Eating and Weight Disorders - Studies on Anorexia, Bulimia and Obesity
https://doi.org/10.1007/s40519-020-00894-8

ORIGINAL ARTICLE

Intuitive eating is associated with glycemic control in type 2 diabetes

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Received: 11 March 2020 / Accepted: 21 March 2020

Abstract

Purpose The intuitive eating approach has shown promise, but studies on its association with diabetics are scarce. The aim of this study is to identify the association between intuitive eating and glycemic control in individuals with type 2 diabetes mellitus.

Methods This is an observational cross-sectional analytical study in patients at the endocrinology service of a university hospital in Vitória/ES, Brazil. For data collection, a semi-structured questionnaire was used and intuitive eating was assessed by Intuitive Eating Scale-2.

Results A total of 179 individuals, mostly female and elderly, and predominantly taking oral antidiabetic drugs without association with insulin were evaluated. In adjusting for the total scale score, the most intuitive eating was associated with lower chances of patients presenting inadequate glycemic control by 89% (OR = 0.114; CI 0.024–0.540; $p = 0.006$), and a higher score on the Body–Food–Choice Congruence subscale was associated with lower chances of participants presenting this inadequacy by almost 66% (OR = 0.341; CI 0.131–0.891; $p = 0.028$), regardless of their body mass index.

Conclusion Eating intuitively, especially in accordance with body needs may be associated with lower chances of type 2 diabetics having inadequate glycemic control.

Level of evidence Level V, cross-sectional descriptive study.

Keywords Eating behavior · Nutrition · Diabetes mellitus · Glycosylated hemoglobin

Introduction

Diabetes mellitus (DM) is a chronic condition characterized by hyperglycemia, with Type 2 (T2DM) being the most prevalent, and its main risk factors are overweight, unhealthy diet, physical inactivity and smoking [1]. Data from the most recent atlas of International Diabetes Federation (IDF) estimated that the prevalence of DM was approximately 8.8% of the global population, and would reach 9.9% (628 million) by 2045 [2].

Lifestyle management is a key aspect of DM control [3], and although nutritional treatment is essential, adherence to dietary prescriptions is still a challenge [4–6], as individuals feel the loss of pleasure, autonomy and the freedom to eat [7]. The American Diabetes Association (ADA) has emphasized the importance of a patient-centered approach [3], and in this context, the importance of non-dietary therapies that shifts the focus of weight towards improving health and psychological well-being outcomes are highlighted. One such approach, intuitive eating (IE), promotes food intake based on internal hunger and satiety cues, body acceptance and health and pleasure-based behavior choices [8].

IE is defined as a dynamic mind–body integration of instinct, emotion, and rational thinking [9]. This approach adopts essential principles for a more intuitive diet, including attention to hunger and satiety signals from the body, and the practice of gentle nutrition, where individuals make their choices corresponding to their bodily needs [10].

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Published online: 30 March 2020

In 2006, Tylka systematized and validated a questionnaire assessing IE [11]. It was revised in 2013, and evaluated the proposed principles through four subscales [12]. Several studies have promoted the importance of IE for improved health, including lower chances of being overweight [13], lower total serum cholesterol and blood pressure [14], lowered concerns with body image [15] and better diet quality [16]. However, the literature associating IE and DM is still scarce.

Thus, the aim of this study was to identify the association between IE and glycemic control in T2DM patients.

Materials and methods

Design and study population

This is an observational cross-sectional analytical study, conducted in the endocrinology department of a university hospital in Vitória/ES, Brazil. The target population consisted of adults and elderly patients of both sexes with T2DM. For the selection of participants, the record of medical care performed at the service in 2018 was used. Individuals who met the research criteria were invited to participate in person.

Inclusion criteria included individuals aged 20 or older and with a T2DM diagnosis of more than 1 year. Participants with eating disorders, pregnant and/or lactating women, alcoholics, individuals with decompensated hypothyroidism, stage IV or V chronic kidney disease, recurrent hypoglycemia, patients on medication or appetite-altering treatments and psychiatric patients were excluded. We also excluded neurological patients who were unable to communicate.

Socio-demographic, clinical, lifestyle and anthropometric variables

Participants answered a semi-structured questionnaire providing socio-demographic data: gender; age; marital status; schooling; self-reported race/skin color (white or non-white) and socioeconomic class [17]. Next, clinical data were obtained from medical records or self-reported by the participant, i.e., T2DM duration and treatment of disease, overweight and medication. Participants were also asked about life style habits, i.e., the consumption of alcohol and tobacco and physical activities. They were also asked about their health (very good/good or regular/poor).

