# World Journal of

# *Diabetes*

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## Contents

# Contents

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**FLYLEAF**

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*REVIEW*

# Type 2 diabetes and quality of life

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## Abstract

It is true that a primary goal of diabetes early diagnosis and treatment is quality of life (QoL). The term QoL is still confusing but it is agreed that it composes of four components: The physical component, mental, cogitative component, psychological and social component. Many articles have been written addressing those four components. During the last five years 15500 articles and reviews have been written addressing diabetes and coronary arterial disease, 16100 addressing diabetes and renal function, 28900 addressing diabetes and retinopathy, 16800 addressing diabetic foot ulcers and other 26300 addressing diabetic neuropathy. Moreover 17200 articles are dealing with diabetic sexual dysfunction, 24500 with the correlation of diabetes and depression 17500 about diabetes and dementia, only 1 about diabetes and family functioning and 1950000 about diabetes and QoL, indicating the worldwide interest. In order to confront this metabolic anomaly and its consequences, researchers developed numerous generic and disease specific psychometric tools. With the aid of those psychometric tools the scientific community has started to realize the gruesome effect of diabetes on patients' lives. Diabetic's QoL becomes worse when complications start to develop or comorbidities coexist. Dominant amongst complications, in health-related quality of life (HRQoL) lowering, but not related to risk factors (genetic, the weight of birth, or others) is coronary arterial disease followed by renal failure, blindness, and the combination of micro- and macro-vascular complications and in some studies by sexual dysfunction. Moreover many are the comorbidities which deteriorate further the effect of diabetes in a patient life. Among them obesity, hypertension, dyslipidemia, depression, arthritis are the most common. Most intriguing field for research is the interaction of diabetes and depression and in some cases the progression to dementia. Many aspects and combinations of actions are under researchers' microscope regarding the improvement of HRQoL scores. Until now, the studies performed, have demonstrated little to moderate benefit. More of them are needed to draw safe conclusions on the topic of the best combination of actions to optimize the HRQoL scores.

Key words: Type 2 diabetes; Quality of life; Diabetes co morbidities; Diabetes complications; Dementia; Diabetes type 3

**Core tip:** Although numerous articles and reviews are written about diabetes every year regarding epidemiology, complications, therapies, comparisons of treatments, health strategies, literature data on diabetic patient's quality of life and how much it is actually affected by complications, comorbidities or different treatments are limited. The current review is focused on: (1) the way patients perceive the changes in different aspects of quality of their lives as recorded by numerous psychometric tools and scales; (2) on the similarities and differences among studies performed worldwide along with the problems and caveats in research; and (3) on aspects intriguing but demanding further research as the effect of diabetes in family life or the common metabolic pathways between diabetes and dementia (recently called also diabetes type 3).

## INTRODUCTION

Diabetes is the increasingly growing metabolic threat of our contemporary era. Diabetes was first described[1] in an Egyptian manuscript from 1500 BC, mentioning "too great emptying of the urine"[2]. Later on, Indian physicians described also the disease and classified it as honey urine by the fact that ants were attacked by patient's urine[2]. The term "diabetes" or "to pass through" was first used in 250 BC by the Greek Apollonius of Memphis[2]. Diabetes type 1 and 2 were recognized for the first time as separate conditions by the Indian physicians Sushruta and Charaka in 400-500 BC, linking type 1 diabetes with youth and type 2 with obesity[2,3]. The term "mellitus" or "from honey" was added by Thomas Willis in the late 1600s because of the sweet taste that urines from diabetic patients had[2]. The first complete clinical description of diabetes was given by the Ancient Greek physician Aretaeus of Cappadocia (1$^{st}$ century AC), who also noted the excessive amount of urine a typical sign of diabetes.

The disease's description has accompanied the human race throughout the centuries. It is found in medieval Persia in Aviccena's *The Canon of Medicine*, in the Roman Empire with Galen describing two cases of diabetic patients during his career[2]. Diabetes was also introduced into Korean and Japanese medicine under the Chinese name táng niào bìng, meaning "sugar urine disease". Although diabetes has been recognized since antiquity, pathogenesis of the disease was understood about 1900[4] while insulin was discovered by Canadians Frederick Banting and Charles Bestthe in 1921 and was first used in 1922[2].

