

RESEARCH ARTICLE

Prevalence of binge eating disorder symptoms and associated characteristics in Danish adults with type 2 diabetes: A cross-sectional study

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Abstract

Aims: Coexistence of binge eating disorder (BED) and type 2 diabetes is linked to poor health outcomes, but data on the prevalence and clinical profile of BED symptoms remain limited and inconsistent. We estimated the prevalence of BED symptoms and examined their associated clinical characteristics in Danish adults with type 2 diabetes.

Methods: We conducted a cross-sectional study within the Danish Centre for Strategic Research in Type 2 Diabetes (DD2) cohort. Adults with type 2 diabetes completed the Binge Eating Disorder Questionnaire (BED-Q) to determine the presence of BED symptoms. Data on well-being, comorbidities, treatment and biomarkers were retrieved from national health registers. Associations between participant characteristics and BED symptoms were examined using Poisson regression to estimate prevalence ratios (PRs).

Results: Among 2459 individuals, 72 (2.9%) screened positive for BED symptoms, and 76 (3.1%) showed subclinical BED symptoms. Individuals with BED symptoms had an earlier age at diagnosis of type 2 diabetes (median 51.8 years, IQR: 41.3–57.6) than adults without BED symptoms (median 59.5 years, IQR: 52.1–66.2). BED symptoms were also associated with severe obesity (BMI ≥ 35 kg/m²) (PR 11.37, 95% CI: 2.78–46.49), female sex (PR 1.54, 95% CI: 1.12–2.10), and lower well-being (PR 1.83, 95% CI: 1.15–2.92).

Conclusions: BED symptoms were associated with a distinct clinical and psychosocial profile in Danish adults with type 2 diabetes. These findings support clinical awareness of BED symptoms in this population, particularly among women, individuals with obesity, those with lower well-being and those diagnosed with diabetes at a younger age.

KEYWORDS

binge eating disorder, cross-sectional study, obesity, prevalence, type 2 diabetes, well-being

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1 | INTRODUCTION

Type 2 diabetes is a chronic condition with a growing impact on global health.¹ An estimated 589 million adults worldwide are currently living with diabetes, projected to reach 853 million by 2050.² Type 2 diabetes frequently co-exists with psychological comorbidities,³ with depression affecting up to 25% of people with type 2 diabetes.¹ Eating disorders, including binge eating disorder (BED), are also more common among people with diabetes than among those without diabetes.⁴ BED is an eating disorder characterised by frequent episodes of large food intake with a loss of control during binge eating episodes.⁵ People with BED suffer from marked psychological distress, and in contrast to bulimia nervosa, they do not engage in regular compensatory behaviours such as purging after binge eating episodes.⁶ BED is often overlooked in health care settings, and many adults with BED report having had symptoms for a long time before the eating disorder is diagnosed.⁵

Estimates of BED prevalence in type 2 diabetes population studies vary widely, suggesting that between 2.5% and 29.6% of people with type 2 diabetes meet the criteria for BED,⁴ compared to a lifetime BED prevalence of 1.9% in the general population.⁷ Several mechanisms may underlie this overlap. The stress associated with diabetes self management can contribute to maladaptive eating behaviours and a higher frequency of emotional eating.^{8–10} Some people with type 2 diabetes also report feelings of deprivation or experience strict dietary rules, which may trigger episodes of binge eating as a coping mechanism.¹¹ This can lead to a cycle alternating between rigid control and loss of control, and it may impair both psychological well-being and diabetes management.^{10,12} At the same time, studies have found binge eating to precede and be an independent risk factor for type 2 diabetes,¹³ suggesting a bidirectional relationship.

