Quality of sleep and quality of life in people with type 2 diabetes

Vanessa Vieira, Tamara Verussa, Michele Lagacci, Mirian Ueno, Monize Cocetti, Maria Ceolim, Maria de Melo Lima

Sleep disorders are common in people with diabetes. They may be associated with the condition itself or with the complications that develop as the condition progresses. This study from Brazil investigated sleep quality and quality of life (QoL) in adults with type 2 diabetes seen at a primary basic health care unit. An association was found between all sleep quality components, except sleep duration, and the QoL domains of WHOQOL-bref, suggesting that sleep quality has a significant impact on perception of QoL. Evaluation of sleep quality in adults with type 2 diabetes may provide a better understanding of the aetiology of sleep disorders in this group and the implications for QoL, as well as identifying non-pharmacological therapies such as manipulation of sleep duration.

Article points

1. Poor sleep quality is a risk factor for the development of diabetes.
2. This study investigated the relationship between sleep quality and quality of life in adults with type 2 diabetes.
3. Longer and more efficient sleep was associated with lower fasting plasma glucose and HbA_{1c} levels.
4. A negative correlation was found between HbA_{1c} levels and global PSQI score, suggesting a better sleep quality in those with lower HbA_{1c} levels.
5. It was concluded that sleep quality is closely related to perceived quality of life in people with diabetes.

Key words

- Type 2 diabetes
- Sleep quality
- Quality of life

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Sleep disorders are common in people with diabetes (Lamond et al, 2000) and may be associated with the condition itself or with the complications that develop as the condition progresses. Existing studies indicate that poor sleep quality, especially excessive sleep duration or sleep deprivation, is a risk factor for the development of diabetes (Mallon et al, 2005; Tuomilehto et al, 2008). Spiegel et al (1999) found that sleep deprivation increased night-time cortisol levels by activating the hypothalamic–pituitary–adrenal axis, impairing glucose tolerance. This suggests that sleep disorders might be a risk factor for the development of insulin resistance.

Alvarez and Ayas (2004) reported that, under experimental conditions, short-term sleep restriction results in adverse physiological effects, such as hypertension, activation of the sympathetic nervous system, impaired glycaemic control and increased inflammatory activity. The authors also suggested that adequate sleep quality and quantity should be considered a fundamental component of a healthy lifestyle, like weight control and physical activity, rather than a luxury.

Diabetes has a significant impact on an individual's quality of life (QoL) because of the long-term effects and the lifestyle changes required to maintain glycaemic control. QoL assessment is a useful tool for eliciting an individual's perception of his or her health and wellbeing and also contributes to evaluation of the effectiveness of the treatment given (Pibernik-

Okanovíc, 2001).

An individual's perception of his or her own health status should be a co-adjuvant in the assessment of health requirements, given that complex physical, emotional and social interactions are implicated in the development of disease and influence treatment outcomes, thus demonstrating 'the need to value, validate and appreciate certain vital processes inherent to the health-disease continuum (Botell, 2002).

Aim of the study

The aim of the study was to investigate sleep quality and quality of life in adults with type 2 diabetes seen at a primary basic health care unit, and to examine the relationships between these two parameters, anthropometric data and biochemical variables.

Participants and methods

The study was conducted on 105 adults with type 2 diabetes seen at a primary health care unit in the municipality of Campinas, São Paulo, Brazil, between January and June 2005.

Criteria for inclusion in the study were:

- Age 18 years or more.
- A confirmed diagnosis of diabetes mellitus for at least one year.
- Ability to communicate verbally and to respond to an interview.
- Voluntary participation in the study after willingly signing an informed consent form.

Participants were interviewed at the primary health care unit or at home using the following instruments:

- WHOQOL-bref – an abbreviated version of the Portuguese version of the World Health Organization QoL assessment instrument (WHOQOL-100) already in use in Brazil (Fleck et al, 1999).
- A generic instrument for evaluating quality of life.
- The Pittsburgh Sleep Quality Index (PSQI) (Buysse et al, 1989) for evaluation of sleep quality.

The following anthropometric measurements were obtained: weight, height, waist circumference and neck circumference. Venous blood samples were collected from participants after an 8-hour fast for measurement of HbA_{1c} and fasting plasma glucose.

The WHOQOL-bref contains 26 questions: two general questions on QoL and one from each of the 24 aspects in the original instrument. The questions are organised into four domains: physical, psychological, social relations and environment (Fleck et al, 1999). The score for each response ranges from 1 to 5, with higher scores indicating better quality of life. Each domain is evaluated separately.

