



# HEALTH-RELATED QUALITY OF LIFE, ANXIETY, DEPRESSION AND CARDIOMETABOLIC VARIABLES IN PEOPLE WITH TYPE 2 DIABETES

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## ABSTRACT

Type 2 diabetes Mellitus is related to the increase prevalence of mental health problems. The aim of this study was to a) verify the anxiety and health-related quality of life (HRQoL) of diabetics with and without symptoms of depression; b) correlate HRQoL with blood glucose levels and abdominal adiposity and c) investigate if there is difference between genders. Ninety-six individuals, with an average age of  $56.2 \pm 9.6$  years, men and women, carried out anthropometric measure: waist circumference (WC), body mass index, evaluation of blood pressure (BP), heart rate (HR) and fasting blood glucose. The Beck Depression Inventory, the Trait-State Anxiety Inventory and the SF-36 Questionnaire verified the presence of depressive symptoms, the anxiety level and the HRQoL respectively. Most individuals were overweight (78%) and altered WC (72.9%). The depression's prevalence was 34.1%, and the levels of trait and state anxiety were 63.3% and 77%. Individuals with depression had worse HRQoL, anxiety (trait) and altered WC, but without differences in HR and BP. Men had better HRQoL and lower levels of depression than women. Cardiometabolic variables (abdominal adiposity and blood glucose) correlated with altered HRQoL, despite gender. In men, correlations between glycemia and functional capacity, and HR with mental health were observed. In women, anxiety levels correlated with functional capacity and abdominal adiposity. Diabetes is directly related to biopsychosocial factors, mainly HRQoL and depression. In addition, depressive diabetics have worse HRQoL, more anxiety and, in men, changes in body composition.

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**Keywords:** Diabetes *Mellitus*; Mental health; Blood glucose; Diabetes Complications; Waist Circumference.

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## QUALIDADE DE VIDA RELACIONADA À SAÚDE, ANSIEDADE, DEPRESSÃO E VARIÁVEIS CARDIOMETABÓLICAS EM PESSOAS COM DIABETES TIPO 2

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## RESUMO

O diabetes Mellitus tipo 2 está relacionado ao aumento da prevalência de problemas de saúde mental. O objetivo deste estudo foi a) verificar a ansiedade e a qualidade de vida relacionada à saúde (QVRS) de diabéticos com e sem sintomas de depressão; b) correlacionar QVRS com glicemia e adiposidade abdominal ec) investigar se há diferença entre os sexos. Noventa e seis indivíduos, com idade média de  $56,2 \pm 9,6$  anos, homens e mulheres, realizaram medidas antropométricas: circunferência da cintura (CC), índice de massa corporal, avaliação da pressão arterial (PA), frequência cardíaca (FC) e glicemia de jejum. O Inventário de Depressão de Beck, o Inventário de Ansiedade Trait-State e o Questionário SF-36 verificaram a presença de sintomas depressivos, o nível de ansiedade e a QVRS respectivamente. A maioria dos indivíduos apresentava excesso de peso (78%) e CC alterada (72,9%). A prevalência de depressão foi de 34,1%, e os níveis de ansiedade traço e estado foram de 63,3% e 77%. Indivíduos com depressão apresentaram pior QVRS, ansiedade (traço) e CC alterada, mas sem diferenças na FC e PA. Os homens apresentaram melhor QVRS e menores níveis de depressão do que as mulheres. Variáveis cardiometabólicas (adiposidade abdominal e glicemia) correlacionaram-se com alteração da QVRS, independente do sexo. Nos homens, foram observadas correlações entre glicemia e capacidade funcional e FC com saúde mental. Nas mulheres, os níveis de ansiedade correlacionaram-se com a capacidade funcional e adiposidade abdominal. O diabetes está diretamente relacionado a fatores biopsicossociais, principalmente QVRS e depressão. Além disso, diabéticos depressivos apresentam pior QVRS, mais ansiedade e, nos homens, alterações na composição corporal.

**Palavras-Chave:** Diabetes Mellitus; Saúde Mental; Glicemia; Complicações do Diabetes; Circunferência da Cintura.

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## CALIDAD DE VIDA RELACIONADA CON SALUD, ANSIEDAD, DEPRESIÓN Y VARIABLES CARDIOMETABÓLICAS EN PERSONAS CON DIABETES TIPO 2