It is well established that the prevalence of diabetes has increased in the developed and developing countries during the last four decades. That is a result of the abundance of food, the consequent change of our dietary habits and the lack of exercise. According to International diabetes Federation, nowadays, one every 11 adults has diabetes (415 million worldwide). By 2040, one adult in 10 (642 million worldwide) will suffer from diabetes. One in 7 births is affected from gestational diabetes and 542000 children worldwide have type 1 diabetes[5]. Additionally every 15 s a person dies from diabetes and the 12% of the global expenditure is spent on diabetes. What is fearful is that 46.5% of adults with diabetes are undiagnosed! In a recent Greek study an age- and sex-adjusted prevalence of diabetes of 10.6% was found, while the prevalence of undiagnosed diabetes was 34%[6].

Progression of diabetes, and especially poor glycemic control, leads to numerous potentially life threatening complications. Almost half of the adults with chronic kidney disease are derived from diabetic population. Likewise, 9.8% of diabetics have experienced heart attack, 9.1% suffer from coronary artery disease (CAD), 7.9% have congestive heart failure, 6.6% have stroke while more than a quarter of them 27.8% suffer from chronic kidney disease, almost a quarter 22.9% have foot problems and last but not least 18.9% have eye damage[4]. All these complications along with the metabolic deterioration demands a large amount of patient's every day energy, planning and thought[7], which leads to a situation called by Rubin[7] "diabetes overwelmus".

## QUALITY OF LIFE

The reality is that diabetes influences patients' lives. The mere presence of diabetes deteriorates a person's quality of life (QoL). When diabetes coexists with other chronic illnesses the effect is even worse. But what exactly is QoL? Is it the mere absence of sickness in a man's life? Is it something more? Is it measurable? The worldwide interest is reflected on the 1950000 articles and reviews published the last five years on this research area while the numbers of publications on each diabetic complication are between 15000 and 28000 depending on the complication. Notably only one article was found to asses family functioning.

As Snoek *et al*[8] describes, we are not certain of the origin of the phrase QoL, but American economists Samuel Ordway (1953) and Fairfield Osborn (1954) are considered to be the first to have used the term. Others who used almost the same words was John Galbraith (1967), American president Lyndon B Johnson 1964 followed by social scientists in 1960's who were interested in the new topic of QoL, and particularly the correlation between markers of QoL (such as income level social interaction), and the way individuals perceive them то define their QoL. Surprisingly enough

biological health wasn't a determining factor. Because of the social progress and the medical development, research focused on the issue of well being as patients perceive it.

As Snoek *et al*[8] describes after World War II and the introduction of new medicines, the numbers of patients with chronic diseases increased continually. In parallel there was a growing need for evaluation of treatments in terms of medical efficacy but also in terms of everyday life improvement as patients understood it[8]. No sooner than 1976 was the concept of QoL included in the *Index Medicus*[8]. By the year 2000, there had been over 300 articles on the issue of QoL in diabetic population.

In 1997, the World Health Organization (WHO) introduced the first definition of health as "A state of complete physical, mental, and social well-being not merely the absence of disease". WHO, furthermore, introduced QoL as an estimation of well-being as well as a the measurement of health and the effects of health care[9]. WHO defined QoL as individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. Therefore, except for person's physical health definition of QoL includes psychological state, level of person's independence, social life and personal beliefs[9].

According to United States Centers for Disease Control and Prevention (CDC) QoL is a multidimensional concept that includes evaluations of both positive and negative aspects of a person's life. Since the 1980s, the term health-related quality of life (HRQoL) has comprised those aspects of QoL that can be shown to affect physical or mental health[10-13]. HRQoL includes physical and mental health perceptions (health conditions, social and socioeconomic status) and community-level resources, conditions (practices that influence health perceptions and functional status). According to the above, CDC has defined HRQoL as "an individual's or group's perceived physical and mental health over time"[10-13].

Undoubtedly the answer to the context of happiness and QoL is obscure and although there is no consensus among scientists, it is mostly agreed that QoL: (1) includes many different aspects as mentioned previously; and (2) should be measured through patients perception of well being or the lack of it in their lives[8]. Directly related and a crucial component of QoL is HRQoL. Many times the two concepts have been confused or thought to be identical, or synonymous to well-being, which of course is a mistake. During the last decades the researcher's interest has turned to the concept of disease specific QoL as a treatment goal[14] and important component of therapy. The whole philosophy of diabetes treatment has changed from physician-centered to patient-centered. The last ADA-EASD guidelines focus on patient participation in treatment options along with the physician. Concurrently HRQoL questionnaires have become important com-

ponent of public health and are considered valid indicators of intervention outcomes and a powerful predictor of mortality and morbidity[15-18].

