

1 **Prevalence of anxiety and depression among diabetic Africans patients in Guinea:**
2 **association with HbA1c levels**

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1 **Abstract**

2

3 *Aim.*- The prevalence and risk factors associated with symptoms of anxiety and depression
4 were determined in African people with diabetes.

5 *Methods.*- This cross-sectional study involving 491 out-patients with type 2 diabetes (T2D)
6 recruited from four diabetes clinics (Conakry, Labé, Boké, Kankan) in Guinea was carried
7 out. The Hospital Anxiety and Depression Scale was used to evaluate the symptoms of
8 anxiety and depression. Logistic regression analysis stratified by sex was performed to
9 identify the associated risk factors.

10 *Results.*- Anxiety and depression symptoms were present in 58.7% and 34.4% of the 491
11 people with T2D (62.7% women, mean \pm SD age: 57.9 ± 10.2 years). The odds ratios (95%
12 CI) of risk factors independently associated with anxiety were urban residence 2.98 (1.81 to
13 4.89) in women, low level of socio-economic status 0.19 (0.05 to 0.70), HbA1c $\geq 9.0\%$ 2.61
14 (1.07 to 6.39)] in men. Factors associated with depression were urban residence 2.13 (1.27 to
15 3.58)], older age 1.03 (1.01 to 1.06)], socio-economic status 2.21 (1.34 to 3.66), no previous
16 measurement of HbA1c 12.45 (1.54 to 100.34) in women and insulin therapy 2.28 (1.05 to
17 4.92), HbA1c $\geq 9.0\%$ 3.85 (1.02 to 14.48) in men.

18 *Conclusions.*-Anxiety and depression symptoms in people with T2D are common in Guinea.
19 Urban residence, level of socio-economic status and high levels of HbA1c were significantly
20 associated with a higher risk of anxiety or depression, highlighting the psychological burden
21 related to diabetes in Africa.

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23 *Key words:* Anxiety, depression, type 2 diabetes, risk factors

24

1 **1. Introduction**

2 According to the World Health Organization, we are facing an epidemic of diabetes in
3 developing countries. Currently, over 80% of people with diabetes live in low and middle
4 income countries (LMICs) [1]. This clinical situation relates also to Guinea where the age-
5 standardized prevalence of diabetes according the Guinean census was 6.5% (95% CI: 5.3-
6 7.7%) [2].

7 A large body of evidence has highlighted that both anxiety and depression are more
8 common in people with diabetes than in the general population [3,4]. Furthermore, it has been
9 consistently shown that depression is associated with an increased risk of morbidity and
10 mortality in people with diabetes [3,4] and that depression may have a deleterious impact on
11 adherence to glucose lowering treatments [5]. However, recent studies suggest that
12 psychological disorders remain often undiagnosed and therefore not appropriately treated
13 among people with diabetes [6,7]. This issue is particularly relevant in Africa where
14 healthcare infrastructures have mainly focused on infectious diseases rather than on type 2
15 diabetes (T2D). Yet, the combination of depression and diabetes among the poor populations
16 in LMICs might favor the development of diabetic complications and ultimately greater
17 morbidity and mortality [8].

18 Epidemiological data on the characteristics of T2D patients who are most affected by
19 anxiety/depression in LMICs remain sparse but are essential to implement public health
20 programmes in these countries [8]. The goal of the present study is to assess the prevalence of
21 both anxiety and depression in people with T2D in Guinea and to identify the factors
22 associated. Furthermore, we examined whether the association between psychological distress
23 and diabetes is affected by the level of glycaemic control in these people from a low-income
24 country who have limited access to regular healthcare.

1 **2. Materials and Methods**

2

3 2.1 Study setting and design

4 This cross-sectional multicentre study was conducted in four institutions in Guinea: the
5 Endocrinology, Diabetology and Metabolic Disease Unit of the University Teaching Hospital
6 (UTH) of Conakry, and the Diabetes Unites of regional Hospitals at Boké, Kankan and Labé.

7

8 2.2 Population

9 Between August 2009 and October 2010, a study to improve access to glycated haemoglobin
10 (HbA1c) in diabetic patients was carried out in Cameroon and Guinea. The study included
11 patients aged ≥ 16 years and having T2D for at least 12 months. They were contacted at the
12 outpatient clinic of the four study sites and invited to participate in the study. Patients who
13 had lost a family member (parent, brother, sister, husband, children) and/or lost their job in
14 the month preceding the study were excluded from the study. In total, 491 patients with T2D
15 were included in this study.