### REANUDAR

La diabetes mellitus tipo 2 se relaciona con una mayor prevalencia de problemas de salud mental. El objetivo de este estudio fue a) verificar la ansiedad y la calidad de vida relacionada con la salud (CVRS) de diabéticos con y sin síntomas de depresión; b) correlacionar la CVRS con la glucemia y la adiposidad abdominal yc) investigar si existe diferencia entre sexos. A 96 individuos, con una edad media de  $56,2 \pm 9,6$  años, hombres y mujeres, se les realizaron mediciones antropométricas: circunferencia de cintura (CC), índice de masa corporal, presión arterial (PA), frecuencia cardíaca (FC) y glucemia en ayunas. El Inventario de Depresión de Beck, el Inventario de Ansiedad Rasgo-Estado y el Cuestionario SF-36 verificaron la presencia de síntomas depresivos, el nivel de ansiedad y la CVRS respectivamente. La mayoría de los individuos tenían sobrepeso (78%) y CC alterada (72,9%). La prevalencia de depresión fue del 34,1%, y los niveles de ansiedad rasgo y estado fueron del 63,3% y 77%. Los individuos con depresión tenían peor CVRS, ansiedad (rasgo) y CC alterada, pero sin diferencias en FC y PA. Los hombres tenían mejor CVRS y niveles más bajos de depresión que las mujeres. Las variables cardiometabólicas (adiposidad abdominal y glucemia) se correlacionaron con cambios en la CVRS, independientemente del sexo. En los hombres se observaron correlaciones entre la glucemia y la capacidad funcional y la FC con la salud mental. En las mujeres, los niveles de ansiedad se correlacionaron con la capacidad funcional y la adiposidad abdominal. La diabetes está directamente relacionada con factores biopsicosociales, principalmente la CVRS y la depresión. Además, los diabéticos depresivos tienen peor CVRS, más ansiedad y, en los hombres, cambios en la composición corporal.



Palabras Clave: Diabetes Mellitus; Salud mental; Glucosa en sangre; Complicaciones de la diabetes; Circunferencia de la cintura.

## 1 INTRODUCTION

Diabetes Mellitus (DM) is a set of metabolic diseases characterized by hyperglycemia caused by defects in insulin action and/or secretion. According to the American Diabetes Association (2020), “The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction and insufficiency of different organs, especially eyes, kidneys, nerves, heart and blood vessels”. It is considered an independent risk factor for cardiovascular disease (CVRD) and is frequently associated with other factors, such as obesity (Bhupathiraju & Hu, 2016) e sedentary lifestyle (Van Der Berg *et al.*, 2016).

The human body is a biological, psychological and social organism, so it must be studied from all perspectives. Therefore, health care must provide an integral view of the human being, thus, the biopsychosocial model has been proposed. In the last decades, there has been a progressive increase in the prevalence of biopsychosocial factors in adult population worldwide. Studies indicate that DM2 is related to the increased prevalence of mental health problems, especially depression, anxiety and quality of life (Bickett & Tapp, 2016).

This was defined by the WHO as “the subject's self-perception in the context in which he is inserted, taking into account his objectives, goals and concerns” (WHOQOL, 1997). So, quality of life is a subjective condition related to people's culture, goals and expectations. Studies show a strong correlation between these factors and quality of life in diabetics (Souza *et al.*, 2019). The diagnosis of diabetes is also associated with twice the risk of developing depression when compared to the non-diagnosis of the disease (Asman *et al.*, 2020). There has been an increased risk of depression in the diabetic population as well as an increases risk of changes in glucose homeostasis in the population with symptoms of depression (Felisberto *et al.*, 2017).

Studies suggest that this relationship between DM2 and symptoms of depression can possibly be explained by the physical stress of maintaining the disease and its associated complications, such as autonomic and peripheral neuropathy, nephropathy, retinopathy causing an increased risk of mortality (Gonzalez *et al.*, 2018). Physical inactivity, poor diet, poor sleep pattern and low social status can also affect the mental health of this population,



in addition to financial difficulties due to the expenses of the disease, shaken self-esteem and even unemployment as a result of health status and fatigue (Asibong *et al.*, 2020).

There is wide research on health-related quality of life in this population in the literature, however, there are few studies that assess the impact of metabolic changes and the presence of anxiety and depressive symptoms on the quality of life of diabetic type 2 men and women. The aim of this study was i) to verify the anxiety and quality of life of diabetics type 2 with and without symptoms of depression; ii) correlate quality of life with blood glucose levels and abdominal adiposity and iii) investigate whether there is a difference between genders.