Anthropometric data (weight and height) were evaluated, and the body mass index (BMI) was calculated and classified according to WHO criteria for adults [18] and Lipschitz for the elderly (aged 60 and over) [19].

Glycemic control

Glycemic control (study outcome variable) was assessed using glycosylated hemoglobin (HbA1c) levels from patient medical records, through analysis of exams performed within a period of up to 90 days (validity of the HbA1c assessment exam). This value was categorized within the glycemic target (adequate glycemic control) when HbA1c levels were $\leq 7\%$, or above this target (inadequate glycemic control) when HbA1c $> 7\%$ [3].

Intuitive eating assessment

IE was assessed by the Intuitive Eating Scale-2 (IES-2) [12] validated in Portuguese [20]. The scale comprises questions on eating attitudes involving IE, ranging from strongly disagree to strongly agree. The analysis was performed through the total score, which is generated from the average score of 23 questions (the higher the score, the higher the IE) and its four components (subscales). The components addressed were: unconditional permission to eat the desired food when hungry, classifying the food as neutral (UPE); eating for physical and non-emotional reasons (EPR); reliance on hunger to determine when and how much to eat (RHSC); and congruence in food choices, allowing good body nutrition (B-FCC).

Data analysis

When estimating the sample size calculation, we considered the prevalence of DM in Vitória as 9.7% [21], a significance of 95%, a maximum error of 5% and losses of 20%. This meant 161 participants would be required for the study. Sample accuracy was calculated using Epidat 4.2 software. For the number of 179 participants (final sample) and a prevalence of 55.3% HbA1c above the target [3], the sample precision is 5.8%. Data were analyzed using IBM SPSS Statistics for Windows software, version 22.0 (Armonk, NY, USA: IBM Corp). The normality of the variables was assessed by the Shapiro–Wilk test. To describe the study variables, medians with interquartile ranges and absolute and relative frequencies were used. For analysis of differences between the medians, the Mann–Whitney test was performed, and for analysis of the differences of proportions, the Chi-square (χ^2) or Fisher's exact test was used. The significance level for all tests was 5%.

To quantify independent variables for the outcome of interest, multivariate analyses were performed, including, in the binary logistic regression model, the independent variables that presented a significance level of up to 20% in the bivariate tests. The assumption of absence of multicollinearity and the adjustment of the model according to the Hosmer–Lemeshow test were also considered. The enter method of variable selection was adopted, estimating odds ratio (OR) values and their respective confidence intervals (CI). As the total IES-2 score and its subscales were correlated, these variables were analyzed separately in this model.

Ethical considerations

All procedures performed were in accordance with the ethical standards of the institutional research committee (Research Ethics Committee of the Federal University of Espírito Santo, CAAE: 87981718.6.0000.5060, protocol number 2.621.801, approved on April 25, 2018) and with the Helsinki Declaration and its subsequent amendments or comparable ethical standards. All individuals were fully informed about the study and consented their participation by signing the consent forms.

Results

A total of 2517 records of patients seen by doctors in 2018 were evaluated, and 2022 were excluded because they were repeat records (returning patients) or did not meet the study criteria, leaving 495 eligible participants who were invited to participate. Of these, 239 individuals agreed to participate, of which 179 attended.

Most of the sample was female ($n=133$; 74.3%) and elderly ($n=97$; 54.2%) (Table 1). Most participants were diagnosed and treated for T2DM in the previous five years, and most had been overweight for more than 10 years. For drug treatment evaluations, most were taking oral antidiabetic drugs, without association with insulin. Regarding physical activity, 93 individuals reported being sedentary (52%). It was also observed that most of the sample was overweight/obese ($n=142$; 79.3%). IE was assessed by total scores and its subscales, and no differences were observed between the sexes. Over half ($n=84$; 55.3%) had HbA1c levels above the ADA glycemic target, without differences between the sexes.

For data analysis of HbA1c classifications (Table 2), 152 individuals who presented these data were included. It was observed that participants with inadequate glycemic control had longer T2DM duration and treatment, and were taking oral antidiabetic drugs in association with insulin ($p<0.001$). These participants had also self-rated their health status as regular/poor ($p=0.031$). Participants with adequate glycemic control had significantly higher scores on the total IE scale ($p=0.010$) and for RHSC ($p<0.001$) and B-FCC ($p<0.001$) subscales. There were no statistical differences in HbA1c levels according to the other parameters, including BMI ($p=0.134$).

The total IES-2 score and its subscales were analyzed separately in a logistic regression model (Table 3). When adjusted for the total score, participants taking only oral antidiabetic drugs were approximately 90% less likely to have inadequate glycemic control (OR = 0.101; CI 0.035–0.296; $p<0.001$) when compared to the use of oral antidiabetic drugs together with insulin. In the adjustment for subscales, the result was similar (OR = 0.099; CI 0.034–0.292; $p<0.001$).