16

17 2.3 Methods

18 A semi-structured questionnaire and a standardized interview were completed for all patients.
19 Data involving socioeconomic status (SES), history of diabetes and levels of anxiety and
20 depression were collected.

21 2.3 1 *Socio-demographic profile*

22 The Socio-demographic data collected included age, sex, zone of residence (rural or
23 urban), marital status (single or married) and unemployment status (yes or no). The level of
24 education was divided into two classes (less than 7 years of school, at least 7 years of school).
25 SES was assessed from unemployment status and level of education and dichotomized into
26 low (lower education and unemployment) or high (higher education or/and employment).

27 2.3 2 *History of diabetes and clinical data*

28 Other information collected included type of glucose lowering treatment, duration of
29 diabetes and previous measurement of HbA1c (yes or no). HbA1c was classified into: $< 7.0\%$,
30 7.0 to 8.9% and $\geq 9.0\%$.

31 The clinical data collected including current tobacco smoking (yes or no) and known
32 hypertension (yes or no). Alcohol consumption during the previous month was self-reported.
33 Body mass index (BMI) was calculated.

34

1 2.3 3 *Level of Anxiety and depression:*

2 Symptoms of anxiety and depression were evaluated using the Hospital Anxiety and
3 Depression Scale (HADS) [9]. The French version that we used had previously been
4 validated, both in family medicine and in hospital settings [10]. The HADS measures levels of
5 symptoms in the last week. There is a medium-to-strong correlation between the HADS score
6 and other instruments used to measure anxiety and depression, including the Beck's
7 Depression Inventory, Spielberger's State-Trait Anxiety Inventory, the Symptom Checklist 90
8 Scale, and the Montgomery-Asberg Depression Rating Scale [11]. The main characteristic of
9 HADS is that items that could be attributed to physical illnesses, such as insomnia, fatigue,
10 headaches, dizziness, sleep, and appetite disturbance, have been omitted to avoid false-
11 positive cases among individuals with somatic diseases. HADS has 14 questions: seven
12 related to depression (HADS-D) and seven related to anxiety (HADS-A). Each question has
13 four possible responses from zero (no symptoms) to three (maximum symptoms). The
14 severity of the symptoms is determined by the total score obtained in each sub-scale (HADS-
15 A and HADS-D) and is classified as: 0-7 (normal), 8-10 (mild disorder) and 11-21 (marked
16 disorder). HADS-D covers mainly anhedonia and loss of interest, which are core depressive
17 symptoms, while HADS-A covers the core anxiety features of worry and tenseness.

18

19 2.4 Ethical considerations:

20 The ethics committee of the Ministry of public health of Guinea approved the study.
21 Only patients who signed the informed consent form were included in the study.

22

23 2.5 Statistical analysis:

24 The prevalence of symptoms of anxiety and depression was determined using the
25 HADS scale and classified as normal, mild, and marked disorder. For the logistic regression
26 analysis, the HADS scores were dichotomized as normal (score 0 - 7) and presence of anxiety
27 / depression (score 8 - 21), to include all possible cases of anxiety and depression as
28 suggested by Zigmond [9]. Univariate logistic regression analyses evaluated the relationships
29 between anxiety and depression and the associated factors, and results are presented as odd
30 ratios (OR) and 95 % confidence intervals. Interactions were tested with sex, and as there was
31 a significant interaction for some variables, all results are presented stratified on sex.
32 Variables with p values <0.20 in the univariate tests were selected as covariates for the
33 multivariable models. A p value <0.05 was considered statistically significant. Analysis used
34 SAS (version 9.3; SAS Institute, Cary, NC).

1 **3. Results**

2 3.1 General patients' description

3 General characteristics of the 491 people with T2D included in this study are
4 presented in Table 1. The majority was female (62.7%), married (76.4%), with a job (54.2%)
5 and high level of education (50.5%). No patient was treating with antidepressant drugs. Mean
6 age was 57.9 ± 10.2 years, and the men were older (59.8 ± 9.7) than the women (56.7 ± 10.3).
7 Only 6.7% of the patients had a previous measurement of HbA1c. Out of all the study
8 patients, 15.7% had a good glycaemic control (HbA1c <7.0%), and 29.1% (n=143) were
9 being treated with insulin, with the remainder taking oral glucose-lowering drugs.