## 2 METHODS

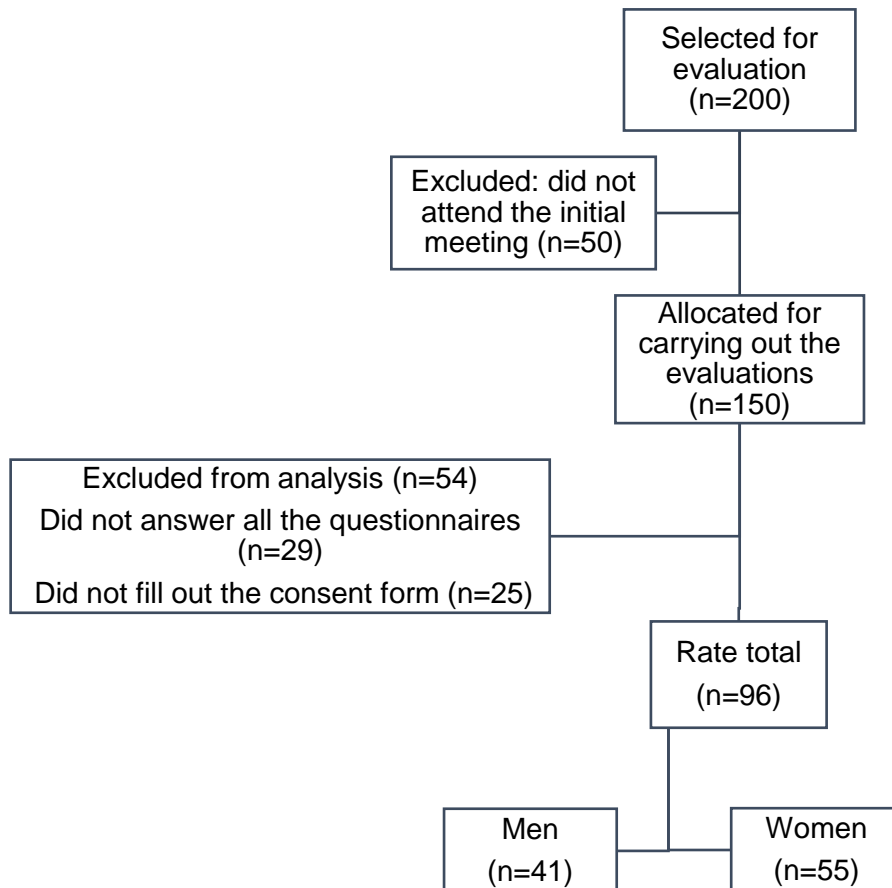
### Participants and procedures

Sedentary individuals aged between 40-60 years, both sexes, with various socioeconomic levels, were assessed using the International Physical Activity Questionnaire (IPAQ). Individuals diagnosed with severe psychiatric disorders, significant cognitive impairment, assessed by the mini-Mental State exam (scores below 24 as cut-off points); and insulin addicts were excluded from the analysis.

Initially 350 volunteers were invited, after telephone contact there was a loss of 57.14% for the following reasons: wrong or non-existent telephone number and refused to participate in the first contact. With a total of 200 volunteers who agreed to participate in the initial meeting, after reading and explaining the Free and Informed Consent Term and study procedures, 150 chose to continue the study and at the end 96 completed the assessments, as shown in the figure 1.

Ninety-six individuals, with a mean age of  $56.2 \pm 9.6$  years, 55.3% female and 42.7% male, and with an average diagnosis time of diabetes mellitus of  $10, 0 \pm 7.6$  years participated in the survey.

Figure 1. Diagram of the flow of selection and continuity of the study participants.



## Data collect

A questionnaire was conducted in order to document the medications used by the participants and the history of the disease and comorbidities.

### *Anthropometry and hemodynamics*

Waist circumference (WC) was measured with an anthropometric tape (Sanny brand, São Paulo, Brazil). The body mass index (BMI) was calculated according to the recommendations of the World Health Organization (WHO, 1998). To measure systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR), a semiautomatic device (G. TECH - MA100, São Paulo / Brazil).

### *Depression*

Depression-related behaviors were assessed using the Beck Depression Inventory (BDI), which classifies depressed and non-depressed individuals. It is a structured instrument, composed by 21 items of symptoms and attitudes, which describe affective and somatic cognitive behavioral



manifestations of depression. The score ranges from 0 to 63, and for this study, the following classification was accepted: scores of up to 9 points mean absence of depression or clinically not relevant symptoms, 10 to 18 points mild or moderate depression, 19 to 29 points, moderate to severe and 30 to 63 points, severe depression (Cunha, 2001).

### *Anxiety*

Anxiety levels were assessed using the State-Trait Anxiety Inventory (STAI), which is a tool used to quantify subjective components related to anxiety (Spielberger, 1970). STAI presents a scale that assesses anxiety as a state (STAI-S), which reflects a transient reaction directly related to an adversity situation that presents itself at a given moment, and as a trait (STAI-T), which concerns a more stable aspect related to the individual's propensity to deal with greater or lesser anxiety throughout his life (Cattell & Scheier, 1961). The sum of the values obtained in each answer (final score) varies from 20 to 80 points and corresponds to the level of anxiety, with 20 to 40 points equivalent to a low level of anxiety; 41 to 60 points, at medium level of anxiety; and 60 to 80 points, at a high level of anxiety (Biaggio, Natalicio & Spielberger, 1977).

### *Health-related quality of life*

Health-related quality of life was assessed using the SF-36 questionnaire (Short-Form Health Survey (Ware, 1993). The results were interpreted by assigning scores for each question, which were transformed on a scale from zero to 100, where zero corresponded to a worse quality of life and 100 to a better quality of life. Each dimension was analyzed separately (Adorno & Brasil-Neto, 2013). The dimensions studied were: Functional Capacity, Physical Aspects, Pain, General Health, Vitality, Social Aspects, Emotional Aspects and Mental Health.

### *Glycemic Profile*

To measure blood glucose, the samples were collected using the vacuum method in 4 mL EDTA tubes (Plastilab, São José dos Pinhais - PR) and transported in thermal bags under temperature control between 2 to 8 °C. For the preparation and processing of the samples, homogenized whole blood was used. Blood glucose was measurement on fasting (the absence of any food intake, except water, for at least 8 hours is recommended) (Rodbard *et al.*, 2007). The reference value adopted was fasting blood glucose  $\leq 99$  mg / dL, according to the criteria of the American Association of Clinical Endocrinologists (AACE).

