient with impaired cognitive functioning and patient's own ability to evaluate their progress[29]. Understanding how to increase compliances by understanding the patient's cognition and Health Self Efficacy are the only ways to make progress in this critical area[30]. Clinicians and researchers need to begin to view diabetic cognitive impairment and impaired Self Efficacy as problems, which must be addressed in getting full treatment compliances. In addition clinicians must keep in mind that not all cultures respond the same way to attempts to influence various types of compliance[31]. Intervention

must be tried measuring success and failure and tracking cultural, gender, and age differences.

ACTION PLAN FOR INTERVENING

Biessels *et al*[32] have called for improvement in research in this area, since in their metaanalysis both statistical and theoretical foundations are found in the interplay between and amongst cognition, self-efficacy and compliance. The first step in doing this is to recognize these impairments affect compliance. Secondly, they can be easily measured. Third, once discovered, intervention needs to be actively attempted and success or failure measured.

With the growing number of individuals affected by diabetes with very poor rates of compliance, it is important to expand research in order to improve interventions. With early detection of cognitive impairment and impaired Health Self Efficacy, health professionals can provide ways to slow down the development of diabetic dementia, but it cannot be done unless HSE is taken into account. Health care professionals can respond to the increased need for more effective screening methods by creating brief test batteries, which aid in making appropriate treatment plans for patients, and then using those plans and repeated testing to improve compliance and patient outcomes. Clinicians would not think of treating a diabetic without regular testing of blood sugar levels, how then is it possible to not test for both cognitive impairment and impairment in Health Self Efficacy both of which affect the compliances which help manage the sugar that is being tested for. Lastly, due to the extent of the disorder perhaps it is time to study Physicians and other health care professionals in terms of their self-efficacy. Success requires that they be engaged and have a sense that their interventions are being followed to some extent.

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