The presence of BED complicates diabetes management, and BED has been associated with obesity and higher body mass index (BMI).^{10,11} BED may increase the complications of type 2 diabetes, with studies linking BED to elevated Haemoglobin A1c (HbA1c) and other adverse metabolic outcomes.^{14,15} BED seems to be more frequent among women,^{11,16} although the proportion of men with BED is higher compared to other eating disorders.⁶ From a psychological perspective, co-occurring BED and type 2 diabetes is frequently accompanied by depression, anxiety and impaired well-being, which may further challenge self management and treatment adherence.^{11,12} Despite its clinical relevance, less than half of adults with BED are recognised in health care settings, leaving most cases undiagnosed and untreated.⁵

What's new?

- Estimates of binge eating disorder (BED) prevalence in people with type 2 diabetes vary widely, and the associated clinical profile remains poorly characterised.
- In this Danish cross-sectional study, 2.9% screened positive for BED symptoms and 3.1% reported subclinical symptoms. BED symptoms were associated with female sex, younger age at diabetes diagnosis, higher BMI and lower well-being.
- These findings highlight the need for greater clinical awareness of BED symptoms in adults with type 2 diabetes, particularly among women, people with obesity or lower well-being and those diagnosed with diabetes at a younger age.

The presentation of BED symptoms among people with type 2 diabetes has been examined in several studies, but population-based evidence from outside the United States remains limited.⁷ Prevalence estimates also vary widely, and relatively little is known about how BED symptoms are distributed across clinical and psychosocial characteristics in Danish adults with type 2 diabetes. In addition, BED remains under-recognised in routine care, which may contribute to unmet psychological and clinical needs in this population. A clearer description of the prevalence and associated characteristics of BED symptoms may help improve clinical recognition of BED symptoms in adults with type 2 diabetes.

The aim of this study was to estimate the prevalence of BED symptoms and examine the associated characteristics in a Danish cohort of adults with type 2 diabetes, thereby contributing to improved clinical recognition of BED symptoms in adults with type 2 diabetes.

2 | METHODS

2.1 | Study design

This cross-sectional study was conducted in February 2024 within the Danish Centre for Strategic Research in Type 2 Diabetes (DD2) cohort, based on survey data from adults diagnosed with type 2 diabetes in Denmark. Reporting of this study follows the STROBE guidelines for cross-sectional studies.¹⁷

2.2 | Study population

The DD2 cohort was initiated in 2010 and included approximately 11,000 Danish adults diagnosed with type 2 diabetes when inclusion into this study ended in 2024.¹⁸ Participants are continuously enrolled through both primary and secondary care settings up to 2 years after diagnosis, which allows the cohort to focus on people with newly diagnosed diabetes.¹⁹ Participants provide blood and urine samples and complete a short questionnaire upon study enrolment. Data are securely stored on a cloud-based server at the Danish Health Data Authority, while the biological samples are stored in a national biobank in the Region of Southern Denmark.

Through the Danish civil registration system, DD2 can be linked to national health registers, enabling longitudinal follow-up. This makes the DD2 cohort one of the most extensive cohorts available worldwide for examining individuals recently diagnosed with type 2 diabetes.¹⁸ DD2 participants represent a subset of Danish adults with type 2 diabetes, and a recent cohort update suggests that the cohort may be representative of average Danish individuals with type 2 diabetes.¹⁸

For the present study, we invited a regional subsample of the DD2 cohort, limited to individuals residing in the Region of Southern Denmark. This regional restriction was ethically motivated, as it ensured access to clinical follow-up for participants identified with BED symptoms. Of the initial 3511 individuals invited, 2459 were included in the final analyses (Figure 1).

2.3 | Data

We assessed BED symptoms using the Binge Eating Disorder Questionnaire (BED-Q),²⁰ a validated, digital, 9-item self-report questionnaire based on DSM-5 and ICD-11 criteria.^{21,22} Items were rated on a 5-point Likert scale.²³

Participants were classified into three categories: probable BED, subclinical BED, and no BED based on the diagnostic criteria from DSM-5 and ICD-11.^{21,22} Probable BED was defined as reporting both binge eating episodes and loss of control at least once per week, corresponding to the response category '1-3 times per week' or a higher frequency category, together with a 'yes' response to the binary question assessing distress related to binge eating. Participants with subclinical BED met the same criteria for binge frequency and loss of control but responded 'no' to the distress question. For both classifications, compensatory behaviours had to occur less than once per week. Participants with no BED either reported no binge eating episodes or reported binge eating accompanied by compensatory behaviours consistent with bulimia nervosa.