## Ethics

Respecting the rules of conduct in experimental research with human beings (Resolution 196/96 of CNS), and the Guidelines for Ethical Analysis and Processing of Research Projects in the Special Thematic Area of Human Genetics (Resolution 340/2004), this study was submitted and approved by the Ethics and Research Committee of University, under protocol 2,615,302 and in the Brazilian Clinical Trial Registry (REBEC, number RBR-4rjgc3).

## Statistical analysis

The normality of the data was assessed by the Kolmogorov-Smirnov test. Descriptive statistics were presented as mean and standard deviation for parametric data, and median and interquartile range for nonparametric data. The inferential tests applied were: Student's t-test and Mann-Whitney to compare means between groups, Pearson's and Spearman's bivariate correlation to identify the relationship between cardiometabolic variables and the domains of quality of life, depression and anxiety. In addition, the effect size was performed using Cohen's d, which refers to the size of the difference between the groups. All statistical tests performed were bilateral and the level of significance was set at  $p \leq 0.05$ .

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## 3 RESULTS

Table 1 shows the drugs used by the participants and the history of the disease and comorbidities, as well as the anthropometric and biochemical characteristics. The results showed that the majority had blood glucose (66.7%) and WC (72.9%) above normal values. Some were overweight (30%) or obese (48%), the prevalence of depression was 34.1%, and the average levels of trait and state anxiety was medium (63.3% and 77% respectively) (Table 1).

The domains of quality of life and the average values related to the anthropometric, hemodynamic and glycemetic profile are shown in table 2. In the comparison of the data according to sex, there was a significant difference between the WC measures, and the domains: social aspects, mental health, functional capacity, emotional aspects, with the highest values in males, except for the depression score, which was higher in women (Table 2).

When comparing volunteers with symptoms and without clinically relevant symptoms of depression, a significant difference was found between groups for the values of trait anxiety and several domains of quality of life. In other words, depressed individuals also had reduced quality of life and increased anxiety. Among men, there was also a significant difference for WC and BMI. (Table 3).



Correlation analysis showed a correlation between glycemia and trait anxiety ( $r = 0.230$ ;  $p = 0.024$ ) in the entire group, indicating that the latter correlates with diabetes regardless of the presence or absence of depressive symptoms. When the groups were evaluated by sex, a correlation between glycemia and functional capacity, and HR and mental health was observed in men. In women, a correlation was observed between anxiety levels with functional capacity and abdominal adiposity (Table 4).

**Table 1.** Demographic characteristics and frequency of medication use, symptoms of depression and antropometric and biochemical profile of the participants.

<b>CLASSIFICATIONS (REFERENCE VALUES)</b>	<b>N (%)</b>	<b>CLASSIFICATIONS (REFERENCE VALUES)</b>	<b>N (%)</b>
<b>Sex</b>		<b>Waist circumference</b>	
Male	41(42,7)	Normal (Female<84; Male< 90)	22(23,9)
Female	55(57,3)	Elevated	70(76,1)
<b>Age</b>		<b>Body mass index rank</b>	
Adult	58 (60,4)	Underweight (<18,4)	2 (2,1)
Senior	38(39,6)	Eutrophic (18,5 – 24,9)	18 (18,8)
<b>Diagnoses time</b>		Overweight (25,0 – 29,9)	29 (30,2)
Uninformed	28 (29,1)	Obese (>30,0)	47 (49,0)
<5 years	21 (21,8)	<b>Fasting blood glucose</b>	
Between 5 and 9 years	15 (15,6)	Normal $\leq 99$	32(33,3)
Between 10 and 19 years	24 (25,0)	$\geq 100$	64(66,7)
$\geq 20$ years	8 (8,3)	<b>Depressive symptoms</b>	
<b>Presense of related complications</b>		Clinically not relevant symptoms	62 (64,6)
Arterial hypertension	43 (44,7)	With mild to moderate symptoms	34(35,4)
Acute myocardial infarction	10 (10,4)	With moderate to severe symptoms	0 (0,0)
Cerebral vascular attack	6 (6,2)	<b>Depression medication</b>	0 (0,0)
Dyslipidemia	37 (38,5)	<b>Anxiety trait levels</b>	
Retinopathy	65 (67,7)	Low	33(44,6)
Cataract	47 (48,9)	Medium	61 (63,6)
<b>Types of diabetic medications</b>		High	2(2,1)
Metformin	27 (92,7)	<b>Anxiety state levels</b>	
Sulphonylureas	1 (3,1)	Low	21(21,8)
Insulin	2 (5,2)	Medium	74 (77,0)
<b>Arterial blood pression</b>		High	1 (1,04)
Normal (< 130/90mmhg)	41(55,4)		
Elevada	33(44,6)		



**Table 2.** Average values of the hemodynamic, anthropometric profile, quality of life, depression and anxiety of the participants divided by sex.