10

11 3.2 Prevalence of anxiety and depression

12 On the HADS, a mean score of 8.5 ± 3.2 , with a median of 8 for anxiety was recorded.
13 For depression, the mean score was 6.3 ± 3.3 with a median of 6. Table 2 presents the
14 prevalence of anxiety and depression as classified by the HADS according to gender.
15 Symptoms of anxiety were present in 58.7% of patients while 34.4% had symptoms of
16 depression. The prevalence of marked anxiety was 27.5% and was more common in women
17 (36.1%) when in men (13.1%). Marked depression was present in 11.4% of the population,
18 and again was more common in women (14.0%) as compared to men (7.1%). Of our 491
19 diabetic patients, 127 (25.9%) had both anxiety and depression and neither anxiety nor
20 depression was related to overweight/obese status.

21

22 3.3 Factors associated with anxiety

23 As shown in Table 3, anxiety in men was significantly associated with low SES [Odds
24 ratio: 0.19 (95% CI: 0.05 to 0.70)], HbA1c 7-8.9% [2.80 (1.13 to 6.93)] and HbA1c $\geq 9.0\%$
25 [2.61 (1.07 to 6.39)] in the multivariable model. In women, only residence in urban area [2.98
26 (1.81 to 4.89)] was associated with anxiety in the multivariable model.

27

28 3.4 Factors associated with depression

29 In a multivariate model (Table 4), depression in men was significantly associated with
30 insulin therapy [2.28 (1.05 to 4.92)], and HbA1c $\geq 9.0\%$ [3.85 (1.02 to 14.48)]. In women, age
31 [1.03 (1.01 to 1.06)], residence in an urban area [2.13 (1.27 to 3.58)], low level of SES [2.21
32 (1.34 to 3.66)], and no previous measurement of HbA1c [12.45 (1.54 to 100.34)] were
33 independently associated with depression.

34

1 **4. Discussion**

2 This study showed that both anxiety and depression are common in people with T2D attending
3 out-patients clinics in Guinea. The prevalence of depression and anxiety in the present study
4 is higher than that observed previously in Caucasian type 2 diabetic populations [12,13].
5 However, a recent large cross-sectional multinational study did not find an association
6 between diabetes and the prevalence of depressive symptoms in Africa, in contrast to other
7 continents [14].

8 Other studies reported a higher prevalence of depression for diabetes in developing
9 countries with results similar to our results in Pakistan 57.9% had anxiety and 43.5% had
10 depression [15]. In a recent review, the percentage of people with depression among those
11 with diabetes was 45.9% in South Africa and between 15 and 30% in Nigeria [8]. This high
12 prevalence of anxiety and depression in LMICs such as Guinea could be explained by gender
13 inequality, social insecurity, low educational levels and poverty [16].

14 In the present study, we observed that poor glucose control was independently
15 associated with both anxiety and depression in men. Some previous reports have shown a
16 positive association between HbA1c levels, fasting blood glucose and the level of anxiety
17 [4,6,17]. Depressive mood has been also associated with glucose levels in T2D [18]. In a
18 recent study in Netherlands, several individual depressive symptoms were related to higher
19 HbA1c in outpatients with T2D and these associations persisted over time [19]. Underlying
20 mechanisms proposed to explain the increase in glycaemia are enhanced inflammation [20],
21 insulin resistance [21], alterations in insulin secretion [22] and activation of the hypothalamic-
22 pituitary-adrenal axis [23]. Furthermore, depression and anxiety are also linked with poorer
23 behavioral management of diabetes and glycemic control [24].

24 The use of insulin therapy was independently associated with the symptoms of
25 depression. This is in agreement with previous reports [25,26]. Insulin therapy could be
26 associated with negative beliefs about the future and the risk of death for the patient.
27 However, the need for insulin therapy often indicates a more severe stage of the disease,
28 which is characterized by age, poorer glycaemic control, and a higher rate of complications.
29 Nevertheless, in our study, this association persisted after adjusting for age and HbA1c,
30 suggesting that the perceptions surround insulin therapy itself, irrespective of the metabolic
31 context, could favour the development of depressive symptoms. Only a prospective study
32 with a longitudinal follow-up could adequately test this hypothesis.