The PSQI has been translated into Portuguese and has been used by other investigators in Brazil (e.g. Ceolim and Menna-Barreto, 2000). The questions should be answered with regard to sleep over the previous 30 days. The instrument is divided into seven components: sleep quality, sleep latency, sleep duration, sleep efficiency, night-time sleep disorders, use of hypnotic medications and daytime sleepiness. Each component receives a score ranging from 0 to 3, and the sum of the scores provides the global PSQI score, with a score > 5 indicating poor sleep quality. The highest score indicates the poorest sleep quality. The components can be examined separately for a more detailed evaluation of possible factors contributing to the disorder.

The Epi-Info 6.02 software was used to construct the database and for statistical analysis. Descriptive analysis consisted of determination of central trend and dispersion. The results were analysed by non-parametric tests because of the pattern of data distribution. Correlation tests were performed in order to assess the relationship between two variables. In a positive correlation, the relationship between two variables is such that as one variable's values increase, the other variable's values also tend to increase. A negative correlation means that the relationship between two variables is such that as one variable's values increase the other variable's values tend to decrease. Multivariate logistic regression (stepwise forward model) was applied to the comparison of different instruments and measures. $P < 0.05$ was adopted as the level of significance.

The study was approved without restrictions by the Ethics Committee of the School of Medical Sciences, State University of Campinas, in 2004 (protocol CEP 492/04).

Page points

1. A total of 105 adults with type 2 diabetes seen at a primary healthcare unit in São Paulo, Brazil, took part in the study.
2. Participants were interviewed at the primary healthcare unit or at home.
3. Quality of life was assessed by three instruments: the WHOQOL-bref; a generic instrument; and the Pittsburgh Sleep Quality Index (PSQI).
4. The anthropometric data collected were weight, height, waist circumference and neck circumference.
5. The biochemical variables measured were HbA_{1c} and fasting plasma glucose.

Page points

1. A total of 105 people with type 2 diabetes who met the inclusion criteria were interviewed.
2. Participants differed significantly in terms of the scores obtained for the psychological and environmental domains and in terms of general QoL as a function of time since diagnosis of diabetes.
3. A significant difference between patients with good sleep quality (n=27), and patients with poor sleep quality (n=78) was observed in all domains and in general QoL (P<0.005 for general QoL and all domains, except for P < 0.01 for psychological domain).

Results

A total of 105 people with type 2 diabetes who met the inclusion criteria were interviewed. *Table 1* summarises the socio-demographic characteristics of the participants, anthropometric measures, biochemical variables, and QoL and sleep quality scores (mean and standard deviation obtained with the WHOQOL-bref and PSQI, respectively).

Table 2 shows the median sleep quality and QoL parameters according to time since diagnosis of diabetes mellitus and age of participants.

Participants differed significantly in terms of the scores obtained for the psychological and environmental domains and in terms of general QoL as a function of time since diagnosis of diabetes mellitus. Those with more than 10 years since diagnosis had lower scores, which were indicative of poorer general QoL and QoL in each domain, compared with the other two groups. There was no significant difference in sleep quality evaluated by the PSQI between the groups with different times since diagnosis.

Participants aged 60 years or more reported better sleep quality, demonstrated by a lower PSQI score, than those aged 60 years or less; the difference was statistically significant. General QoL also tended to be significantly different between age groups, with those aged 60 years or more having a better QoL (P=0.08).

Body mass index (BMI) was positively correlated with the 'subjective sleep quality' component of the PSQI (P<0.05) and negatively correlated with the physical domain of the WHOQOL (P<0.05). No significant correlation was observed between the remaining anthropometric measures and PSQI components, global PSQI score, WHOQOL domains or general QoL.

With respect to the biochemical variables, a negative correlation was observed between HbA_{1c} and sleep duration (P<0.01) and sleep efficiency (P<0.005). In addition, HbA_{1c} tended to be positively correlated with global PSQI score (P=0.07). A negative correlation was observed between fasting plasma glucose and sleep duration (P<0.05) and sleep efficiency (P<0.02). There was no correlation between the WHOQOL domains and the biochemical variables measured.

A negative correlation was seen between the WHOQOL-bref domains and the PSQI components, except for the 'sleep duration' component. This suggests an association between the subjective assessment of QoL and sleep quality. In addition, a moderate positive correlation was found between all WHOQOL-bref domains. Most PSQI components also showed a significant positive correlation, with 'use of hypnotic medication' being significantly correlated with only three other domains of the PSQI.