In the adjustment for the total score, it was observed that IE was associated with an 89% lower chance of inadequacy in glycemic control (OR = 0.114; CI 0.024–0.540; $p=0.006$). When investigated which subscale this contribution was most effective (adjustment by subscales), the data indicated that the higher score on the B-FCC subscale was associated with almost 66% less chance of participants presenting this inadequacy (OR = 0.341; CI 0.131–0.891; $p=0.028$).

Discussion

This study outlined the potential contributions of IE to the glycemic control of individuals with T2DM. Our findings indicated that eating more intuitively, especially in congruence with bodily needs, may be associated with lower chances of inadequate glycemic control, as assessed by HbA1c levels, the main predictor of this control. This study is the first to show this association in adults and the elderly with T2DM, using a validated scale to measure IE.

DM is extremely prevalent, and contributed to approximately four million deaths in 2017 [2]. Thus, proper disease management is essential [1], especially in the lifestyle. In this context, the ADA highlights the need to provide DM patients with the practical tools for developing healthy eating patterns, rather than focusing on individual nutrients or single foods [3]. Péres et al., reported on difficulties in following prescriptions associated with the loss of pleasure and the freedom to eat [7]. This reinforces the ADA's position to treat diabetic patients according to their nutritional demands, through patient-centered care.

Given these recommendations, the IE based approach is promising. Studies have shown it has role in body weight control [13], influencing metabolic changes [14] and body satisfaction [15], but few studies have addressed this approach within a DM context. In our study, it was shown that eating more intuitively, regardless of BMI, could considerably be associated with lower chances of T2DM impacting on glycemic control.

Willig et al., in their qualitative study of women with T2DM, demonstrated that self-reported eating was

Table 1 Socio-demographic, clinical and nutritional data distributed by sex of type 2 diabetics

Variables	Sex		*p* value	Total *N* (%)
	Male *N* (%)	Female *N* (%)		
Age group[a]				
Adult (< 60 years)	16 (34.8)	66 (49.6)	0.089	82 (45.8)
Elderly (≥ 60 years)	30 (65.2)	67 (50.4)		97 (54.2)
Age (years)*[b]	63 ± 9	60 ± 10	**0.037**	60 ± 10
Marital status[a]				
Live maritally	32 (69.6)	82 (61.7)	0.378	114 (63.7)
Do not live maritally	14 (30.4)	51 (38.3)		65 (36.3)
Education				
Up to primary complete	32 (69.6)	91 (68.4)	0.874	123 (68.7)
Secondary complete	9 (19.6)	30 (22.6)		39 (21.8)
Higher education	5 (10.9)	12 (9)		17 (9.5)
Race/skin color[1a]				
White	15 (32.6)	33 (25)	0.338	48 (27)
Non-white	31 (67.4)	99 (75)		130 (73)
Socioeconomic class[2a]				
A/B	13 (28.9)	15 (11.4)	**0.009**	28 (15.8)
C/D/E	32 (71.1)	117 (88.6)		149 (84.2)
T2DM time[1]				
< 5 years	17 (37)	47 (35.6)	0.220	64 (36)
5–10 years	17 (37)	34 (25.8)		51 (28.7)
> 10 years	12 (26.1)	51 (38.6)		63 (35.4)
T2DM treatment time[2]				
< 5 years	22 (48.9)	56 (42.4)	0.327	78 (44.1)
5–10 years	13 (28.9)	31 (23.5)		44 (24.9)
> 10 years	10 (22.2)	45 (34.1)		55 (31.1)
Overweight time[3]				
< 5 years	9 (30)	32 (29.9)	0.746	41 (29.9)
5–10 years	8 (26.7)	22 (20.6)		30 (21.9)
> 10 years	13 (43.3)	53 (49.5)		66 (48.2)
Drug treatment for T2DM[4]				
Insulin and oral antidiabetics**	15 (34.9)	42 (31.6)	0.652	57 (32.4)
Oral antidiabetics**	24 (55.8)	83 (62.4)		107 (60.8)
Insulin	4 (9.3)	8 (6)		12 (6.8)
Alcohol use				
Yes	9 (19.6)	11 (8.3)	**< 0.001**	20 (11.2)
No	17 (37)	100 (75.2)		117 (65.4)
In the past	20 (43.5)	22 (16.5)		42 (23.5)
Tobacco use				
Yes	6 (13)	6 (4.5)	**< 0.001**	12 (6.7)
No	13 (28.3)	86 (64.7)		99 (55.3)
In the past	27 (58.7)	41 (30.8)		68 (38)
Physical activity[a]				
No	25 (54.3)	68 (51.1)	0.735	93 (52)
Yes	21 (45.7)	65 (48.9)		86 (48)
Self-rated health[a]				
Very good/good	23 (50)	48 (36.1)	0.116	71 (39.7)
Regular/poor	23 (50)	85 (63.9)		108 (60.3)
BMI classification[a]				
Underweight/adequate	12 (26.1)	25 (18.8)	0.298	37 (20.7)