## PSYCHOMETRIC TOOLS

Consequently, the necessity of developing special psychometric tools to measure HRQoL has risen rapidly. Thus, numerous such tools were developed, other generics and other disease specific in an attempt to determine the impact of diabetes and other chronic diseases, along with their complications on patient's lives and also the effect of medical interventions to the evolution of maladies. But as Snoek *et al*[8] states "there isn't a gold standard for the assessment of overall health related or diabetes specific QoL and efforts should be made towards the development of valid, reliable and user friendly assessment tools".

There are many psychometric tools developed in different languages which attempt to asses may aspects of diabetes interference with a person's life. The most used of the later or those which present a special interest are presented below.

The Diabetes Quality of Life Measure (DQOL) was introduced in the Diabetes Control and Complications Trial[19,20]. The scope was to assess four dimensions of diabetes impact: Satisfaction, treatment impact, anxiety for complications and social issues. The DQOL is widely used despite its limitations. Lower scores in this scale are associated with diabetic complications and glycemic control[19,21].

The Diabetes-Specific Quality of Life Scale (DSQOLS) has 64 questions has six dimensions: Social relations, leisure time restrictions and flexibility, physical complaints, worries about the future, diet restriction, and daily hassles. It is used only for type 1 diabetes and it is not validated in English[19,22].

The Diabetes Quality of Life Clinical Trial Questionnaire-Revised has 57 questions measuring physical function, energy, health distress, mental health, satisfaction, treatment satisfaction, treatment flexibility, and frequency of symptoms[19,23].

The Appraisal of Diabetes Scale has 7 questions focusing on diabetic patients' feelings and attitudes and the psychological effect of diabetes[19,24].

The ATT-39 and the revised ATT19 scale focus on the psychological adjustment to diabetes and diabetes integration which is not necessarily synonymous to diabetes specific HRQoL[19,25].

The Questionnaire on Stress in Patients with Diabetes-Revised has 8 dimensions: Leisure and work time, relationship with partner, with doctor, hypoglycemia, therapy, physical symptoms and anxiety about diabetic complications[19,26].

The Type 2 Diabetes Symptom Checklist is a 34-item scale assessing symptoms as hypoglycemic, cardiac, neuropathic, psychological, and vision-related. The scale covers a broad spectrum of symptoms which nevertheless can't always be attributed to diabetes.

The scale was developed in Dutch but there is English translation and validation[19,27].

The Problem Areas in Diabetes Scale (PAID-1) and the revised (PAID-2) are focusing on four dimensions: Overall emotional, interpersonal, treatment-related, and physician-related distress[19,28-30].

The Audit of Diabetes-Dependent Quality of Life (ADDQoL) has 15 questions measuring 13 life domains: Career, social life, family, friendships, sex life, leisure time opportunities, traveling, worries about the future, worries about the future for one's family and friends, and motivation to achieve things[19,31].

The widely used SF36 has 36 questions: An 8-scale profile of biological health and well-being scores as well as psychometrically-based physical and mental health measures and a preference-based health utility index. Physical function, pain, general and mental health, emotional and social function are assessed[32].

## DIABETES AND HEALTH RELATED QOL

It is well-known that diabetes *per se*[33] causes a serious deterioration in general QoL mainly affecting the HRQoL. The outcomes are similar worldwide, varying in the grade of influence. Most importantly there are studies[34] implementing that the low QoL anxiety and depression of individuals who, aren't yet officially diagnosed for diabetes but who are at high risk for diabetes. Therefore, clinicians should be educated that high-risk patients at a prediabetic state might have decreased HRQoL and depression, a health dimension that should not be ignored[34].

As shown in a study in three different states in Malaysia there was a statistically important difference in QoL among the three studied populations Malaysian, Indian and Chinese[35]. The Chinese scored significantly lower (21.0 ± 4.3) in the Asian DQOL compared to Malays (81.4 ± 9.0) and Indians (81.5 ± 9.2). Moreover, Chinese scored significantly lower (21.0 ± 4.3) on the Asian DQOL (diet) score compared to Malays (22.8 ± 3.6) and Indians (22.5 ± 3.7). The only component different in a deeper analysis was the different perception of diet among ethnic groups[35]. In the same study, sexual dysfunction lead consistently to lower QoL (-10% in English speaking -5.9%, in Mandarin speaking Chinese, -6% in Malaysians traditional language speaking) in all sub groups whilst there were differences in other predictors. These findings are similar to a Singapore study by Wee *et al*[36] in 2005 which showed ethnicity as an important factor influencing QOL in people with diabetes[37].