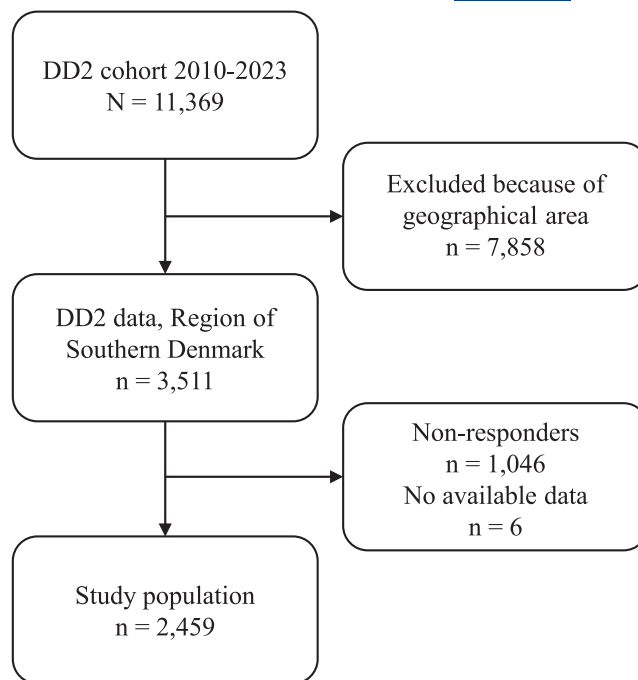


FIGURE 1 Flowchart of participant selection from the Danish Centre for Strategic Research in Type 2 diabetes (DD2) cohort.

We chose a criteria-based operationalisation rather than a total-score cut-off to preserve alignment with DSM-5 symptom structure and to distinguish probable BED symptoms from binge eating accompanied by compensatory behaviours.

We used data from national health registers²⁴⁻²⁶ and the DD2 cohort to obtain information on self-reported well-being, comorbidities, pharmacological treatment and biochemical measurements. Clinical, biochemical and pharmacological data were extracted from national registers and the DD2 cohort and included only if collected within predefined time windows relative to BED-Q completion. Information on medical databases and time windows for data collection is provided in the Supplementary Material.

Table 1 provides an overview of the clinical characteristics of the study population. Most clinical and demographic variables were complete or nearly complete (68%–98%). No imputation was performed, and analyses were conducted on a complete case basis.

2.4 | Statistical analysis

Data were analysed with Stata 19 and visualisations created with GraphPad Prism 10. All analyses were performed on de-identified data within a secure research environment provided by the Danish Health Data Authority to ensure participant anonymity.

TABLE 1 Characteristics according to the presence of binge eating disorder (BED) symptoms of 2459 Danish adults with type 2 diabetes. Shown as *n* (%) or median (IQR).