Variables	Total	Male (n=41)	Female (n=55)	p-Value	D
	M± SD	M± SD	M± SD		
Age	56,21±9,6	55,83±9,7	56,50±9,7	0,743	-0,06(T)
SBP <sup>2</sup>	132,9±20,6	133,5 ± 21,4	132,5 ± 20,3	0,834	0,04(T)
DBP <sup>1</sup>	86,9±14,0	89,8±14,2	84,6±13,8	0,115	0,37(S)
HR <sup>2</sup>	72,3±13,4	75,3 ± 16,1	69,7 ± 1,00	0,075	0,49(S)
WC (cm) <sup>1</sup>	95,7±13,2	100,1±11,7	92,5±13,5	<b>0,006</b>	-0,42(S)
BMI <sup>2</sup>	28,8±5,3	29,3±4,0	28,5±6,0	0,501	0,15(T)
Blood glucose <sup>1</sup>	151,4±76,6	164,2±72,2	141,9±79,0	0,159	0,29(S)
Physical Aspects <sup>1</sup>	65,1±40,9	69,5±39,3	61,8±42,2	0,365	0,18(T)
Social Aspects <sup>1</sup>	76,0±26,0	82,0±23,8	71,5±26,9	<b>0,049</b>	0,41(S)
Mental Health <sup>1</sup>	68,2±22,0	82,1±32,6	61,3±42,5	<b>0,010</b>	0,59(M)
Functional Capacity <sup>1</sup>	66,1±28,2	75,1±26,2	59,5±28,0	<b>0,006</b>	0,57(M)
Pain <sup>1</sup>	56,6±27,3	61,4±27,5	52,9±26,8	0,132	0,31(S)
General Health <sup>1</sup>	53,5±8,8	52,8±7,2	53,9±9,9	0,532	-0,12(T)
Vitality <sup>1</sup>	60,4±21,6	63,4±19,7	58,1±22,8	0,234	0,24(S)
Emotional Aspects <sup>1</sup>	70,2±39,7	75,6±18,4	62,6±23,0	<b>0,004</b>	0,62(M)
STAI-T <sup>1</sup>	43,4±6,9	44,3±6,9	44,3±5,9	0,866	0(T)
STAI-S <sup>1</sup>	44,3±6,3	44,3±6,9	44,3±5,9	0,982	0(T)
BDI <sup>2</sup>	9,3±6,3	7,8 ± 4,8	10,4 ± 7,0	<b>0,045</b>	-0,43(S)

Mann-Whitney Test; <sup>2</sup>T student Test; \*\*p<0,05. M: mean; SD: standard deviation; SBP: systolic blood pressure; DBP: diastolic blood pressure; HR: heart rate; WC: waist circumference; SAI-T: anxiety trait; STAI-S: anxiety state; BDI: depression score; D: effect size; T: trivial; S: small; M: mediu



**Table 3.** Comparison of the average values of the cardiometabolic, anthropometric, quality of life and anxiety profile of the participants classified by symptoms of depression.

Variables	Total			Male				Female			
	Clinically not relevant symptoms	Presence of moderate symptoms	p	Clinically not relevant symptoms	Presence of moderate symptoms	p	d	Clinically not relevant symptoms	Presence of moderate symptoms	p	d
	BDI ≤ 9	BDI 10 to 19		BDI ≤ 9	BDI 10 to 19			BDI ≤ 9	BDI 10 to 19		
	[n=62]	[n=34]	[n=28]	[n=13]	[n=34]	[n=21]					
M± SD	M± SD	M± SD	M± SD	M± SD	M± SD						
Age	56,9±9,9	54,9±9,4	0,334	57,5±8,9	52,2±10,6	0,106	0,54(M)	56,4±10,7	56,7±8,3	0,962	- 0,03(T)
SBP <sup>2</sup>	134,6 ± 22,3	130,1 ± 17,3	0,371	136,4±23,4	126,9±14,9	0,250	0,48(P)	132,9±21,6	131,9±19,1	0,887	0,04(T)
DBP <sup>1</sup>	87,9±15,8	85,4±10,7	0,465	91,7±15,1	85,3±11,0	0,236	0,48(P)	84,0±15,9	85,4±10,9	0,746	- 0,10(T)
HR <sup>2</sup>	71,6 ± 14,0	73,4 ± 12,6	0,585	73,8±16,9	79,0±14,2	0,402	- 0,33(P)	69,3±9,7	70,2±10,7	0,789	- 0,08(T)
WC (cm) <sup>1</sup>	94,3 ± 12,9	98,6 ± 13,7	0,144	97,4±11,5	106,1±10,2	<b>0,032</b>	- 0,80(G)	91,8±13,5	93,8±13,8	0,599	- 0,14(T)
IMC <sup>2</sup>	28,1±5,0	30,1±5,2	0,088	28,2±3,8	31,6±3,6	<b>0,017</b>	- 0,91(G)	28,0±5,9	29,2±6,3	0,477	- 0,19(T)
Blood glucose <sup>1</sup>	143,8±79,3	165,3±70,6	0,191	158,9±75,1	175,6±67,2	0,497	- 0,23(P)	131,4±81,6	158,9±73,4	0,213	- 0,35(S)
Functional Capacity <sup>1</sup>	75,6±24,1	52,6±30,4	<b>0,000</b>	83,4±20,4	57,3±29,1	<b>0,002</b>	1,03(G)	65,4±24,2	49,8±31,4	<b>0,042</b>	0,55(M)
Physical Aspects <sup>1</sup>	80,2±31,4	37,5±42,3	<b>0,000</b>	83,0±27,3	40,4±46,3	<b>0,001</b>	1,12(G)	78,0±34,7	35,7±40,8	<b>0,000</b>	1,11(B)
Pain <sup>1</sup>	64,8±25,4	41,4±24,1	<b>0,000</b>	68,9±24,5	43,1±25,2	<b>0,003</b>	1,03(G)	60,7±25,8	40,3±23,9	<b>0,005</b>	0,82(B)
General Health <sup>1</sup>	54,8±9,1	51,0±7,7	<b>0,042</b>	54,0±7,9	50,2±4,4	0,118	0,59(M)	55,5±10,4	51,5±9,3	0,147	0,40(S)