A significant difference between patients with good sleep quality (n=27) and patients with poor sleep quality (n=78) was observed in all domains and in general QoL (P<0.005 for general QoL and all domains, except for P<0.01 for psychological domain).

Linear regression analysis showed that the physical and psychological domains of the WHOQOL-bref and HbA_{1c} explained 44% of the variation in global PSQI score. The linear model that included the physical domain, environmental domain and general QoL explained 54% of the variation in the psychological domain.

Discussion

Assessment of QoL currently includes factors that affect the individual's perception of his or her physical and mental health, and is considered a fundamental measure for understanding the health status of a population (Brown et al, 2004), as well as that of specific groups of subjects with defined diseases, such as asthma (asthma quality of life questionnaire - AQLQ), heart failure (MacNew heart disease questionnaire), gastrointestinal diseases (gastrointestinal quality of life index - GIQLI) among others.

Several instruments for the subjective assessment of health-related QoL have been proposed, and generic and specific instruments are available in the literature. Widely known and internationally used generic instruments include the Sickness Impact Profile (SIP), Nottingham Health Profile (NHP), Medical Outcomes Health Survey Short-Form-36 (SF-36), and the WHOQOL in its original (100 questions) and short version (WHOQOL-bref, 26 questions). The WHOQOL and SF-36 have been used extensively in Brazil. The WHOQOL-bref was

chosen for the present study, as it is shorter and easier to apply than other instruments, while covering all aspects and domains that may be altered in people with diabetes. The diversity of instruments and lack of standardisation of the domains of each instrument make it difficult to compare the present findings with results of studies of the QoL of people with type 2 diabetes mellitus reported in the international literature.

The general features of participants in the present study, i.e. mean age 62 years and 65% female, are characteristic of an elderly population. The time since diagnosis of diabetes was more than 5 years in 72.1% of participants, i.e. sufficient time for the development of complications.

The mean sleep quality score of participants was similar to that reported in another study conducted in India on 220 middle-aged and elderly adults (mean age 59.4 years) with type 2 diabetes (Vigg et al, 2003). In Vigg et al's study the mean PSQI score was 8.3, and 71% of participants had poor sleep quality, defined as a PSQI score of >5 (Vigg et al, 2003).

In the present study, participants with more than 10 years since diagnosis of diabetes showed signs of poor QoL in the environmental and psychological domains and in general QoL. These data agree with those found in international studies. For example, Schappert (1992) demonstrated a decline in the QoL of people with diabetes who presented with associated physical symptoms and complications. In addition, epidemiological studies have reported a low QoL in people with diabetes compared with the general population (Rubin and Peyrot, 1999). In their study of elderly people with diabetes, Wändell and Tovi (2000) found poorer QoL in those with a longer duration of diabetes, compared with the general population, especially in aspects related to physical health. These findings support those of Klein et al (1998).

Brown et al (2004) point out that low QoL scores are to be expected in people with diabetes, given the changes in lifestyle required to control the disease. These changes include physical and behavioural adaptations such as dietary modifications, physical activity and treatment; such changes may also have psychological consequences, for example, depression, frustration due to treatment and emotional stress.

In the present study, participants aged 60 years or more reported better sleep quality than those younger than 60 years. Similar findings were reported by Vitiello et al (2004), who suggested that older subjects may adapt their perception to a pattern of 'acceptable' sleep and thus have fewer

Table 1. Characteristics of the study participants

Variable	No. (%)	Mean (±SD)
Gender		
Men	37 (35.2%)	
Women	68 (64.8%)	
Age (years)		
All ages	62.0 (± 11.1)	
<60 years	48 (45.7%)	
≥60 years	57 (54.3%)	
Time since diagnosis of diabetes mellitus	9.9 (± 7.7)	
<5 years	29 (27.9%)*	
5–10 years	38 (36.5%)*	
>10 years	37 (35.6%)*	
Anthropometric measures		
Body mass index (weight [kg]/height [m]^2)	29.7 (± 4.9)	
Waist circumference (cm)		102.3 (± 12.3)
Neck circumference (cm)		38.6 (± 3.7)
Biochemical variables		
Glycosylated haemoglobin (HbA_{1c})		7.9 (± 2.4)
Fasting plasma glucose (mg/dl)		170.8 (± 66.3)
Quality of life (WHOQOL-bref)		
General		58.5 (± 20.4)
Physical domain		59.2 (± 18.2)
Psychological domain		61.5 (± 17.3)
Social relations		65.9 (± 17.9)
Environmental domain		54.7 (± 13.1)
Sleep quality (PSQI)		
Good (≤5 points)	27 (25.7%)	
Poor (>5 points)	78 (74.3%)	
Global PSQI score		8.1 (± 4.2)
Subjective sleep quality (score)		1.3 (± 0.6)
Sleep latency (score)		1.5 (± 1.1)
Sleep duration (score)		1.3 (± 1.0)
Sleep efficiency (score)		0.9 (± 1.2)
Night-time sleep disorders (score)		1.5 (± 0.6)
Use of hypnotic medications (score)		0.5 (± 1.1)
Daytime sleepiness (score)		1.1 (± 0.9)
Sleep duration (hours)		6.3 (± 1.6)
Sleep efficiency (%)		80.8 (± 17.0)