Characteristics	No BED (<i>n</i> = 2311)	Subclinical BED (<i>n</i> = 76)	Probable BED (<i>n</i> = 72)
Demographics			
Female	944 (40.8)	41 (53.9)	40 (55.6)
BMI (kg/m ²)	30.4 (27.1; 34.5)	31.7 (28.0; 38.3)	37.3 (33.3; 42.0)
Age at BED-Q assessment	67.6 (59.7; 74.7)	61.2 (54.8; 66.8)	57.6 (50.8; 62.9)
Diabetes history			
Age at type 2 diabetes diagnosis	59.5 (52.1; 66.2)	56.8 (48.4; 62.0)	51.8 (41.3; 57.6)
Type 2 diabetes duration	8.3 (2.9; 12.1)	4.1 (1.7; 10.1)	4.8 (2.5; 9.4)
Smoking status			
Never	594 (47.9)	12 (40.0)	15 (46.9)
Former	481 (38.8)	16 (53.3)	14 (43.8)
Current	165 (13.3)	<5 (.)	<5 (.)
Physical activity in leisure time			
Sedentary activities	338 (14.6)	15 (19.7)	13 (18.1)
Light physical activities	1489 (64.4)	53 (69.7)	47 (65.3)
Moderate/Vigorous physical activities	484 (21.0)	8 (10.5)	12 (16.7)
Health-related quality of life			
SF-12 physical component score	49.3 (39.9; 54.1)	48.1 (39.6; 52.4)	42.5 (37.9; 52.6)
SF-12 mental component score	53.7 (45.2; 57.9)	50.3 (43.7; 57.5)	49.0 (37.6; 53.9)
WHO-5 well-being score	68.0 (48.0; 80.0)	60.0 (40.0; 72.0)	44.0 (32.0; 68.0)
Clinical measures			
HbA1c (mmol/mol)	48 (44; 54)	49 (44; 53)	49 (42; 58)
HbA1c (%)	6.5 (6.2; 7.1)	6.6 (6.2; 7.0)	6.6 (6.0; 7.5)
Systolic blood pressure (mm Hg)	130.0 (125.0; 139.0)	130.0 (123.0; 140.0)	132.0 (125.0; 140.0)
Diastolic blood pressure (mm Hg)	80.0 (74.0; 85.0)	80.0 (75.0; 89.0)	84.5 (77.8; 90.0)
Medication use			
Insulin	241 (10.4)	<5 (.)	11 (15.3)
GLP-1 receptor agonist use	896 (38.8)	36 (47.4)	45 (62.5)
Glucose-lowering drugs (not insulin)	2125 (92.0)	74 (97.4)	68 (94.4)
Lipid-lowering drugs	1946 (84.2)	63 (82.9)	56 (77.8)
Anti-hypertensive drugs	1886 (81.6)	62 (81.6)	54 (75.0)
Aspirin	428 (18.5)	8 (10.5)	8 (11.1)
Antidepressants	331 (14.3)	17 (22.4)	20 (27.8)
Anxiolytics	37 (1.6)	<5 (.)	<5 (.)
Comorbidities			
Depression	53 (2.3)	<5 (.)	5 (6.9)
Anxiety	40 (1.7)	<5 (.)	5 (6.9)
Cardiovascular disease (CVD)	1088 (47.1)	25 (32.9)	30 (41.7)
Chronic kidney disease (CKD)	95 (4.1)	<5 (.)	<5 (.)
Cancer	329 (14.2)	7 (9.2)	5 (6.9)

Descriptive statistics were used to summarise participant characteristics. Continuous variables were reported as medians with interquartile range (IQR) to accommodate non-normally distributed data, and categorical variables as frequencies with percentages.

Associations between clinical, psychosocial and biochemical characteristics and the prevalence of BED symptoms were estimated using modified Poisson regression with robust standard errors, adjusting for age at BED-Q assessment and sex. BED and subclinical

BED were combined to represent the presence of BED symptoms irrespective of distress level. Estimates are presented with 95% confidence intervals (CIs).

2.5 | Ethics

The study was conducted in accordance with the principles of the Declaration of Helsinki and approved by the Danish Health Research Ethics Committee of the Region of Southern Denmark (21 November 2023; number: 23/46385). All data were handled in compliance with national data protection regulations. Participants were informed of their right to withdraw consent at any time, and those who screened positive for BED symptoms were referred to relevant treatment services within the Region of Southern Denmark.