Vitality <sup>1</sup>	67,9±19,3	46,6±18,8	<b>0,000</b>	70,2±14,7	48,9±21,8	<b>0,001</b>	1,14(G)	66,0±22,5	45,2±17,1	<b>0,001</b>	1,04(B)
Social Aspects <sup>1</sup>	85,5±18,5	58,7±29,0	<b>0,000</b>	89,0±14,5	67,2±32,7	<b>0,005</b>	0,86(G)	82,7±21,0	53,4±26,0	<b>0,000</b>	1,23(B)
Emotional Aspects <sup>1</sup>	79,1±32,6	53,9±46,5	<b>0,003</b>	89,4±22,3	66,6±45,2	<b>0,036</b>	0,63(M)	70,7±37,4	46,1±46,6	<b>0,036</b>	0,58(M)
Mental Health <sup>1</sup>	77,8±17,2	50,6±18,9	<b>0,000</b>	83,1±13,4	59,4±17,6	<b>0,000</b>	1,51(G)	73,4±18,8	45,1±17,9	<b>0,000</b>	1,54(B)
STAI-T <sup>1</sup>	41,1±5,2	47,6±7,8	<b>0,000</b>	41,8±5,6	46,0±6,8	<b>0,046</b>	- 0,67(M)	40,5±4,8	48,7±8,5	<b>0,000</b>	- 1,18(B)
STAI-S <sup>1</sup>	44,2±6,4	44,6±6,4	0,806	44,8±7,6	43,3±5,2	0,524	0,23(P)	43,7±5,2	45,4±7,1	0,325	- 0,27(S)

<sup>1</sup>Mann-Whitney Test; <sup>2</sup>T student Test; \*\*p<0,05. M: mean; SD: standard deviation; SBP: systolic blood pressure; DBP: diastolic blood pressure; HR: heart rate; WC: waist circumference; SAI-T: anxiety trait; STAI-S: anxiety state; BDI: depression score; D: effect size; T: trivial; S: small; M: medium; B: big.

**Table 4.** Correlation between the domains of quality of life, anxiety and depression with the cardiometabolic variables.

DOMAINS OF QUALITY OF LIFE, ANXIETY AND DEPRESSION SCORES	CARDIOMETABOLIC VARIABLES								
	Blood glucose			WC R-Value			HR		
	Men	Women	Total	Men	Women	Total	Men	Women	Total
Functional Capacity	<b>-0,410*</b> <sup>1</sup>	-0,224 <sup>1</sup>	-0,182 <sup>1</sup>	-0,257 <sup>1</sup>	<b>-0,370*</b> <sup>1</sup>	<b>-0,225*</b> <sup>1</sup>	-0,122 <sup>1</sup>	0,167 <sup>1</sup>	0,076 <sup>1</sup>
Physical Aspects	0,095 <sup>1</sup>	-0,183 <sup>1</sup>	-0,069 <sup>1</sup>	-0,254 <sup>1</sup>	-0,114 <sup>1</sup>	-0,147 <sup>1</sup>	0,052 <sup>1</sup>	-0,255 <sup>1</sup>	-0,083 <sup>1</sup>
Pain	-0,242 <sup>1</sup>	-0,128 <sup>1</sup>	-0,108 <sup>1</sup>	-0,031 <sup>1</sup>	-0,235 <sup>1</sup>	-0,115 <sup>1</sup>	-0,149 <sup>1</sup>	-0,171 <sup>1</sup>	-0,141 <sup>1</sup>
General Health	<b>-0,373*</b> <sup>1</sup>	<b>-0,449*</b> <sup>1</sup>	<b>-0,406*</b> <sup>1</sup>	-0,099 <sup>1</sup>	<b>-0,434*</b> <sup>1</sup>	<b>-0,301*</b> <sup>1</sup>	-0,137 <sup>1</sup>	-0,024 <sup>1</sup>	-0,074 <sup>1</sup>
Vitality	-0,227 <sup>1</sup>	-0,071 <sup>1</sup>	-0,100 <sup>1</sup>	-0,207 <sup>1</sup>	0,098 <sup>1</sup>	0,010 <sup>1</sup>	<b>-0,468*</b> <sup>1</sup>	-0,157 <sup>1</sup>	<b>-0,261*</b> <sup>1</sup>
Social Aspects	-0,161 <sup>1</sup>	-0,175 <sup>1</sup>	-0,132 <sup>1</sup>	0,052 <sup>1</sup>	-0,147 <sup>1</sup>	-0,047 <sup>1</sup>	-0,249 <sup>1</sup>	-0,147 <sup>1</sup>	-0,114 <sup>1</sup>
Emotional Aspects	-0,146 <sup>1</sup>	0,029 <sup>1</sup>	0,022 <sup>1</sup>	-0,177 <sup>1</sup>	-0,114 <sup>1</sup>	-0,053 <sup>1</sup>	-0,070 <sup>1</sup>	-0,051 <sup>1</sup>	-0,017 <sup>1</sup>
Mental Health	-0,207 <sup>1</sup>	-0,252 <sup>1</sup>	-0,139 <sup>1</sup>	-0,215 <sup>1</sup>	-0,141 <sup>1</sup>	-0,076 <sup>1</sup>	<b>-0,363*</b> <sup>1</sup>	-0,207 <sup>1</sup>	-0,187 <sup>1</sup>
STAI-S	0,258 <sup>1</sup>	0,129 <sup>1</sup>	0,175 <sup>1</sup>	-0,015 <sup>1</sup>	0,249 <sup>1</sup>	0,000 <sup>1</sup>	0,088 <sup>1</sup>	0,297 <sup>1</sup>	0,177 <sup>1</sup>
STAI-T	0,211 <sup>1</sup>	0,185 <sup>1</sup>	<b>0,220*</b> <sup>1</sup>	-0,261 <sup>1</sup>	<b>0,277*</b> <sup>1</sup>	0,154 <sup>1</sup>	-0,178 <sup>1</sup>	0,239 <sup>1</sup>	0,211 <sup>1</sup>
BDI	,0,089 <sup>1</sup>	0,202 <sup>1</sup>	0,121 <sup>1</sup>	0,290 <sup>1</sup>	0,095 <sup>1</sup>	0,128 <sup>1</sup>	0,052 <sup>2</sup>	0,091 <sup>2</sup>	0,005 <sup>2</sup>