PSQI = Pittsburgh Sleep Quality Index
**Total = 104. Data incomplete for one participant*

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3. Sleep duration was positively correlated with HbA_{1c} and fasting plasma glucose levels.
4. HbA_{1c} was negatively correlated with global PSQI score, suggesting that a lower HbA_{1c} level was associated with better quality sleep.
5. Sleeping for 6 hours or less per night or 9 hours or more increases the risk of developing diabetes mellitus and glucose intolerance (Gottlieb et al, 2005).
6. Further research is needed to determine whether an adequate number of hours' sleep (7–8 hours per night) is useful as a non-pharmacological treatment for people with diabetes mellitus and glucose intolerance.

subjective complaints about sleep, evaluating as 'normal for their age' some aspects which, in fact, indicate sleep disorders.

The association between sleep quality and BMI found in the present study is still a matter of controversy. Strine and Chapman (2005) noted that obese people (BMI >30 Kg/M^2) reported insufficient sleep more frequently than non-obese individuals. Dixon et al (2001) found a high prevalence of sleep disorders associated with sleep-related respiratory disorders in obese men and women (BMI >35 Kg/M^2), and showed an evident improvement after BMI reduction. However, Sridhar and Putcha (2005) concluded that BMI was not a risk factor for sleep disorders, with obese and overweight patients showing no difference in sleep disorders compared with normal weight individuals.

The relationship between sleep duration, glucose intolerance and the development of diabetes has been debated extensively by Gottlieb et al (2005). In the present study, sleep duration was positively correlated with HbA_{1c} and fasting plasma glucose levels. In addition, 33.3% of the people studied reported that they slept less than 6 hours, whereas only 4.8% reported sleeping an average of 9 hours or more.

In the present study, an association was found between sleep duration and efficiency and fasting plasma glucose and HbA_{1c} levels, with individuals with longer and more efficient sleep showing lower levels of these variables. HbA_{1c} was also negatively correlated with global PSQI score, suggesting that people with lower HbA_{1c} levels had a better quality of sleep.

In a study conducted on middle-aged and elderly community-living adults, and therefore similar to participants in the present study, Gottlieb et al (2005) showed that short-duration sleep was associated with an increased risk of diabetes mellitus and glucose intolerance according to the glycaemic control measures evaluated. Participants who slept 6 hours or less per night, or 9 hours or more, had an increased risk of developing diabetes mellitus and glucose intolerance. This association persisted even after controlling for other known risk factors for the development of diabetes mellitus. The findings of this study support the recommendation that adults need 7–8 hours sleep per night. The authors also suggest that further research is needed to determine whether sleeping an adequate number of hours (7–8 hours per night) is useful as a non-pharmacological treatment for people with diabetes mellitus and glucose intolerance (Gottlieb et al, 2005).

However, in the present study no association was observed between the WHOQOL domains and the biochemical variables measured. Goddijn et al (1999) studied glycaemic control

Table 2. Median sleep quality scores (global PSQI, sleep duration and efficiency) and median quality of life scores (WHOQOL-bref domains and general QoL) according to time since diagnosis of type 2 diabetes and age

	Time since diagnosis of diabetes (years)			Age (years)	
Variable	**<5 (n=29)**	**5–10 (n=38)**	**>10 (n=37)**	**<60 (n=48)**	**≥60 (n=57)**
PSQI					
Sleep duration (hours)	6.5	7.0	6.0	6.8	6.5
Sleep efficiency (%)	87.5	85.7	84.6	84.3	85.7
Global PSQI score	7.5	6.5	7.0	**7.5***	**6.5***
WHOQOL-bref					
Physical domain	60.7	64.3	60.7	60.7	60.7
Psychological domain	**66.7***	**66.7***	**54.2***	66.7	62.5
Social relations	66.7	75.0	58.3	66.6	66.6
Environmental domain	**53.2***	**60.9***	**50.0***	54.7	53.1
GQoL	**62.5***	**62.5***	**50.0***	56.3	62.5