2.6 | Data and resource availability

The data analysed in this study are not publicly available due to Danish data protection regulations and restrictions on sharing data from the DD2 cohort. Data may be obtained from the corresponding author (PFN) upon reasonable request and with permission from the DD2 steering committee.

3 | RESULTS

A total of 2465 people responded to the BED-Q, corresponding to a response rate of 70%. Of these, 2459 individuals were included in the analyses, as baseline data from DD2 were not available for six respondents. Respondents were generally younger, had a shorter diabetes duration and had a lower HbA_{1c} than non-respondents. Details are provided in the Supporting Information.

3.1 | Prevalence of BED

Of the 2459 participants, 2.9% ($n = 72$) met the criteria for probable BED, defined as experiencing binge eating episodes at least once a week, accompanied by a perceived loss of control, absence of compensatory behaviours and marked emotional distress. An additional 3.1% ($n = 76$) reported subclinical BED symptoms, indicating the presence of binge eating behaviour but with a distress level below the diagnostic threshold. The remaining 94% ($n = 2311$) of respondents did not meet the criteria for BED. This group includes a small number of

individuals who reported symptoms suggestive of bulimia nervosa or other specified feeding or eating disorders ($n = 7$).

3.2 | Descriptive characteristics

Participants with probable BED symptoms were characterised by a younger age at type 2 diabetes diagnosis, higher BMI and a higher proportion of women than participants with subclinical BED symptoms or no BED symptoms (Table 1). They also reported lower well-being and more frequently had depression or anxiety. Use of GLP-1 receptor agonists and antidepressants was more common among participants with probable BED symptoms. Median age at type 2 diabetes diagnosis was 51.8 years (IQR 41.3–57.6) in participants with probable BED symptoms, compared with 56.8 years (IQR 48.4–62.0) in those with subclinical BED symptoms and 59.5 years (IQR 52.1–66.2) in those without BED symptoms.

3.3 | Clinical and psychosocial characteristics associated with BED symptoms

The prevalence of BED symptoms decreased markedly with increasing age at diabetes diagnosis (Figure 2). Compared with individuals diagnosed before age 50, prevalence ratios (PRs) were 0.58 (95% CI: 0.41–0.83) at age of diagnosis of 50–59, 0.32 (95% CI: 0.21–0.49) at age of diagnosis of 60–69, and 0.17 (95% CI: 0.08–0.40) at age of diagnosis ≥ 70 years. Compared to men, women also had a higher prevalence of BED symptoms (PR 1.54, 95% CI: 1.12–2.10). BMI showed a strong association with the presence of BED symptoms, with PRs of 6.56 (95% CI: 1.61–26.77) for BMI 25–29, 6.41 (95% CI: 1.56–26.28) for BMI 30–34, and 11.37 (95% CI: 2.78–46.49) for BMI ≥ 35 , relative to the reference group of BMI < 25 .

For psychosocial characteristics, participants with BED symptoms had nearly twice the prevalence of poor well-being (WHO-5; PR = 1.83, 95% CI: 1.15–2.92). The prevalence of poor mental well-being as measured by SF-12 (MCS-12) was also higher, though not statistically significant. Similar trends were observed for depression (PR = 1.84, 95% CI: 0.99–3.40), antidepressant use (PR = 1.41, 95% CI: 0.99–2.01), anxiety (PR = 1.37, 95% CI: 0.68–2.77) and use of anxiolytics (PR = 1.38, 95% CI: 0.50–3.76).

