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ORIGINAL ARTICLE

Alexithymia, more than depression, influences glycaemic control of type 2 diabetic patients

A. Luca · M. Luca · M. Di Mauro · F. Palermo · F. Rampulla · C. Calandra

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Abstract
Purpose Psychiatric disorders could affect the patients' abilities to cope with diabetes. The objectives of this study were to assess the prevalence of depression and alexithymia among type 2 diabetic patients and investigate the possible correlations between these psychopathological phenomena and glycaemic control assessed through glycated hemoglobin (HbA1c).
Methods All the patients were evaluated through 20-item Toronto Alexithymia Scale (TAS-20), Hamilton rating scale for depression and Quality of Life Index. HbA1c values, diabetes duration, therapy and socio-demographic characteristics were recorded.
Results One hundred and twenty-eight patients (75 males and 53 female, mean age 64.7 ± 11.2 years) were enrolled. Alexithymic patients, compared to non-alexithymic ones, presented a significantly higher HbA1c (7.7 ± 1.5 vs. 7 ± 1.5, $p = 0.016$). No statistically significant difference was found when comparing the HbA1c of depressed versus non-depressed patients. Considering the raw values of HbA1c, the higher percentage was recorded among patients suffering from depression plus alexithymia (comorbidity group) followed by patients presenting alexithymia only, patients with neither depression nor alexithymia (control group) and, finally, those presenting depression only. The comorbidity group presented a significantly higher value of HbA1c (7.7 ± 1.2) than the control group (7 ± 1.6, $p < 0.04$) and the depressed patients (6.9 ± 1.3, $p = 0.04$). At the logistic regression, the HbA1c was found to be significantly associated only with alexithymia (TAS-20 total score) and insulin therapy.
Conclusions Alexithymia more than depression influences glycaemic control. When evaluating a diabetic patient, a rapid screening for psychopathological alterations would guarantee a more accurate management. The treatment of any associated psychiatric disorders would improve the patients' quality of life.

Keywords Alexithymia · Depression · Diabetes · Glycaemic control · HbA1c

A. Luca and M. Luca contributed equally to this work.

A. Luca
Department "GF Ingrassia", Section of Neuroscience, University Hospital "Policlinico-Vittorio Emanuele" of Catania (Sicily), Via S. Sofia 78, 95100 Catania, Italy

M. Luca · F. Rampulla · C. Calandra (✉)
Department of Medical and Surgery Specialties, Psychiatry Unit of the University Hospital "Policlinico-Vittorio Emanuele" of Catania (Sicily), Via S. Sofia 78, 95100 Catania, Italy
e-mail: c.calandra@unict.it

M. Di Mauro
Department of Clinical and Molecular Biomedicine, Andrology and Endocrinology Unit, University Hospital "Policlinico-Vittorio Emanuele" of Catania (Sicily), Via S. Sofia 78, 95100 Catania, Italy

F. Palermo
Department of Clinical and Molecular Biomedicine, Infectious Diseases Unit, University of Catania, ARNAS Garibaldi Nesima, Catania (Sicily), Via Palermo 636, 95122 Catania, Italy

Introduction

Diabetes represents a major public health problem and implies huge consequences on patient's physical and mental health as well as on the quality of life [1–3].

Being diabetic requires special efforts and a considerable compliance in order to achieve the goal of a good glycaemic control [4]. The presence of a psychiatric disorder could

sensitively affect the patient's ability to cope with diabetes and to correctly follow the strict and complex therapeutic protocols. A strong link between diabetes and psychiatric disorders has been in fact demonstrated [2, 5]. If the presence of diabetes doubles the odds of developing depression [6], on the other hand depressive symptoms could represent an independent risk factor for diabetes [7]. The comorbidity of depression and diabetes leads to metabolic imbalance (in terms of higher blood glucose levels and increased risk of hypoglycaemic episodes) [8–10], worse quality of life [11], more diabetic complications and higher mortality [12, 13]. Conversely, the treatment of depression ameliorates the glycaemic control and, vice versa, the latter exerts positive effects on the patient's mental health [14]. Another psychopathological phenomenon which has been frequently reported among diabetic patients is represented by alexithymia, a multidimensional concept that associates an emotional component, focused on the difficulty in identifying and describing feelings, with a cognitive one, centered on the use of a concrete and poorly introspective way of thinking [15].

It goes without saying that the presence of alexithymia could deeply affect the patients' compliance and their self-regulation. This psychological construct is highly represented among diabetic patients and exerts a negative effect on their glycaemic control [4].