HR: heart rate; WC: waist circumference; STAI-T: anxiety trait; STAI-S: anxiety state; BDI: depression score; \*p<0,05; <sup>1</sup>Spearman's correlation; <sup>2</sup>Pearson's correlation



## 4 DISCUSSION

The main results were: i) Individuals with depression presented worse levels of quality of life, anxiety (trait) and altered WC, but without differences in HR and BP; ii) In addition, there was a correlation between cardiometabolic variables (abdominal adiposity and blood glucose) and altered quality of life, regardless of gender; iii) When the groups were evaluated by sex, a correlation was observed in men between blood glucose and functional capacity, and HR with mental health. In women, a correlation was observed between anxiety levels with functional capacity and abdominal adiposity. In men, these levels were altered only in the presence of symptoms of depression.

Most of the diabetics evaluated showed not only hyperglycemia, but also elevated WC, which reinforces the association between diabetes and abdominal adiposity. In addition, most were overweight or obese. This prevalence of overweight diabetic individuals has been shown by other epidemiological studies that show that around 80% of patients with DM2 are overweight or obese, and even in those with normal weight, there may be a greater predominance of fat in the abdominal region (Bhupathiraiu & Hu, 2016).

For a better discussion of the findings of this study, the categories that emerged from the results will be further detailed below.

### *Impact of anxiety and health-related quality of life in diabetics with symptoms of depression*

It was found that quality of life and trait anxiety are influenced by the presence of symptoms of depression in diabetics, and this influence is more expressive in women. Similar studies have found an association between the presence of symptoms of depression and anxiety and worse quality of life (Jing *et al.*, 2018). In addition, in men with symptoms of depression, body composition may be altered (Table 3).

Anxiety was significantly different between groups, being higher among diabetics with depression regardless of gender (Table 3). This finding reinforces the statement that depression has often been accompanied by anxiety.

Depression has neurochemical and hormonal changes that would have hyperglycemic effects and could cause disturbances in glycemetic metabolism. In contrast, DM has neurochemical effects on central serotonergic, noradrenergic and dopaminergic systems, leading to impaired monoaminergic function, similarly to what occurs in depression (Moreira *et al.*, 2003). The overlapping of pathophysiological changes in both conditions could explain the frequent occurrence of depressive symptoms in diabetic patients. Previous studies have produced similar results, with some documenting a positive correlation (Gois *et al.*, 2018).



### *Cardiometabolic factors and biopsychosocial aspects: the emotional impact of the diagnosis and pathophysiological mechanisms*

Several studies have investigated the association between cardiometabolic factors and biopsychosocial aspects. In a meta-analysis, Jing *et al.*, (2018) found that patients with diabetes complications and the presence of arterial hypertension had a worse quality of life than those without complications. Anderson *et al.*, (2017) found a negative correlation between glycosylated hemoglobin and quality of life in diabetics. Similarly, in our study there was a correlation between cardiometabolic variables (WC, HR and blood glucose) and domains of quality of life (general health and vitality) regardless of sex.

When the groups were evaluated by sex, there was a correlation between glycemia and functional capacity, and HR with mental health among men. Among women, a correlation was found between WC and functional capacity and trait anxiety (Table 4).