Regarding lifestyle, participants with BED symptoms reported lower levels of moderate-to-vigorous physical activity (PR = 0.72, 95% CI: 0.41–1.25). Poor physical health

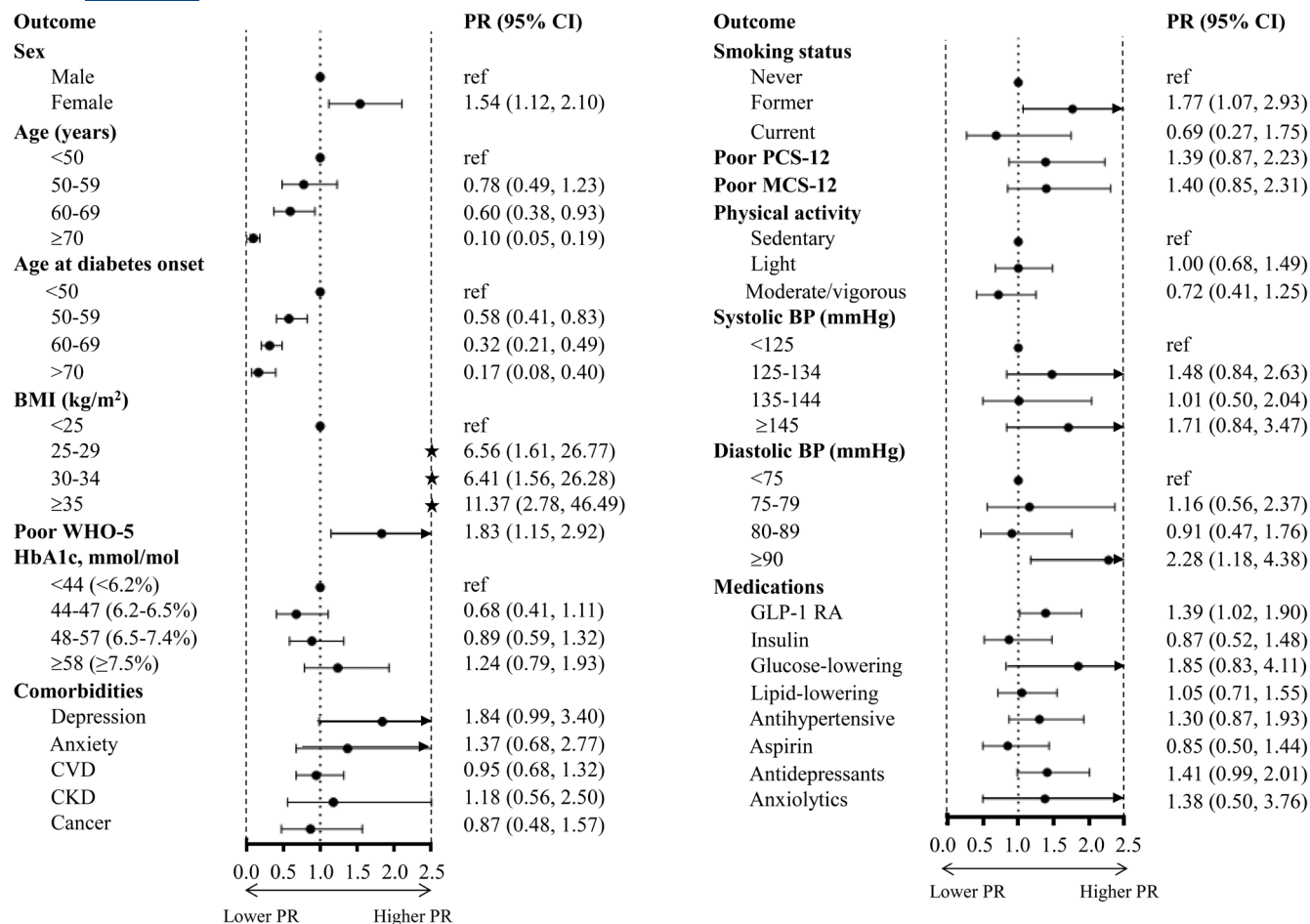


FIGURE 2 Forest plot showing associations between BED symptoms (probable BED and subclinical BED combined) and demographic, clinical, biochemical and psychosocial characteristics. Adjusted prevalence ratios (PRs) with 95% confidence intervals (CIs) are shown. Estimates were adjusted for age and sex. BMI estimates are marked with asterisks because of high PR values. Arrows indicate confidence intervals extending beyond the plot range. Cancer includes all malignancies except non-melanoma skin cancer.