It has been reported that patients with 'difficulty in describing feelings' were more likely to present higher values of glycated hemoglobin (HbA1c) over the time and took advantage from treatments performed in a hospital setting [5]. The findings since here reported are not exempt from criticism and the supposed link between diabetes, depression and alexithymia needs to be confirmed. Some authors, in fact, have questioned the role of depression and alexithymia on glycaemic control [16, 17]. In order to provide further evidence in this field, the objectives of this study were to: (a) assess the prevalence of depression and alexithymia in a sample of type 2 diabetic patients; (b) investigate the possible correlations between these psychopathological phenomena and patient's glycaemic control, assessed through HbA1c.

Methods

Subjects suffering from type 2 diabetes referring to the Andrology and Endocrinology Unit of our University Hospital for a first or control visit have been consecutively enrolled. No form of compensation was given to subjects who accepted to participate to the study. The study was approved by the Hospital Ethics Committee and each individual signed a written informed consent. Each enrolled subject, during one visit, underwent the following questionnaires:

- The Italian version of the 20-item Toronto Alexithymia Scale (TAS-20) [18, 19] investigating the presence of alexithymia. It consists of three subscales: subscale I (assessing the "difficulty in identifying feelings"); subscale II (assessing the "difficulty in describing feelings"); subscale III (assessing the "externally oriented thinking"). Each item provides answers from a Likert-scale specifying levels of "strong disagreement" or "strong agreement". Total scores of 61 and above indicate an alexithymic state. This self-rating questionnaire presents a good internal consistency and an acceptable relative stability [20].
- The Italian version of the Hamilton rating scale for depression (HAM-D) [21] investigating the presence of depressive symptoms. It consists of 21 items, each of which provides answers with a 5-, 4-, or a 3-point rating scale. A score >7 indicates the presence of a depressive condition. Six factors can be isolated from the HAM-D: factor I (anxiety/somatization), factor II (weight), factor III (cognitive disturbance), factor IV (diurnal variation), factor V (psychomotor retardation) and factor VI (sleep).
- The Italian version of the Quality of Life Index (QL) [22] evaluating the individual's quality of life. It consists of five items pertaining to activity, daily life, health, support and mood. Each item provides answers on a 3-point rating scale. There is not a defined cut-off; the higher the total score, the better the quality of life.
- A questionnaire on socio-demographic characteristics, created ad hoc. The questions pertain to the following information: sex, age, diabetes duration, type of work, marital status, presence of a living alone condition, presence of children and frequency of contact with them, presence of grandchildren, the patient's definition of family relationships (excellent/good/bad), the patient's self-sufficiency (self-sufficient/not self-sufficient). The latter was interpreted as the ability to care for themselves independently (everyday activities, personal hygiene, etc.).

In addition, the values of glycated hemoglobin (HbA1c) exhibited by the patients were recorded. The analysis had been carried out by independent laboratories and only those performed within 3 months from the beginning of the study were considered.

HbA1c is a reliable biomarker of average blood glucose concentrations over the preceding 2–3 months [23] universally used for the assessment of glycaemic control; as reported in literature, a value of HbA1c <7 % (measured with a blood sample) indicates a good glucose balance, both in healthy and diabetic individuals, while a value ≥7 % is considered "pathological" as indicative of a bad glucose balance [24].

Moreover, therapy [diet, oral therapy, or insulin (the latter group including also the cases of oral therapy + insulin)] and diabetes duration have been recorded for each patient. All the variables above mentioned have been collected for each patient and stored in a database created ad hoc.

Based on the HAM-D total score, the TAS-20 total score and the HbA1c value, the patients were divided into depressed and non-depressed, alexithymic and non-alexithymic, and subjects with normal or pathological HbA1c. Differences in terms of age, disease duration, HbA1c, therapy of diabetes and psychiatric variables were analyzed for each group (depressed versus non-depressed, alexithymic versus non-alexithymic, subjects with normal versus subjects with pathological HbA1c). Since psychiatric disorders could exist in comorbidity (i.e. among depressed patients there could be alexithymic subjects), a further analysis has been performed after dividing the whole sample into four groups: control group (no depression–no alexithymia); depressed patients (depression only); alexithymic patients (alexithymia only); comorbidity group (depression+alexithymia). This was done in order to eliminate the risk of confounding variables.