GQoL = general quality of life; * P <0.05

based on symptoms of hypoglycaemia and hyperglycaemia and measurement of HbA_{1c} in 99 people with type 2 diabetes over a one-year period. The authors examined the association between these parameters and QoL evaluated using a specific instrument for use in people with diabetes (Diabetes Health Profile) and a general instrument (SF-36). By the end of one year, QoL had improved, especially in the group that achieved better glycaemic control associated with an absence of, or reduction in, the signs and symptoms of hyperglycaemia. Reduced HbA_{1c} levels alone were not associated with improved QoL.

In a multicentre study, Testa and Simonson (1998) studied 569 people with type 2 diabetes divided into two groups (placebo and intensive therapy with glipizide) to evaluate the association between glycaemic control and QoL, as well as the cost-benefit relationship. Plasma glucose and HbA_{1c} levels in the group on glipizide therapy were reduced at the end of 12 weeks when compared with the placebo group, and these parameters were associated with a significant improvement in QoL.

In the present study, an association was found between all sleep quality components, except for sleep duration, and the QoL domains of the WHOQOL-bref. This finding was in agreement with the association between QoL and sleep quality reported in the international literature by Strine and Chapman (2005).

A study involving about 2000 subjects interviewed at home was carried out in Great Britain in order to characterise the sleep patterns of adults. The authors found that sleep quality has a great impact on the perception of QoL (Groeger et al, 2004). Furthermore, as in the present investigation, in the British study a longer duration of sleep did not always mean a better quality of sleep, with the involvement of mood as an intervening variable becoming more complex. Groeger et al (2004) noted that the group sleeping more than 9 hours a night were less satisfied, had less energy and were less successful than the other groups. The mean duration of sleep was found to be associated with QoL (energy, satisfaction and success at work, at home and during leisure activities) but only up to 9 hours of sleep, and was negatively associated with QoL when sleep duration was 9 hours or more. Groeger et al (2004) suggested that individuals who reported sleeping less than 9 hours a night tend to associate insufficient sleep with poorer performance and QoL, and that a sleep duration of more than 9 hours would show the same association, probably together with depressive mood.

These findings could not be reproduced in the present study as no significant correlation was observed between the QoL domains and sleep duration (data not shown). Furthermore, no significant correlation between sleep duration and QoL was observed when participants were divided into two groups, one with a sleep duration of less than 9 hours (n = 100) and the other with a sleep duration of 9 hours or more (n = 5).

Limitations

One limitation of our study is that we did not include a control group consisting of either people without diabetes and other diseases, or of healthy people. In a previous study, where the WHOQOL-bref was validated for Brazilian patients there was a healthy control group in which the score was higher (indicating an improved quality of life) compared to patients with diseases (Fleck, et al. 1999). These control groups would have allowed us to better define whether our findings were solely due to diabetes. Despite this, our conclusion is still valid.

Suggestions for future research

The findings suggest that in future studies it will be important to:

- Evaluate diabetes-associated complications in people with diabetes to establish the association between metabolic variables, time since diagnosis of diabetes, QoL and sleep quality as a whole.
- Include an instrument to evaluate depression, in view of the association between the psychological domain and sleep quality observed in this study.

Conclusion

Sleep assessment is an important component of health care. Sleep evaluation in adults with type 2 diabetes may improve our understanding of the

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1. Further research is needed to determine the association between metabolic variables, time since diagnosis of diabetes, QoL and sleep quality as a whole in people with diabetes-associated complications.
2. Future studies should include an instrument to evaluate depression, in view of the association between the psychological domain and sleep quality observed in the present study.
3. Sleep assessment is an important component of health care.

Sleep evaluation in adults with type 2 diabetes may improve our understanding of the prevalence of sleep disorders in this group and the implications, including the identification of non-pharmacological therapies such as manipulation of sleep duration.

prevalence of sleep disorders in this group and the implications, including the identification of non-pharmacological therapies such as manipulation of sleep duration. Nurses can educate patient and family to consider these fundamental recommendations: strive to have regular sleep and waking hours; create a sleep inducing environment, quiet and comfortable, with a pleasant room temperature; avoid liquid intake near bedtime, as well as caffeinated drinks (coffee, black tea) and improve daily activities outdoors, especially in the early morning, for example, light walking or gardening. ■

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