Table 1 (continued)

Variables	Sex		p value	Total N (%)
	Male N (%)	Female N (%)		
Overweight/obese	34 (73.9)	108 (81.2)		142 (79.3)
IES-2 total score*[b]	3.22 ± 0.31	3.22 ± 0.39	0.636	3.22 ± 0.39
UPE subscale*[b]	3.50 ± 0.50	3.50 ± 0.66	0.371	3.50 ± 0.66
EPR subscale*[b]	3.00 ± 0.38	3.00 ± 0.50	0.237	3.00 ± 0.50
RHSC subscale*[b]	3.67 ± 0.67	3.67 ± 1.17	0.097	3.67 ± 1.17
B-FCC subscale*[b]	4.00 ± 0.67	4.00 ± 0.33	0.248	4.00 ± 0.33
Glycosylated hemoglobin[5a]				
Within ADA targets	17 (45.9)	51 (44.3)	0.999	68 (44.7)
Above ADA targets	20 (54.1)	64 (55.7)		84 (55.3)

Number of participants differs from total due to missing data

Data expressed as *n* (%)

T2DM Type 2 Diabetes Mellitus, *BMI* Body Mass Index, *IES-2* Intuitive Eating Scale-2, *UPE* unconditional permission to eat, *EPR* eating for physical rather than emotional reasons, *RHSC* reliance on hunger and satiety cues, *B-FCC* Body–Food–Choice Congruence, *ADA* American Diabetes Association

In bold: statistically significant values ($p < 0.05$)

*Data expressed as p50 ± interquartile range. Chi-square test

**Oral antidiabetics: metformin, glibenclamide, glicazide, sitagliptin, dapagliflozin, empagliflozin, glimepiride, vildagliptin or alogliptin. Target of glycosylated hemoglobin for diabetics equal to or less than 7.0%, according to ADA, 2019

[a]Fisher's exact test

[b]Mann–Whitney test. $N = 179$

[1]$N = 178$

[2]$N = 177$

[3]$N = 137$

[4]$N = 176$

[5]$N = 152$

misaligned with IE. The women reported a lack of self-control with respect to food; they regularly ate in the absence of hunger, yet stated that the determining factor for stopping eating was recognizing the fullness feeling. Interventions that encourage IE may possibly be associated with less unhealthy eating behaviors such as dietary restriction and binge eating, thus improving an individual's relationship with food [22].

Miller et al., in a randomized clinical trial with an approach based mainly on hunger and satiety cues, demonstrated that in type 2 diabetics, this treatment promoted greater reduction in HbA1c levels when compared to conventional treatments [23].

In a study of type 1 diabetic children and adolescents, Wheeler and colleagues also highlighted this association. These authors observed similar results to this study, pointing to a strong association between IE and lower HbA1c levels. They demonstrated that the subscale most interfering with this control was "eating for physical and non-emotional reasons" (EPR), highlighting the effects of emotion on diet and glycemic control [24]. Our result regarding the subscale differs from this work, but a comparison is not possible, since the authors used the scale in their 2006 version, where the B-FCC subscale had not yet been inserted. In addition, there were differences in terms of the target audience, since their study was conducted in a different age group and in patients with type 1 DM.

Our results show that eating congruently with bodily needs can be associated with lower chances of type 2 diabetics presenting inadequate glycemic control. The B-FCC subscale was added to the second version of the questionnaire and was related to one of the ten principles of IE, the practice of "gentle nutrition". It assesses the extent to which individuals make their choices corresponding to their bodily needs [12]. This principle reflects the tendency to choose nutritious foods that promote health, body function and well-being, while satisfying the taste buds. Individuals who demonstrate high congruency between body needs and food choices do not feel pressured to eat healthy foods; they choose to do so because they feel it is what their body needs. This concept is a central component of IE [25]. This subscales of IE is also related in a

Table 2 Socio-demographic, clinical and nutritional data distributed according to the glycosylated hemoglobin classification of type 2 diabetics