Statistical analysis

The collected data have been recorded in an Excel database and have been analyzed using Statistical Package for Social Science (SPSS). Data not implying a numerical ordering (qualitative data, e.g. presence or absence of depression/alexithymia) are expressed as absolute and percentage frequency while quantitative data (e.g. age, duration of disease) are expressed as mean ± standard deviation (SD). The comparisons between the groups have been performed through *t* test for mean ± SD and Chi-square and *z* test for percentages.

Furthermore, a multivariate approach, trough unconditional regression analysis, was performed in order to evaluate the relationship between psychiatric and demographical variables, therapy of diabetes and HbA1c. In particular, the odds ratio (OR), confidence interval (CI) 95 % and *p* value were calculated for each clinical variable (depression, alexithymia and therapy). Possible correlations between psychiatric variables and glycaemic control have been investigated through the Spearman's correlation coefficient. The level of significance was kept at 0.05.

Results

General characteristics of the sample

One hundred and twenty-eight patients (75 males and 53 females) suffering from type 2 diabetes have been included in the study. The mean age was 64.8 ± 11.2 years, the mean diabetes duration was 11.9 ± 9.9 years, the mean value of HbA1c was 7.3 ± 1.5. The TAS-20 total mean score was 55.9 ± 14.0, that of HAM-D was 8.8 ± 6.5 and that of QL was 8.7 ± 1.3. For more details on the general characteristics of the sample, see Table 1.

Table 1 General characteristics of the sample

Gender	75 M, 53 F
Age	64.8 ± 11.2
Diabetes duration	11.9 ± 9.9
HbA1c	7.3 ± 1.5
HAM-D total score	8.8 ± 6.5
HAM-D factor I	3.0 ± 2.5
HAM-D factor II	0.1 ± 0.4
HAM- D factor III	1.6 ± 1.4
HAM-D factor IV	0.3 ± 0.9
HAM- D factor V	2.3 ± 2.1
HAM-D factor VI	1.5 ± 1.5
TAS-20 total score	55.9 ± 14.0
TAS-20 subscale I	18.4 ± 6.7
TAS-20 subscale II	14.4 ± 4.0
TAS-20 subscale III	23.1 ± 5.1
QL	8.7 ± 1.3
Therapy	
Diet	12 (9.4)
Oral therapy	100 (78.1)
Insulin	16 (12.5)

The table shows the general characteristics of the sample. Data are reported as number, percentage, mean and SD (standard deviation)

HbA1c glycated hemoglobin, *HAM-D* Hamilton Depression Rating Scale, *TAS-20* 20-Item Toronto Alexithymia Scale, *QL* Quality of Life Index

Socio-demographic characteristics of the sample

No statistically significant differences were recorded in terms of socio-demographic characteristics when comparing patients with normal to those with pathological HbA1c values. See Table 2.

Depressed versus non-depressed patients: glycaemic control and psychosocial variables

The whole sample was divided into two groups (considering the HAM-D total score): depressed patients and non-depressed patients.

Sixty-three (49.2 %) patients had a HAM-D total score ≤7 (non-depressed patients) while 65 (50.8 %) patients had a HAM-D total score >7 (depressed patients). Depressed patients presented a longer even if not significant

Table 2 Socio-demographical characteristics of patients with normal versus patients with pathological HbA1c values

	Normal HbA1c values, *n* (%)	Pathological HbA1c values, *n* (%)	*p* value
Gender			
Male	40 (53.3)	35 (46.7)	NS
Female	19 (35.8)	34 (64.2)	
Job			
Employed	14 (43.7)	18 (56.3)	NS
Unemployed	5 (29.4)	12 (70.6)	
Retired	40 (50.6)	39 (49.4)	
Partner			
Yes	15 (45.5)	18 (54.5)	NS
No	44 (46.3)	51 (53.7)	
Living			
Alone	9 (47.4)	10 (52.6)	NS
With a partner	20 (47.6)	22 (52.4)	
With partner and relatives	24 (45.3)	29 (54.7)	
With relatives	6 (42.8)	8 (57.2)	
Family relationships			
Excellent	23 (56.1)	18 (43.9)	NS
Good	34 (42.0)	47 (58.0)	
Bad	2 (33.3)	4 (66.7)	
See their children			
No children	6 (42.8)	8 (57.2)	NS
Daily	27 (42.8)	36 (57.2)	
Weekly	26 (51.0)	25 (49.0)	
Grandchildren			
Yes	31 (47.7)	34 (52.3)	NS
No	28 (44.4)	35 (55.6)	
Self-sufficiency			
Yes	51 (49.5)	52 (50.5)	NS
No	8 (32.0)	17 (68.0)	