In contrast to other studies, the surveys conducted in Nordic population[38] in primary health showed difference between impaired glucose tolerance and overt diabetics whilst the outcomes on HRQoL showed lower scores especially for type 2 diabetics in accordance with literature[39,40]. Older and poorer controlled patients showed lower scores. The most important factor in Nordic studies[38] for the deterioration of HRQoL was

the presence of complications, especially CAD and non-vascular complication such as minor psychiatric disorders or musculoskeletal disorders. Nevertheless Viinamäki *et al*[41], found no increased rate of minor mental disorders among diabetic patients but when they coexisted the symptoms tended to be more severe. Furthermore, neuropathy was found to be a predictor of mental disorders in that study. Surprisingly microvascular complications did not have great effect in HRQoL. Other notable findings were that personalization and tailor suited therapy along with continuity in care[42-44] have promising results.

In a study[45], which started in the Cost of Diabetes Type 2 in Europe - (CODE-2) study, a Dutch population of 1371 type 2 diabetics was evaluated using EQ-5D and EuroQol VAS scores for HRQoL and Diabetes Treatment Satisfaction Questionnaire (DTSQ). The outcomes showed good correlation between EQ-5D and EuroQol Vas score although scores in one did not necessarily mean same scores in other. Lower scores were reported as age preceded more, in female sex, with obesity, with insulin use and as complications appeared. Especially low scores were observed for the combination of microvascular and macrovascular complications[45]. Notable points were that anxiety and depression increased and then decreased with age. An explanation given from the writers is that older people attribute their limitations to aging and cope or accept them better than younger people. Another explanation is that in younger populations the fear of future complications is greater. One more interesting point is that duration of diabetes isn't correlating with HRQoL as does not treatment satisfaction. The later is associated with the physician attitude towards the patient and the level of communication between them, fact consistent with literature[14]. The individuals with diabetic neuropathy had lower scores than those with foot ulcers. At last, questions were posed in term of EQ-5D responsiveness to change[45,46].

In another cross sectional study[47], conducted in United States, Self-Administered Quality of Well Being index (QWB-SA) was given to 2048 diabetics type 1 and type 2. Health scores were lower in women and obese patients, and in subjects with kidney disease and arterial hypertension. Scores were substantially lower in type 1 diabetic subjects with retinopathy, neuropathy, foot ulcers, amputation, stroke, and congestive heart failure. The highest scores among the subgroups had the group of diet controlled no obese diabetic men without microvascular, neuropathic, or cardiovascular complications. The same findings were observed in type 2 diabetics. At last, the authors implemented that there might be a correlation between lower than high school education and a deterioration of scores but the writers explained that the sample was inappropriate less than 7% and the chose not to comment on that variable.

Also similar were the findings of a study of diabetic population of a small isolated rural Canadian diabetic population in Bella Coola valley[48]. SF36 and BRFSS

(devised by the CDC, which aims to healthy/unhealthy days and limitations) were used and the scores were correlated to clinic chart information. Of note 57% of diabetic responded, whilst only 37% of non-diabetics. The sample was estimated as representative of the population of diabetics of the area and also in terms of complications CAD (16% *vs* 19%), retinopathy (15% *vs* 14%), cerebrovascular disease (9% *vs* 8%), neuropathy (9% *vs* 10%), peripheral vascular disease (7% *vs* 7%), and nephropathy (6% *vs* 7%). HRQoL scores were lower for diabetics. Factors related to health related QoL scores were duration of diabetes, insulin, and long-term complications of diabetes. Low HbA1c levels were paradoxically associated with lower QoL scores and there was an inverse relationship between duration of diabetes and QoL. The later is consistent with some studies[49] reporting the same outcomes while there are others reporting improvement with age[49-51].