Variables	Glycosylated hemoglobin		*p* value	Total *N* (%)
	Within ADA targets *N* (%)	Above ADA targets *N* (%)		
Sex[a]				
Male	17 (25)	20 (23.8)	0.999	37 (24.3)
Female	51 (75)	64 (76.2)		115 (75.7)
Age group[a]				
Adult (< 60 years)	28 (41.2)	43 (51.2)	0.254	71 (46.7)
Elderly (≥ 60 years)	40 (58.8)	41 (48.8)		81 (53.3)
Age (years)*[b]	61 ± 9	59 ± 10	0.322	60 ± 10
Marital status[a]				
Live maritally	44 (64.7)	56 (66.7)	0.864	100 (65.8)
Do not live maritally	24 (35.3)	28 (33.3)		52 (34.2)
Education				
Up to primary complete	47 (69.1)	61 (72.6)	0.258	108 (71.1)
Secondary complete	18 (26.5)	15 (17.9)		33 (21.7)
Higher education	3 (4.4)	8 (9.5)		11 (7.2)
Race/skin color[a]				
White	21 (30.9)	23 (27.4)	0.720	44 (28.9)
Non-white	47 (69.1)	61 (72.6)		108 (71.1)
Socioeconomic class[1a]				
A/B	10 (14.9)	13 (15.7)	0.999	23 (15.3)
C/D/E	57 (85.1)	70 (84.3)		127 (84.7)
T2DM time				
< 5 years	38 (57.4)	18 (21.4)	**< 0.001**	57 (37.5)
5–10 years	18 (26.5)	26 (31)		44 (28.9)
> 10 years	11 (16.2)	40 (47.6)		51 (33.6)
T2DM treatment time[2]				
< 5 years	43 (64.2)	26 (31)	**< 0.001**	69 (45.7)
5–10 years	16 (23.9)	23 (27.4)		39 (25.8)
> 10 years	8 (11.9)	35 (41.7)		43 (28.5)
Overweight time[3]				
< 5 years	21 (39.6)	18 (26.9)	0.295	39 (32.5)
5–10 years	10 (18.9)	18 (26.9)		28 (23.3)
> 10 years	22 (41.5)	31 (46.3)		53 (44.2)
Drug treatment for T2DM[1]				
Insulin and oral antidiabetics**	6 (8.8)	41 (50)	**< 0.001**	47 (31.3)
Oral antidiabetics**	61 (89.7)	32 (39)		93 (62)
Insulin	1 (1.5)	9 (11)		10 (6.7)
Alcohol use				
Yes	6 (8.8)	12 (14.3)	0.316	18 (11.8)
No	43 (63.2)	56 (66.7)		99 (65.1)
In the past	19 (27.9)	16 (19)		35 (23.1)
Tobacco use				
Yes	5 (7.4)	3 (3.6)	0.561	8 (5.3)
No	38 (55.9)	47 (56)		85 (55.9)
In the past	25 (36.8)	34 (40.5)		59 (38.8)
Physical activity				
No	39 (57.4)	40 (47.6)	0.256	79 (52)
Yes	29 (42.6)	44 (52.4)		73 (48)
Self-rated health[a]				
Very good/good	33 (48.5)	26 (31)	**0.031**	59 (38.8)

Table 2 (continued)

Variables	Glycosylated hemoglobin		*p* value	Total *N* (%)
	Within ADA targets *N* (%)	Above ADA targets *N* (%)		
Regular/poor	35 (51.5)	58 (69)		93 (61.2)
BMI classification[a]				
Underweight/adequate	16 (23.5)	11 (13.1)	0.134	27 (17.8)
Overweight/obese	52 (76.5)	73 (86.9)		125 (82.2)
IES-2 Total Score*[b]	3.30 ± 0.26	3.17 ± 0.46	**0.010**	3.22 ± 0.39
UPE Subscale*[b]	3.58 ± 0.66	3.33 ± 0.58	0.168	3.50 ± 0.66
EPR Subscale*[b]	3.00 ± 0.38	3.00 ± 0.50	0.914	3.00 ± 0.50
RHSC Subscale*[b]	4.00 ± 0.92	3.33 ± 1.08	**0.001**	3.67 ± 1.17
B-FCC Subscale*[b]	4.00 ± 0.00	4.00 ± 0.67	**0.001**	4.00 ± 0.33

Data expressed as *n* (%)

Number of participants differs from total due to missing data

T2DM type 2 diabetes mellitus, *BMI* body mass index, *IES-2* Intuitive Eating Scale-2, *UPE* unconditional permission to eat, *EPR* eating for physical rather than emotional reasons, *RHSC* reliance on hunger and satiety cues, *B-FCC* Body–Food–Choice Congruence, *ADA* American Diabetes Association

In bold: statistically significant values ($p < 0.05$)

*Data expressed as p50 ± interquartile range. Chi-square test

**Oral antidiabetics: Metformin, Glibenclamide, Glicazide, Sitagliptin, Dapagliflozin, Empagliflozin, Glimepiride, Vildagliptin or Alogliptin. Target of glycosylated hemoglobin for diabetics equal to or less than 7.0%, according to ADA, 2019

[a]Fisher's exact test

[b]Mann–Whitney test. $N = 152$

[1]$N = 150$

[2]$N = 151$

[3]$N = 120$

[4]$N = 149$

positive way to psychological well-being, body appreciation, self-esteem and life satisfaction [12].