The table shows the general characteristics of patients with normal HbA1c values versus patients with pathological HbA1c values. Data are reported as number (*n*) and percentage (%), along with the *p* value obtained from the statistical comparison of the two groups

HbA1c glycated hemoglobin, *NS* not significant

diabetes duration (13.5 ± 11.0) than non-depressed patients (10.3 ± 8.6, $p = 0.064$). TAS-20 total score was higher in depressed patients (60.6 ± 13.1) than in non-depressed patients (51 ± 13.1, $p < 0.001$); each TAS-20 subscale was higher among depressed patients than non-depressed patients. QL was lower in depressed patients (8.1 ± 1.4) than in non-depressed patients (9.3 ± 0.9, $p < 0.001$). No difference in terms of HbA1c value between depressed patients and non-depressed patients was found. For more details see Table 3.

Alexithymic versus non-alexithymic patients: glycaemic control and psychosocial variables

Based on the TAS-20 total score, the whole sample was divided into two groups: alexithymic patients and non-alexithymic patients.

Sixty-four (50 %) patients had a TAS-20 total score ≥61 (alexithymic patients). Alexithymic patients presented a significantly higher (11.0 ± 6.5) HAM-D total score than non-alexithymic patients (6.6 ± 5.6, $p < 0.001$). In addition, a positive correlation between HbA1c values and TAS-20 factor I has been recorded ($r = 0.304$; $p < 0.05$).

QL was lower (8.2 ± 1.3) in alexithymic patients than in non-alexithymic patients (9.1 ± 1.2, $p < 0.001$). HbA1c value was higher in alexithymic patients (7.7 ± 1.5) than non-alexithymic patients (7 ± 1.5, $p = 0.016$). For more details, see Table 3.

Psychosocial variables in subjects with normal versus subjects with pathological subjects

Based on the HbA1c values, patients were divided into two previously reported groups: subjects with normal HbA1c and subjects with pathological HbA1c. Subjects with pathological HbA1c presented a significantly higher scores than subjects with normal HbA1c at both HAM-D (10.8 ± 6.8

Table 3 Comparisons according to the psychiatric variables

	Non-depressed patients ($n = 63$)	Depressed patients ($n = 65$)	p value
Age	65.1 ± 11.0	64.5 ± 11.5	0.768
Diabetes duration	10.3 ± 8.6	13.5 ± 11.0	0.064
HbA1c	7.3 ± 1.8	7.4 ± 1.3	0.500
HAM-D total score	3.6 ± 2.2	14.0 ± 5.1	<0.001
TAS-20 total score	51.0 ± 13.1	60.6 ± 13.1	<0.001
TAS-20 subscale I	16.0 ± 6.4	20.8 ± 6.2	0.001
TAS-20 subscale II	13.0 ± 3.7	15.7 ± 3.8	0.001
TAS-20 subscale III	22.0 ± 5.0	24.1 ± 5.1	0.018
QL	9.3 ± 0.9	8.1 ± 1.4	<0.001
Therapy			
Diet	9 (75.0)	3 (25.0)	0.07
Oral therapy	36 (51.4)	34 (48.6)	0.3
Insulin	18 (39.1)	28 (60.9)	0.08
	Non-alexithymic patients ($n = 64$)	Alexithymic patients ($n = 64$)	p value
Age	64.3 ± 10.9	65.2 ± 11.5	0.637
Diabetes duration	10.3 ± 9.7	13.6 ± 9.9	0.059
HbA1c	7.0 ± 1.5	7.7 ± 1.5	0.016
HAM-D total score	6.6 ± 5.6	11.0 ± 6.5	<0.001
HAM-D factor I	2.1 ± 2.1	3.8 ± 2.5	<0.001
HAM-D factor II	0.1 ± 0.4	0.2 ± 0.4	0.319
HAM- D factor III	1.3 ± 1.4	1.8 ± 1.4	0.043
HAM-D factor IV	0.1 ± 0.6	0.5 ± 1.1	0.031
HAM- D factor V	1.7 ± 1.7	2.8 ± 2.2	0.002
HAM-D factor VI	1.1 ± 1.3	1.8 ± 1.6	0.009
TAS-20 total score	43.5 ± 7.3	68.2 ± 5.0	<0.001
QL	9.1 ± 1.2	8.2 ± 1.3	<0.001
Therapy			
Diet	10 (83.3)	2 (16.7)	0.05
Oral therapy	36 (51.4)	34 (48.6)	0.3
Insulin	18 (39.1)	28 (60.9)	0.08

The table shows the comparative statistical analysis according to the psychiatric variables (depression ad alexithymia). Data are reported as number (n), percentage (%), mean ± SD (standard deviation), with the p value

HbA1c glycated hemoglobin, *HAM-D* Hamilton Depression Rating Scale, *TAS-20* 20-Item Toronto Alexithymia Scale, *QL* Quality of Life Index

vs. 6.6 ± 5.3, $p < 0.001$) and TAS-20 (60.3 ± 13.1 vs. 51.2 ± 13.3, $p < 0.001$). For more details see Table 4.