Interestingly there were similar results in a recent review of the Iranian studies[52]. On the topic of the QoL in diabetic population, mostly type 2 and to smaller extend type 1 diabetics. Women and older people had lower HRQoL than men and socioeconomic and marital status was positively associated with HRQoL. There were negative associations between HbA1c, BMI, blood pressure, lipids and HRQoL. Also deterioration of HRQoL was shown in the smokers group, whilst conflicting were the results concerning the duration of diabetes and the comparison of rural urban population. The writers note the methodological defaults of the studies. Nevertheless it is notable that the outcomes are consequent with the international studies although there is a difference in culture, diet and exercise habits.

In the UKPDS 37[53], study type 2 diabetics without any complication had a mean EQ-5D index value of 0.83, compared with 0.85 in a Norwegian study[54] conducted by mail in 2006. In the UKPDS 37 study the EQ-5D detected significant differences between people with and without complications In the UKPDS 37 study the EQ-5D detected significant differences between people with and without macrovascular complications, but not microvascular complications. In the same line, in a Singapore cross sectional study by Quah *et al*[55], used EQ5D and SF36 on 699 diabetics reported lower HRQoL in patients with symptomatic complications. This is consistent with many studies[53,56,57].

## DIABETES COMPLICATION AND COMORBIDITIES

As seen in the referred above studies diabetes exercises its dark influence when complications start to make their presence in patients' lives. In a Chinese study involving type 2 diabetics[37], which was part of the JADE program Zhang *et al*[37], reported a mean EQ-5D index was 0.897 ± 0.173. Over 80% of diabetics had either hypertension or dyslipidemia and over half were obese. Nephropathy, neuropathy and CAD were associated with low EQ-5D index while retinopathy was not. Notably, hypertension was correlated with EQ-5D index. The outcomes were consistent with a Singapore study[58] while Dutch and Norwegian studies involving Caucasian populations[45,54] reported lower scores. In another Chinese study by Goh *et al*[35], in multiethnic environment diabetic complications had a great impact on QoL.

In the Norwegian study by Solli *et al*[54], patients with complications had reduced HRQoL; 0.90 for those with type 1 diabetes and 0.85 for those with type 2. Presence of one complication decreased scores to 0.76 and 0.80, respectively while with 2 or more diabetic complications the scores were 0.55 and 0.64, respectively. Cerebrovascular disease and neuropathy had a negative impact on overall HRQoL in both types of diabetes, while CAD had an impact on those with type 1 diabetes.

In the Dutch study by Redekop *et al*[45] in type 2 diabetics older patients, female subjects, treatment with insulin, obesity and presence of complications were correlated with a lower HRQoL. In the Canadian Bella Coola survey[48] the rates for diabetes complications regarding CAD (16%), retinopathy (15%), cerebrovascular accidents (9%), neuropathy (9%), peripheral vascular disease (7%), and nephropathy (6%). SF36 scores for diabetics were lower as follows: Physical functioning -13.7, in Social functioning -8.8, in bodily pain -11.1, in role physical -27.4 in role emotional -22, in mental health -3.5 in vitality -6.3, in general health -16.3. Diabetics had more unhealthy days when measured with Mean healthy/unhealthy day scores: +4.4 for unhealthy physical, +2.3 for unhealthy mental, +3.4 for limited by health, +5.4 for limited by pain, +1.9 for felt depressed, +3 for felt anxious, +2.6 for poor sleep, -1.3 for felt healthy. In an American study by Coffey *et al*[47], with 2048 type 1 and 2 diabetics. scores were lower (0.058-0.208) in type 1 diabetics with retinopathy, neuropathy, foot ulcers, amputation, stroke, and congestive heart failure. Health scores were significantly lower (0.052-0.170) in type 2 diabetics with retinopathy, end-stage kidney disease diabetic foot, neuropathy, stroke and heart failure[47]. Ragnarson Tennvall *et al*[59] also, assessed scores in subjects with diabetic foot problems using the EuroQol-EQ5D questionnaire. In this subgroup, major amputations (EQ5D: 0.31) and current foot ulcers (EQ5D: 0.44) were related with lower scores than primary healed ulcers (EQ5D: 0.60) or minor amputations (EQ5D: 0.61).