In our study, IE, as reflected by the total score and B-FCC subscale, was associated with lower chances of being above glycemic goals, regardless of their BMI. Although the association between being overweight and T2DM is well known [26], in our study BMI did not appear to be a determining factor for glycemic control. This observation also differs from the work by Tylka et al., where the B-FCC subscale showed an inverse association with BMI in male participants [12]. Such differences may be due to sample characteristics (our sample was predominantly female) and participant numbers.

Bacon and colleagues performed a clinical trial based on a model that encouraged health across all body sizes, and showed it was possible to have normal metabolic parameters, independent of body weight. The Health At Every Size® (HAES®) project supports homeostatic regulation and IE, and while glycemic control was not evaluated, improvements in other important parameters were observed, such as significant reductions in serum cholesterol and blood pressure, regardless of changes in body weight and BMI [14].

Importantly, traditional diet programs that encourage individuals to restrict their food intake are not only ineffective in terms of weight outcomes, they are counterproductive in that they promote psychological distress and unhealthy eating behaviors. Non-dietary approaches, such as IE, shift the focus away from weight to improve health and psychological well-being outcomes [8].

In addition to lifestyle management, pharmacological treatment is a very important part of DM care. Our study indicated that when compared to the exclusive use of insulin, the use of oral antidiabetic drugs was associated with lower chance of inadequate glycemic control. Mendes and colleagues found similar results, where non-insulin-treated T2DM patients were more likely to have adequate glycemic control indices when compared to insulin-treated patients. In this study, the satisfaction with current DM treatments was directly associated with glycemic control, i.e. diabetic patients satisfied with treatments were more likely to have adequate glycemic control, and this was more evident in non-insulin treated T2DM patients [27]. In a multicenter study by Peyrot et al., poor adherence to insulin use was observed. The authors concluded that glycemic control may be inadequate for insulin-treated patients, and may be partly

Table 3 Multiple analysis on ADA adequacy of glycosylated hemoglobin in type 2 diabetic patients

Variables	Crude				Adjusted			
	p value	OR	$CI_{95\%}$		*p* value	OR	$CI_{95\%}$	
			Lower	Upper			Lower	Upper
Model 1—IES-2 total score								
Drug treatment for T2DM								
Insulin and oral antidiabetics[a]		1				1		
Oral antidiabetics[a]	**< 0.001**	**0.077**	**0.029**	**0.200**	**< 0.001**	**0.101**	**0.035**	**0.296**
Insulin	0.809	1.317	0.141	12.329	0.654	1.774	0.145	21.721
BMI classification								
Underweight/adequate		1				1		
Overweight/obese	0.098	2.042	0.876	4.759	0.320	1.739	0.584	5.178
IES-2 total score	**0.005**	**0.203**	**0.066**	**0.625**	**0.006**	**0.114**	**0.024**	**0.540**
Model 2—IES-2 subscales score								
Drug treatment for T2DM								
Insulin and oral antidiabetics[a]		1				1		
Oral antidiabetics[a]	**< 0.001**	**0.077**	**0.029**	**0.200**	**< 0.001**	**0.099**	**0.034**	**0.292**
Insulin	0.809	1.317	0.141	12.329	0.748	1.483	0.134	16.391
BMI classification								
Underweight/adequate		1				1		
Overweight/obese	0.098	2.042	0.876	4.759	0.323	1.792	0.564	5.691
B-FCC subscale	**0.007**	**0.392**	**0.199**	**0.774**	**0.028**	**0.341**	**0.131**	**0.891**

Binary logistic regression crude and adjusted

In bold: statistically significant values ($p < 0.05$). Enter method for variable selection. Model adjusted according to Hosmer–Lemeshow test

ADA American Diabetes Association, *T2DM* type 2 diabetes mellitus, *BMI* body mass index, *IES-2* Intuitive Eating Scale-2, *B-FCC* Body–Food–Choice Congruence, *OR* odds ratio, $IC_{95\%}$ 95% confidence interval

[a]Oral antidiabetics: metformin, glibenclamide, glicazide, sitagliptin, dapagliflozin, empagliflozin, glimepiride, vildagliptin or alogliptin

attributable to insulin omission/non-adherence and lack of dose adjustment [28]. Thus, the worst glycemic control observed in participants using insulin in our study may be due to inadequate adherence to this treatment modality.