33 The lack of previous measurement of HbA1c was independently associated with the
34 presence of depression in women. A number of studies showed that depression is associated

1 with poor perceived control of diabetes and poor self-care behaviors [27,28]. In addition, it
2 may be speculated that previous measurement of HbA1c might be an indirect indicator of the
3 patient's participation in a structured diabetes medical programme, which may have contribute
4 to giving more reassurance to the patient, thereby explaining why these patients were less
5 depressed. The lack of information on glycaemia status might also be potentially worrying to
6 the patient. In addition, depression may prevent efforts dedicated to health, resulting in a
7 lower probability of having an HbA1c measurement. Nevertheless, reverse causality, by
8 which poor glycaemic control may induce greater psychological distress, cannot be excluded.

9 It was observed that age was independently associated with symptoms of depression
10 whereas duration of diabetes was not an independent risk factor after accounting for age.
11 Findings for the relationship between age and depression in diabetes have been conflicting,
12 with some studies reporting age as a risk factor for depression [15,29] whereas in other
13 studies, younger age was related to depressive symptoms [30].

14 Our study provides new findings concerning the relationship between socio-
15 environmental factors and the presence of anxiety/depression in people with T2D in a
16 developing African country. Our results for women showed that those of low SES were twice
17 as likely to be depressed compared with of high SES. This is in agreement with other studies
18 showing that the risk of depression is higher for diabetic patients with lower SES [29,31]. In
19 contrast, however a higher SES was independently found to be associated with the symptoms
20 of anxiety. Unemployment is also a consistent risk factor for psychological disorders,
21 suggesting the importance to taking into consideration the presence of depression among
22 patients with diabetes who are unemployed or who have less education, which is common in
23 Africa [32]. It has been shown that depression is more commonly seen among those with a
24 low family income, non-professional/administrative employment, not current employment
25 and so are dependent, and those living alone and with less social support [29]. Indeed, it has
26 long been recognized that individuals with lower SES suffer a disproportionate share of the
27 burden and consequences of numerous diseases than those with higher SES [33].

28 It was also revealed that an urban area of residence was independently associated with
29 symptoms of both anxiety and depression in women, a relationship that remains controversial
30 in the developing countries. A study in Pakistan showed a greater prevalence of mental
31 disorders in urban areas than in rural areas [34]. In contrast, no significant association
32 between depression comorbidity and place of residence was found in a study from Nigeria
33 [35].

1 Our present study has several intrinsic limitations. First, as symptoms of depression
2 and anxiety were only measured at one time point, this study cannot directly evaluate the
3 long-term impact of diabetes on the incidence of anxiety /depression. Thus the observational
4 nature of the study allows no conclusions to be drawn on the causality of the link between
5 depression and poor glycaemic control. Second, the study population was not randomly
6 sampled, which limits attempts to generalize the results to all populations with T2D in
7 Guinea. Third, the HADS-D score predominantly reflects melancholic depressive symptoms
8 over the past week. Thus, levels of lifetime depression and the proportion of subjects with
9 atypical depressive symptoms might have been underestimated in our cohort. Also, the study
10 may have slightly underestimated the prevalence of anxiety and depression because patients
11 who had lost a family member and/or lost their job in the month preceding the study were
12 excluded. Finally, it was not possible to adjust for risk factors such as a previous or family
13 history of depression, childhood experiences, life experiences and sickle cell disease. The
14 prevalence of the latter is high in Guinea, and its presence is known to affect measurements of
15 HbA1c [36].

16 Our findings show that people with T2D in Sub-Saharan Africa are at risk of anxiety
17 and depression, just as reported in high-income countries [37]. The high prevalence of anxiety
18 and depression in Guinea is an important additional public-health burden, as the country faces
19 an alarming increase in the prevalence of T2D in Africa [38].

20 These findings also suggest that the healthcare infrastructure, which has traditionally
21 focused on infectious diseases in Guinea, needs to evolve to take better account of the
22 psychological burden associated with diabetes, particularly in urban areas. The screening and
23 monitoring of psychological disorders in people with diabetes are still neglected in Africa,
24 and the treatment of diabetes-related depression is rare in these countries, too [39,40].
25 Medico-economic studies have shown that the coexistence of depression and diabetes is
26 associated with greater healthcare services and medical costs [4].