A Greek study[6] of elderly people living in rural place showed that the most important predictors of impaired HRQoL were female gender (55.4 in the SF36 psychometric tool), diabetic complications, comorbidities and diabetes duration. Older age (56.5 in the SF36 psychometric tool), lower education (60.5 in the SF36 psychometric tool), being unmarried (59.6 in the SF36 psychometric tool), obesity (60.5 in the SF36

psychometric tool), hypertension (62.7 in the SF36 psychometric tool) and dyslipidemia (58.8 in the SF36 psychometric tool) were also associated with impaired HRQoL. In an article of 2006 Piette *et al*[60] note: Most adults with diabetes have at least one comorbid chronic disease and as many as 40% have at least three. The authors categorize comorbidities into groups according to their clinical severity (end stage cancer or stage IV heart failure), the presence or absence of symptoms (dyslipidemia, hypertension *vs* rheumatoid arthritis) and their concordance or discordance to diabetes (dyslipidemia *vs* low back pain) without clearing the importance of the presence of comorbidities of each category to the evolution of diabetes. In other studies the coexistence of comorbidities resulted in lower scale scores. Also, lower HRQoL was reported in many studies assessing the co-existence of diabetes and other chronic diseases and co morbidities. In a study by Maddigan *et al*[61], the estimated score of diabetics with no complications was slightly lower than the general population, but when co morbidities added up in a patient's life the score deteriorated severely. Triplets of comorbidities were associated with HRQoL deficits. There are studies that correlate exercise with QoL reporting the highest level of physical activity in respondents with better HRQoL and overall health[55]. Wee *et al*[62] describes three possible types of correlation between diabetes and other medical conditions: (1) additive; (2) synergistic; and (3) subtractive relationship, while in his study reports the above mentioned correlation to be additive. He also reports diabetes in general as having moderate influence on subjects in comparison with other chronic illnesses. Another increasingly interesting but not so illuminated point is the interaction between comorbid chronic diseases, innovative treatments such as immunosuppressive agents and the development of overt diabetes to prior non diabetic patients as Pereiraa *et al*[63] high lightened. In this article the authors showed that CsA, tacrolimus and especially rapamycin affected lipolysis of human adipocytes through multiple metabolic pathways and regulations (IL6, TNF, inhibition of mTORC1 and 2 and consequent anomaly in the expression an stimulation of PPARγ) thus impairing the capacity of adipose tissue for plasma lipid clearance, which might contributes to dyslipidemia, fatty liver and promotes the onset of overt diabetes[63].

## DEPRESSION, DEMENTIA AND DIABETES: AN INTERESTING TRIANGLE

The coexistence of depression and diabetes has drawn researchers' attention. The fact is quite justified since numerous studies have demonstrated the obscure effect of depression in the evolution of diabetes especially when comorbidities or complications exist[64-66]. Another less studied aspect is the effect of antidepressants on glucose metabolism. Some of them have shown diabetogenic action in non-diabetic depressed patients while others

have proved to ameliorate glucose metabolism and consequently they are preferable for treatment of the diabetic population[67]. It is described that effective treatment with antidepressants improves glucose levels in nondiabetics. Cognitive behavioral therapy and selective serotonin reuptake inhibitor (SSRI) improve glycemic control, whereas noradrenergic antidepressants and tricyclic antidepressants cause alter metabolic control[67]. Further illumination on the extremely complex issue of interaction between depression treatment and the development and evolution of diabetes is derived from study of Köhler *et al*[68] who reports a beneficial outcome when statins (most of which is diabetogenic and a standard treatment of diabetic dyslipidemia) are added to SSRIS. The study of Goldney *et al*[64], showed increased prevalence of depression almost 24% of the diabetics compared with 17.1% of the non-diabetics. Also Gavard *et al*[69], in a systematic review of depression in diabetes provided the range of 8.5%-27.3% regarding the prevalence of depression in diabetics. On the other hand depression is related with a 60% increased risk of type 2 diabetes[70]. Goldney *et al*[64], gave an explanation through deterioration of recovery after a cardiac[71], malignancy survival, and predisposition to infection. Many pathways have been proposed for this dysfunctional immune system. The impact of depression on diet, exercise, smoking, alcohol abuse, compliance to treatment regimen. Regardless of the mechanism, the outcomes are clear about the negative role of depression on the course of the diabetes progression[66]. At last Lin *et al*[72], implements those patients with diabetes and coexisting depression are at increased risk. Some of those are infections, dementia, chronic obstructive pulmonary disease and arthritis. The new information emerging from the literature is the characterization of Alzheimer's disease as type 3 diabetes due to common metabolic paths, resistance to insulin and to similar deficits of brain nerve cell along with the improvement of brain cognitive function after intranasal insulin or peroxisome proliferator-activated receptor agonists[73-84]. Similar potential was demonstrated with incretin based therapies[85]. Needless to refer to what dementia does not only to a diabetic's QoL but life itself. To make it worse let us include what dementia does not only to the patient but also to spouses or family's life and QoL.