Our findings demonstrate an association between IE and glycemic control in type 2 diabetics, but such data are insufficient to determine causality, because it is a cross-sectional study. In addition, the scale was used in the Portuguese language of Portugal, not of Brazil; however, there was no difficulty in understanding the scale items by the participants, due to the similarity between the languages. In addition, the relatively small sample size is another limitation of this study. However, it meets the sample calculation, and all eligible patients from the service were invited.

Thus, in appreciating the impact of an intuitive diet on health and HbA1c levels, this approach may contribute to good glycemic control in patients, since HbA1c is the main predictor of this control. This study emphasizes the importance of IE as a possible auxiliary tool in DM treatment, helping to adhere to a new view of treatment, combining positive eating behaviors with medical and nutritional treatments. In this context, guiding food choices in accordance with bodily needs may become a fundamental strategy in achieving and controlling diabetic glycemic goals.

What is already known on this subject?

IE is defined as a dynamic mind–body integration of instinct, emotion, and rational thinking [9] that includes attention to hunger and satiety signals from the body, and the practice of gentle nutrition, where individuals make their choices corresponding to their bodily needs [10]. Several studies have promoted the importance of IE for improved health, including lower chances of being overweight [13], lower total serum cholesterol and blood pressure [14], lowered concerns with body image [15] and better diet quality [16]. However, the literature associating IE and DM is still scarce.

What this study adds?

This study outlined the potential contributions of IE to the glycemic control of individuals with T2DM. Our findings indicated that eating more intuitively, especially in congruence with bodily needs, may be associated with lower chances of inadequate glycemic control, as assessed by HbA1c levels, the main predictor of this control. This study is the first to show this association in adults and the elderly with T2DM, using a validated scale to measure IE.

Conclusion

Our work showed that eating intuitively, especially according to body needs, may be associated with a lower chance of glycemic inadequacy in T2DM, regardless of BMI. Thus, future approaches, based on this concept may become essential parallel strategies in the treatment of patients with T2DM, in addition to conventional treatments.

Acknowledgements The authors thank all research participants and the university hospital staff who collaborated in this work.

Author contributions All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by FLPS, MHR, MG, RPP, JSB, MC and LBS. The first draft of the manuscript was written by FLPS and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding This work was funded by the Espírito Santo Research and Innovation Support Foundation (FAPES) through a scholarship for undergraduate students.

Compliance with ethical standards

Conflict of interest The author reports no conflicts of interest in this work.

Ethical approval All procedures performed were in accordance with the ethical standards of the institutional research committee and with the Helsinki declaration and its subsequent amendments or comparable ethical standards.

Informed consent All individuals were fully informed about the study and consented their participation by signing the consent forms.