We saw a high prevalence of the average level of trait and state anxiety values. Several theories attempt to describe the relationship between anxiety and diabetes; being a behavioral, in which some suggest that the emotional impact of the diagnosis of diabetes, with the burden of daily management, can lead to anxiety and less adherence to treatment; and another physiological, in which scholars propose that anxiety predisposes, or exacerbates, DM2 through physiological mechanisms such as changes in the HPA axis and central and peripheral autonomic modulation. It is important to note that both complement each other, and one condition cannot be treated in isolation from the other (Badescu *et al.*, 2016).

A prevalence of 34.1% of depression was observed among diabetics in our study. Others have investigated the pathophysiological mechanisms involved in the relationship between diabetes and depression (Badescu *et al.*, 2016) and converge to the deregulation of the hypothalamic-pituitary axis, with the consequent hyperactivation and increased cortisol levels (Bhupathiraiu & Hu, 2016). Excess cortisol can lead to loss of negative feedback and hinder neogenesis at the level of the hippocampus, responsible for the memory and processing of emotions and which is implicated in both depression and diabetes (SBD, 2014).

The identification of biopsychosocial aspects such as symptoms of depression and anxiety among people with diabetes mellitus will contribute to treatment in this population.

### *Comparison between the genders*

It was observed that men had higher blood glucose levels (Table 2). This can be partially attributable to the greater use of diabetes-related health services by women, greater adherence to glucose monitoring and self-care, or increased social support (Bickett & Tapp, 2016). However, this



group had a lower depression score. This last data contrasts with the findings of Alenzi and Sambamoorthi, (2016) and Serpytis *et al.*, (2018), also found a higher incidence of depression symptoms in women, respectively 64.3% and 64.4%. This corroborates our findings (50%), showing that women are at greater risk of developing emotional disorders. The authors also noticed that, in women with older age (+65 years) the levels of depression and anxiety were similar to those of men. In our study, we found that women between 48 and 65 years old had the highest depression scores, which suggests the theory that these disorders may result from a combination of genetic and environmental factors.

In the present study, women have lower levels of quality of life, especially in the domains of functional capacities, social aspects, emotional aspects and mental health (Table 2). Choi *et al.*, (2018), analyzed 164 Chinese individuals in order to assess the difference in quality of life between genders. It was found that males have better mental health, given by the mental components of quality of life, than females. In functional capacity, there was no difference between genders. The authors also found that postmenopausal women demonstrated lower quality of life than premenopausal women. Thinking about our study, this is true, since the average age of the women assessed was 56 years. A decrease in the neuroprotective function of estrogen may be an indication of this association.

The cross-sectional design used does not allow establishing an association between cause and effect, but points to the need to seek individualized and specialized treatments, which focus on comprehensive support, prevention of complications of diabetes mellitus, in addition to ways to increase adherence to these treatments. In this sense, the assessment of both psychobiological aspects such as anxiety, depression and quality of life, as well as metabolic factors, serves as a tool for the work of professionals. Thus, these data offer evidence to health professionals in order to support and include complementary interventions aimed at this audience in their therapeutic plan. Thus, it is expected that after the adoption of interventions, there will be a reduction in depressive symptoms among people with DM and, consequently, a better quality of life for the population, with reductions in public health costs.

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## 5 CONCLUSIONS

Diabetes is directly related to biopsychosocial factors, mainly the domains of quality of life and depression scores, in addition to the altered waist circumference is related to diabetes, which in turn also influences quality of life, especially in the domains of general health and functional capacity. It is also concluded that diabetics with symptoms of depression have worse levels of quality of life and greater anxiety, and that in men, change in body composition.





## Limitations

Firstly, psychological processes link depression and T2DM. Hypothalamic – pituitary – adrenal axis, the innate immune response and the autonomic nervous system, unhealthy lifestyle behaviors, such as diets and smoking, were not evaluated in our study. Secondly, the cross-sectional nature of the study does not allow for causality inferences. Only with a longitudinal design would it be possible to determine the associative direction between hyperglycemia and depressive symptoms. Thirdly, depressive symptoms were analyzed with a validated questionnaire (BDI), but a psychiatric interview remains the gold standard for depression diagnosis in clinical practice. Nevertheless, as far as we know, this is the first study to assess the relationship between anxiety, depression and cardiometabolic variables with the quality of life of type two diabetics in the city of Goiania.

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## CONFLICT OF INTERESTS

No conflict of interests are declared by the authors.

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## ETICS

Respecting the rules of conduct in experimental research with human beings (Resolution 196/96 of CNS), and the Guidelines for Ethical Analysis and Processing of Research Projects in the Special Thematic Area of Human Genetics (Resolution 340/2004), this study was submitted and approved by the Ethics and Research Committee of the Federal University of Goiás (CEP-UFG), under protocol 2,615,302 and in the Brazilian Clinical Trial Registry (REBEC, number RBR-4rjgc3). The research is part of an umbrella project entitled: "From childhood to maturity: investigating human development from a psychobiological and evolutionary perspective". **Attached**

## AUTHORS' CONTRIBUTIONS

GOT collected data, wrote, reviewed and edited the manuscript. RBNS collected data and reviewed the manuscript. RCS contributed with data analysis. LRBS contributed in the writing, collected data and data analysis. VAM collected data and contributed with the discussion. MVE, MNM and KLR collected data. ACSR collected data, reviewed and edited the manuscript. RRC contributed with data analysis, MSS reviewed the manuscript.



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