27 In conclusion, our results show that both anxiety and depression are common in people
28 with T2D living in Guinea, irrespective of overweight/obesity status. Poor control of
29 glycaemia, residence in an urban area, the absence of previous measurement of HbA1c and
30 use of insulin therapy appear to be risk factors for depression in this population. These
31 findings suggest that depression in T2D patients in Africa needs to be screened for and taken
32 into consideration in their medical care.

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1 **Competing interests**

2 No potential conflict of interest relevant to this article was reported.

3

4 **Acknowledgment**

5 This project is supported by a grant from the BRIDGES International Diabetes Federation, a
6 project of the International Diabetes Federation, supported by an educational grant from Eli
7 Lilly and Company.

8 We thank the French Society of Diabetes (SFD) for the award to Dr. Alioune Camara in 2009.

9 We thank warmly the health professionals who contributed to the recruitment and monitoring
10 of patients, and those who participated in the study.

11

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- 15

1 Table 1
 2 Characteristics of the 491 people with type 2 diabetes in outpatient clinics in Guinea.
 3

	Men (n=183)	Women (n=308)	P value	
Age (years)	59.8 (±9.7)	56.7 (±10.3)	0.001	
Urban zone of residence	112 (61.2)	194 (63.0)	0.69	
Low level of education (<7 years)	67 (36.6)	176 (57.1)	<0.001	
Unemployed	51 (27.9)	174 (56.5)	<0.001	
Duration of diabetes (years)	8.2 (±6.5)	7.5 (±3.3)	0.23	
Insulin therapy use	43 (23.5)	100 (32.5)	0.03	
Known hypertension	150 (82.0)	269 (87.3)	0.10	
BMI (kg/m ²)	23.6 (±3.6)	26.5 (±4.8)	<0.001	
Current smoker	11 (6.0)	0 (0.0)	<0.001*	
Alcohol consumption	34 (18.6)	5 (1.6)	<0.001	
Previous measurement of HbA1c	16 (8.7)	17 (5.5)	0.17	
HbA1c control				
	<7%	34 (18.6)	43 (14.0)	0.02
	7- 8.9%	71 (38.8)	94 (30.5)	
	≥9%	78 (42.6)	171 (55.5)	
HbA1c (%)	9.2 (2.5)	9.7 (2.4)	0.03	
HAD-A	7.2 (±2.8)	9.2 (±3.2)	<0.001	
HAD-D	5.6 (±3.3)	6.8 (±3.3)	<0.001	

Data are presented as n(%), means ± SD; * by Fischer test; HADS-A/D: Hospital Anxiety and Depression Scale for anxiety/depression.

Table 2

Prevalence according to severity of symptoms of anxiety and depression as measured by Hospital Anxiety and Depression Scale (HADS) in 491 diabetic outpatients in Guinea by gender.

Scale	Anxiety, <i>n</i> (%)				Depression, <i>n</i> (%)			
	Overall	95% CI	Women	Men	Overall	95% CI	Women	Men
Normal (0-7)	203 (41.3)	36.9-45.6	99 (32.1)	104 (56.8)	322 (65.6)	61.4-69.8	187 (60.7)	135 (73.8)
Mild disorder (8-10)	153 (31.2)	27.1-35.3	98 (31.8)	55 (30.1)	113 (23.0)	19.3-26.7	78 (25.3)	35 (19.1)
Marked disorder (11-21)	135 (27.5)	23.5-31.4	111 (36.1)	24 (13.1)	56 (11.4)	8.6-14.2	43 (14.0)	13 (7.1)

95% CI: 95% confidence interval

Table 3

Factors associated with symptoms of anxiety (Score HADS-A \geq 8) in outpatients with Type 2 diabetes in Guinea.