## SOCIAL FUNCTION AND HRQOL

Apart from physical function mental and cognitive decline another aspect of diabetes gruesome influence on HRQoL takes place through the disintegration of the family. In a study by Takenaka *et al*[86], it was demonstrated that family issues were common among type 2 diabetics. The diabetic interacts with the family environment and social net (friends, relatives and acquaintances). Sometimes family acts like diabetes police and other times family doesn't want to participate to patients struggle for better glycemic control. Even

worse, they undermine patient's efforts. The patient reacts with aggressiveness, alienation, spite, or denial to comply, all of which leads to loss of social support, loss of belief in self-efficacy, poorer glycemic control, depression smoking, alcohol use and abuse, consequently complications and comorbidities and dramatic deterioration of HRQoL[73,84,87].

## CAN DIABETES HRQOL BE IMPROVED?

Having processed all the above the international community is in search of the proper intervention for the fitting patient and specific divergence. Many studies have been performed and more of them are needed. It is well known the correlation between lifestyle interventions and better glycemic control, hypertension management and lipid management. There are many studies to confirm it[88,89]. In an analysis of 2004 by Ranji *et al*[90], many types of interventions are recognized: (1) provider reminders; (2) facilitated relay of clinical data to providers; (3) audit and feedback; (4) provider education; (5) patient education; (6) promotion of self-management; (7) patient reminders; (8) organizational change; and (9) financial, regulatory, or legislative incentives.

In the same analysis the writers identified as most common type of QoL intervention category of organizational change, followed by patient education and provider education. Moreover, it reports benefit of multifaceted interventions of disease management to a lesser extent and a no statistically significant benefit from the existence of a clinical information system.

Another review by Ricci-Cabello *et al*[91], aimed at quality of care of African Americans reported that interventions targeting self-management, education, reduced the percentage of HbA1c by 0.8%. No such relation was observed with interventions aiming at health care systems and multiple-target interventions

Whilst in a study of Wong *et al*[92], assessing the effect of education interventions among type 2 diabetics showed that there were no associations between the number of sessions attended and HRQoL. Another study evaluated HRQoL in overweight diabetic individuals after attending a weigh-lowering program. The evidence was that the diabetics had significant benefit especially those with the highest baseline BMI and the lower baseline scores[93].

At last a Norwegian review regarding diabetes interventions Sørensen *et al*[89], marked the need for multicomponent interventions targeting patients, health care professionals and policy makers. However, in the same review emphasize the fact that methods to assess the population based impact of these programs in the real world are limited. On the other hand, the outcomes of the Continuous Quality Improvement programme in Catalonia are encouraging and promising since they show the possibilities and potentials of health care interventions on diabetes HRQoL[94].

## CONCLUSION

Diabetes continues to be a major contemporary epidemic. In addressing the challenges of confronting the epidemic a primary therapeutic goal is QoL. There is still a lot of confusion regarding the context of QoL, HRQoL and diabetes specific QoL. Recently numerous psychometric tools have been developed in the effort of evaluating QoL, HRQoL and Diabetes specific QoL. Diabetes affects major components of QoL although differences in terms of ethnicity, environment, gender socioeconomic status, culture, profession dietary and lifestyle habits do exist. More specifically: (1) the physical component especially with coexisting obesity complications as CAD renal failure, diabetic neuropathy or retinopathy or co morbidities; (2) the psychological component especially type 1 in younger subjects and in coexistence with depression; (3) the social component by destroying family ties and friendships; and (4) the mental cognitive component particularly when dementia presents.

In that scope numerous worldwide studies have been performed and have demonstrated little to moderate benefit in different components. Towards positive direction is the development of projects such as diabetes quality improvement project but there is al lot to be done in the future[32].

It would be ideal if the same psychometric tools could be translated validated and used in a worldwide scale in order to explore differences in the populations and extract comparable results. At last, diabetes is a strong and cunning enemy demanding all of our resources but technology development and the quality of unexplored yet human brain provide us with the insinuation of a brighter dawn in diabetes homeland.

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