References

1. WHO (2016) Global report on diabetes. https://apps.who.int/iris/bitstream/handle/10665/204871/9789241565257_eng.pdf?sequence=1. Accessed 03 Dec 2019
2. International Diabetes Federation (2017) Diabetes Atlas-International Diabetes Federation. https://www.idf.org/our-activities/advocacy-awareness/resources-and-tools/134-idf-diabetes-atlas-8th-edition.html. Accessed 03 Dec 2019
3. American Diabetes Association (2019) Standards of medical care in diabetes. Diabetes Care 42(Supplement 1):S1–S2. https://doi.org/10.2337/dc19-Sint01
4. Franks MM, Hemphill RC, Seidel AJ et al (2012) Setbacks in diet adherence and emotional distress: a study of older patients with type 2 diabetes and their spouses. Aging Ment Health 16:902–910. https://doi.org/10.1080/13607863.2012.674486
5. Faria HTG, dos Santos MA, Arrelias CCA et al (2014) Adherence to diabetes mellitus treatments in family health strategy units. Rev Esc Enferm USP 48:257–263. https://doi.org/10.1590/S0080-623420140000200009
6. Juárez-Ramírez C, Théodore FL, Villalobos A et al (2019) The importance of the cultural dimension of food in understanding the lack of adherence to diet regimens among Mayan people with diabetes. Public Health Nutr. https://doi.org/10.1017/S1368980019001940
7. Péres DS, Franco LJ, dos Santos MA (2006) Comportamento alimentar em mulheres portadoras de diabetes tipo 2. Rev Saúde Pública 40:310–317. https://doi.org/10.1590/S0034-89102006000200018
8. Schaefer JT, Magnuson AB (2014) A review of interventions that promote eating by internal cues. J Acad Nutr Diet 114:734–760. https://doi.org/10.1016/j.jand.2013.12.024
9. Tribole E, Resch E (2017) The intuitive eating workbook. New Harbinger Publications, Oakland
10. Tribole E, Resch E (2012) Intuitive eating: a revolutionary program that works, 3rd edn. St. Martin's Press, New York
11. Tylka TL (2006) Development and psychometric evaluation of a measure of intuitive eating. J Couns Psychol 53:226–240. https://doi.org/10.1037/0022-0167.53.2.226
12. Tylka TL, Kroon Van Diest AM (2013) The Intuitive Eating Scale-2: item refinement and psychometric evaluation with college women and men. J Couns Psychol 60:137–153. https://doi.org/10.1037/a0030893
13. Camilleri GM, Méjean C, Bellisle F et al (2016) Intuitive eating is inversely associated with body weight status in the general population-based NutriNet-Santé study: intuitive eating and weight status. Obesity 24:1154–1161. https://doi.org/10.1002/oby.21440
14. Bacon L, Stern JS, Van Loan MD, Keim NL (2005) Size acceptance and intuitive eating improve health for obese, female chronic dieters. J Am Diet Assoc 105:929–936. https://doi.org/10.1016/j.jada.2005.03.011
15. Keirns NG, Hawkins MAW (2019) The relationship between intuitive eating and body image is moderated by measured body mass index. Eat Behav 33:91–96. https://doi.org/10.1016/j.eatbeh.2019.04.004
16. Barad A, Cartledge A, Gemmill K et al (2019) Associations between intuitive eating behaviors and fruit and vegetable intake among college students. J Nutr Educ Behav 51:758–762. https://doi.org/10.1016/j.jneb.2019.03.010
17. ABEP (2016) Critério Brasil 2015 e atualização da distribuição de classes para 2016. https://www.abep.org/. Accessed 03 Dec 2019
18. WHO (2000) Obesity: preventing and managing the global epidemic. Report of a WHO consultation. https://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/. Accessed 03 Dec 2019
19. Lipschitz DA (1994) Screening for nutritional status in the elderly. Prim Care 21:55–67
20. Duarte C, Gouveia JP, Mendes A (2016) Psychometric properties of the Intuitive Eating Scale-2 and association with binge eating symptoms in a Portuguese Community Sample. Int J Psychol Psychol Ther 16:329–341
21. Ministério da Saúde (2017) Vigitel Brasil 2016—Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico. https://bvsms.saude.gov.br/bvs/publicacoes/vigitel_brasil_2017_vigilancia_fatores_riscos.pdf. Accessed 03 Dec 2019
22. Willig AL, Richardson BS, Agne A, Cherrington A (2014) Intuitive eating practices among African–American women living with type 2 diabetes: a qualitative study. J Acad Nutr Diet 114:889–896. https://doi.org/10.1016/j.jand.2014.02.004

23. Miller CK, Kristeller JL, Headings A et al (2012) Comparative effectiveness of a mindful eating intervention to a diabetes self-management intervention among adults with type 2 diabetes: a pilot study. J Acad Nutr Diet 112:1835–1842. https://doi.org/10.1016/j.jand.2012.07.036
24. Wheeler BJ, Lawrence J, Chae M et al (2016) Intuitive eating is associated with glycaemic control in adolescents with type I diabetes mellitus. Appetite 96:160–165. https://doi.org/10.1016/j.appet.2015.09.016
25. Carbonneau E, Carbonneau N, Lamarche B et al (2016) Validation of a French-Canadian adaptation of the Intuitive Eating Scale-2 for the adult population. Appetite 105:37–45. https://doi.org/10.1016/j.appet.2016.05.001
26. World Health Organization (2019) Classification of diabetes mellitus. World Health Organization, Geneva. Licence: CC BY-NC-SA 3.0 IGO
27. Mendes ABV, Fittipaldi JAS, Neves RCS et al (2010) Prevalence and correlates of inadequate glycaemic control: results from a nationwide survey in 6671 adults with diabetes in Brazil. Acta Diabetol 47:137–145. https://doi.org/10.1007/s00592-009-0138-z
28. Peyrot M, Barnett AH, Meneghini LF, Schumm-Draeger P-M (2012) Insulin adherence behaviours and barriers in the multinational Global Attitudes of Patients and Physicians in Insulin Therapy study: insulin adherence in the GAPP Study. Diabet Med 29:682–689. https://doi.org/10.1111/j.1464-5491.2012.03605.x