Impact of alone/comorbid psychiatric variables on glycaemic control

In order to clarify the role of depression and alexithymia (alone or comorbid) on glycaemic control, a further analysis was performed after dividing the whole sample into four groups according to HAM-D and TAS-20 total scores: control group (no depression, no alexithymia); depression group (depression only); alexithymia group (alexithymia only); comorbidity group (depression+alexithymia). The 32.8 % (33 M; 9 F) of patients had neither depression nor alexithymia; the 17.2 % (13 M; 9 F) had depression only; the 16.4 % (12 M; 9 F) had alexithymia only; the 33.6 % (17 M; 26 F) had both depression and alexithymia.

Considering the raw values of HbA1c, the higher value was recorded in the comorbidity group (7.7 ± 1.2 %) followed by the alexithymia group (7.6 ± 2), the control group (7 ± 1.6 %) and depression group (6.9 ± 1.3 %). The comorbidity group presented a significantly higher value of HbA1c than the control group ($p = 0.04$) and the depression group ($p = 0.02$).

Multivariate analysis

A logistic regression has been performed using the value of the HbA1c as dependent variable and age, gender, HAM-D total score, TAS-20 total score and therapy of diabetes as independent variables. The HbA1c was found to be significantly associated with age (OR 0.9, CI 0.91–0.99), alexithymia (OR 3.1, CI 1.28–7.48) and insulin therapy (OR 24.3, CI 2.64–223.98). For more details, see Table 5.

Table 4 Psychosocial variables and therapy of patients with normal and pathological HbA1c values

	Subjects with normal HbA1c values ($n = 62$)	Subjects with pathological HbA1c values ($n = 65$)	p value
Age	66.6 ± 11.0	63.0 ± 11.2	0.170
Diabetes duration	11.3 ± 10.2	12.5 ± 9.7	0.452
HAM-D total score	6.6 ± 5.3	10.8 ± 6.8	<0.001
HAM-D factor I	2.2 ± 2.1	3.7 ± 2.5	<0.001
HAM-D factor II	0.1 ± 0.5	0.1 ± 0.4	0.738
HAM- D factor III	1.3 ± 1.2	1.8 ± 1.5	0.022
HAM-D factor IV	0.1 ± 0.5	0.5 ± 1.1	0.009
HAM- D factor V	1.9 ± 1.8	2.6 ± 2.2	0.031
HAM-D factor VI	0.9 ± 1.2	1.9 ± 1.6	<0.001
TAS-20 total score	51.2 ± 13.3	60.3 ± 13.1	<0.001
TAS-20 subscale I	15.9 ± 6.3	20.8 ± 6.3	<0.001
TAS-20 subscale II	13.7 ± 3.7	15.0 ± 4.1	0.039
TAS-20 subscale III	21.5 ± 5.1	24.6 ± 4.8	0.001
QL	8.9 ± 1.3	8.5 ± 1.3	0.034
Therapy			
Diet	11 (91.7)	1 (8.3)	0.03
Oral therapy	37 (52.8)	33 (47.1)	0.8
Insulin	11 (23.9)	35 (76.1)	0.04

The table shows the general characteristics of patients with normal HbA1c values versus patients with pathological HbA1c values. Data are reported as number and percentage and mean ± SD (standard deviation), with the p value

HbA1c glycated hemoglobin, *HAM-D* Hamilton Depression Rating Scale, *TAS-20* 20-Item Toronto Alexithymia Scale, *QL* Quality of Life Index

Table 5 Logistic regression

	Adjusted OR		
	OR	p value	CI 95 %
Age	0.9	0.02	0.91–0.99
Gender			
Female (reference)			
Male	1.7	0.23	0.7–4.19
HAM-D total			
HAM-D <7 (reference)	1		
HAM-D >7	1.6	0.27	0.68–3.86
TAS-20 total			
TAS-20 normal value (reference)	1		
TAS-20 pathological value	3.1	0.01	1.28–7.48
Therapy			
Diet (reference)	1		
Oral therapy	5.5	0.12	0.63–47.41
Insulin	24.3	0.004	2.64–223.98

The table shows the results obtained from the logistic regression pertaining to the possible link between age, gender, glycaemic control (HbA1c), depression (investigated through the HAM-D), alexithymia (investigated through the TAS-20) and therapy. The odds ratio (OR), the p value and the confidence interval (CI) are reported

Discussion

Interesting findings have arisen from the statistical analysis performed on our sample of type 2 diabetic patients.