Characteristics		Anxiety (Scale HADS-A \geq 8-21 vs. 0-7)							
		Men (n=183)				Women (n=308)			
		OR crude (95% CI)	P value	OR adjusted (95% CI)	P value	OR crude (95% CI)	P value	OR adjusted (95% CI)	P value
Ages (years)		0.98 (0.96-1.02)	0.34			0.98 (0.96-1.00)	0.09	0.98 (0.96-1.00)	0.06
Zone of Residence	Urban vs. Rural	1.17 (0.64-2.13)	0.61			2.98 (1.81-4.89)	<0.001	2.98 (1.81-4.89)	<0.001
Married	Yes vs. No	0.75 (0.18-3.09)	0.69			1.09 (0.66-1.79)	0.74		
Socio-Economic Status	Low vs. High	0.22 (0.06-0.77)	0.02	0.19 (0.05-0.70)	0.01	0.91 (0.56-1.47)	0.70		
Insulin therapy use	Yes vs. No	1.06 (0.53-2.10)	0.88			1.43 (0.85-2.42)	0.18	1.17 (0.67-2.05)	0.58
Duration of diabetes (years)		0.99 (0.94-1.03)	0.57			1.05 (1.01-1.11)	0.03	1.05 (0.99-1.10)	0.05
Previous measurement of HbA1c	No vs. Yes	1.29 (0.45-3.72)	0.63			1.51 (0.56-4.10)	0.41		
HbA1c (versus <7.0%)	7.0 to 8.9%	2.55 (1.05-6.23)	0.04	2.80 (1.13-6.93)	0.02	1.09 (0.51-2.33)	0.82		
	\geq 9.0%	2.38 (1.00-5.75)	0.04	2.61 (1.07-6.39)	0.03	1.19 (0.59-2.41)	0.62		
Known HTA	Yes vs. No	0.57 (0.27-1.22)	0.14	0.55 (0.25-1.22)	0.14	0.60 (0.27-1.31)	0.20		
BMI (kg/m ²)		0.97 (0.89-1.05)	0.49			1.00 (0.95-1.05)	0.91		
Current smoker	Yes vs. No	1.63 (0.48-5.54)	0.43			-	-		
Alcohol consumption	Yes vs. No	1.30 (0.61-2.77)	0.49			0.71 (0.12-4.29)	0.70		

HADS-A: Hospital Anxiety and Depression Scale for anxiety ; 95% CI: 95% confidence interval

Table 4

Factors associated with symptoms of depression (Scale HADS-D \geq 8) in outpatients with Type 2 diabetes in Guinea.

Characteristics		Depression (Scale HADS-D \geq 8-21 vs. 0-7)							
		Men (n=183)				Women (n=308)			
		OR crude (95% IC)	P value	OR adjusted (95% IC)	P value	OR crude (95% IC)	P value	OR adjusted (95% IC)	P value
Ages (years)		1.03 (0.99-1.07)	0.10	1.04 (0.99-1.08)	0.07	1.04 (1.01-1.06)	0.003	1.03 (1.01-1.06)	0.02
Zone of Residence	Urban vs. Rural	0.96 (0.49-1.88)	0.90			1.69 (1.04-2.75)	0.03	2.13 (1.27-3.58)	0.004
Married	Yes vs. No	0.57 (0.13-2.51)	0.46			0.81 (0.50-1.30)	0.38		
Socio-Economic Status	Low vs. High	1.34 (0.48-3.75)	0.58			2.61 (1.63-4.18)	<0.001	2.21 (1.34-3.66)	0.002
Insulin therapy use	Yes vs. No	3.03 (1.46-6.27)	0.002	2.28 (1.05-4.92)	0.04	1.42 (0.87-2.31)	0.15	1.27 (0.75-2.16)	0.37
Duration of diabetes (years)		1.03 (0.97-1.08)	0.26			0.99 (0.95-1.04)	0.80		
Previous measurement of HbA1c	No vs. Yes	5.87 (0.75-45.73)	0.09	6.65 (0.81-54.94)	0.08	11.22 (1.47-85.75)	0.02	12.45 (1.54-100.34)	0.02
HbA1c (versus <7.0%)	7.0 to 8.9%	3.51 (0.96-12.88)	0.06	2.99 (0.80-11.11)	0.10	1.34 (0.63-2.87)	0.44		
	\geq 9.0%	5.47 (1.53-19.55)	0.008	3.85 (1.02-14.48)	0.04	1.44 (0.71-2.91)	0.32		
Known HTA	Yes vs. No	0.78 (0.34-1.78)	0.56			0.64 (0.33-1.26)	0.19	0.57 (0.27-1.18)	0.19
BMI (kg/m ²)		0.91 (0.83-1.00)	0.05	0.92 (0.83-1.02)	0.12	0.94 (0.90-0.99)	0.02	0.97 (0.92-1.92)	0.29
Current smoker	Yes vs. No	0.61 (0.13-2.92)	0.53			-	-		
Alcohol consumption	Yes vs. No	1.07 (0.46-2.49)	0.88			0.38 (0.04-3.45)	0.39		

HADS-D: Hospital Anxiety and Depression Scale for depression.; 95% CI: 95% confidence interval