One of the objectives of the present study was to assess the prevalence of depression and alexithymia. We found that more than the 17 % and the 16 % of the patients were depressed and alexithymic, respectively. Nearly the 34 % had both depression and alexithymia.

Unfortunately, the impact of depression and alexithymia on glycaemic control is still controversial [16, 17, 25]. Previous researches highlighted the bidirectional relationship between depression and diabetes. A recent cohort study demonstrated a certain association between weight cycling (common phenomenon in diabetes) and depression in type 2 diabetic patients [26]. Moreover, it seems that the association between diabetes and depression could be due to the somatic-affective component of the latter [27]; even the depressive temperament seems to negatively affect the glycaemic control adjustment to diabetes [28]. On the other hand, recent evidence suggests that the worse glycaemic control could be linked, more than to depression, to the diabetes-related distress [29], a psychosocial issue

independently associated with self-management and perceived burden of diabetes [30].

Another research topic lately interesting the Scholars is the link between diabetes and alexithymia. In our study, alexithymia more than depression seems to exert a certain role on glycaemic control. More specifically, alexithymic patients compared to non-alexithymic patients presented a significantly higher HbA1c value while no significant difference in terms of HbA1c value was found between depressed patients and non-depressed patients. This association was confirmed at the multivariate analysis: in our sample alexithymia triples the risk of a worse glycaemic control. Our results are consistent with previous studies hypothesizing that alexithymia could even represent an independent risk factor for diabetes, as well as for high triglyceride levels and elevated blood pressure, thus determining a worsening of the metabolic syndrome [31, 32].

Nevertheless, even though in our study no difference between depressed patients and non-depressed patients was found in terms of HbA1c value, subjects with pathological HbA1c presented a higher HAM-D total score when compared to subjects with normal HbA1c: patients with a worse glucose balance are then more likely to present a depressive condition. Speculating, in this case, depression could be probably secondary to a worse glycaemic control. Diabetic patients with alexithymia, and even more those with depression+alexithymia, presented a higher HbA1c if compared to the other groups (control and depression group); therefore, it seems reasonable to hypothesize a certain impact of depression on worsening glycaemic control among alexithymic patients. Another interesting data is the positive correlation between TAS-20 subscale I ("difficulty in identifying feelings") and HbA1c values. Since alexithymia is associated with unhealthy behaviors (such as compulsive eating or dieting) and a biased perception and reporting of somatic symptoms [33, 34], it is easy to imagine how diabetic patients with a difficulty in identifying feelings could scarcely understand their health condition, misinterpret their somatic symptoms and hardly cope with the complex management of diabetes. It has been previously demonstrated, in fact, that alexithymic patients are likely to show impaired ability of self-care and disease coping strategies [4]; hence, it would be risky to underestimate the impact of psychopathology on physical health. It is, in fact, universally recognized that patients with severe psychiatric disorders present worse systemic health and shortened life expectancy [35].

This study presents some limitations. Firstly, the small sample size limits the possibility to generalize our findings to the diabetic population. Secondly, the cross-sectional design of the study does not allow us to infer a causality role of depression and alexithymia on glycaemic control.

Thirdly, we did not consider other variables (e.g. stressful life events) that, according to literature data [36], could affect glucose balance. Our findings shed light to the controversial role of depression and alexithymia on glycaemic control: alexithymia, more than depression, influences glycaemic control of type 2 diabetic patients. Other studies are necessary to confirm or disconfirm the results here reported.

In conclusion, when evaluating a diabetic patient, a rapid screening for psychopathological alterations would guarantee a more accurate management. The treatment of any associated psychiatric disorders and the choice of more acceptable therapeutic approaches for special subpopulations of diabetic patients (e.g. alexithymic ones), thus favoring compliance and reducing the risk of diabetic complications, would improve the patients' quality of life.

Conflict of interest The authors declare that they have no competing interests.

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