(SF-12 PCS) was also more common among those with BED symptoms, although CIs were wide. BED symptoms were more prevalent among former smokers (PR=1.77, 95% CI: 1.07–2.93), whereas no associations were observed for current smoking.

For cardiovascular and metabolic markers, BED symptoms were associated with elevated diastolic blood pressure (≥90 mmHg; PR=2.28, 95% CI: 1.18–4.38), and a trend was seen for systolic blood pressure (≥145 mmHg; PR=1.71, 95% CI: 0.84–3.47). No clear associations were observed for HbA1c, cardiovascular disease, chronic kidney disease or cancer.

Finally, the use of GLP-1 receptor agonists was significantly more prevalent among participants with BED symptoms (PR=1.39, 95% CI: 1.02–1.90). Overall, the pattern of associations was similar when analyses were restricted to probable BED only (Supporting Information).

4 | DISCUSSION

We found that adults with BED symptoms had a younger age at type 2 diabetes diagnosis than adults without BED symptoms, with a median difference of approximately 8 years. BED symptoms were also strongly associated with higher BMI, with more than a 10-fold higher prevalence among individuals with severe obesity (BMI ≥35 kg/m²). In addition, BED symptoms were more common in women, younger individuals and those with poorer well-being. BED symptoms were also associated with elevated diastolic blood pressure, former smoking and more frequent use of GLP-1 receptor agonists, while similar but less precise patterns were observed for depression and antidepressant use. Overall, these findings suggest a distinct clinical and psychosocial profile. This may support greater clinical awareness of BED symptoms in adults with type 2 diabetes, particularly among women, individuals with

obesity, those with lower well-being and those diagnosed with diabetes at a younger age.

The prevalence of BED symptoms observed in our sample was at the lower end of the range reported in previous studies, which estimate between 2.5% and 29.6% among individuals with type 2 diabetes.⁴ In our study, the relatively low prevalence may reflect characteristics of the DD2 cohort and possible under-reporting of binge eating symptoms in self report data due to social desirability factors.²⁷ Our findings may therefore represent a conservative estimate of BED symptom prevalence in Danish adults with type 2 diabetes.

A central finding in our study was that BED symptoms were associated with a younger age at type 2 diabetes diagnosis. This result is consistent with previous research in an eating disorder population that has demonstrated that individuals engaging in binge eating behaviours tend to be diagnosed with type 2 diabetes significantly earlier than those who do not.¹³ This may indicate that binge eating behaviours and type 2 diabetes diagnosed at a younger age are linked. However, BED symptoms were assessed at only one point in time and may therefore represent recent onset of symptoms or long-standing binge eating. Consequently, the temporal and potentially bidirectional relationship between binge eating and type 2 diabetes cannot be determined from our cross-sectional data.

In line with previous studies, individuals with BED symptoms displayed higher BMI values compared to those without BED symptoms.^{10,11,15} Longitudinal work has further established BED as a predictor of obesity in youth,²⁸ highlighting that binge eating behaviours may act as a driving force behind weight gain. In the context of type 2 diabetes, these behaviours may contribute to both the development and maintenance of obesity, thereby exacerbating metabolic risk.¹⁵

Our findings also add to the evidence that BED symptoms are associated with lower well-being and greater psychological distress among individuals with type 2 diabetes. Previous studies have shown that comorbid BED is linked to reduced health-related quality of life, more depressive symptoms and greater use of antidepressant medication.^{11,13,28} These psychological burdens can complicate diabetes management as distress, loss of control over eating and negative self-image may undermine adherence to treatment recommendations.

Sex differences also emerged as a notable feature. In line with previous findings,¹¹ women in our sample reported BED symptoms more frequently than men. This pattern is consistent with other eating disorders, where female sex is generally a risk factor.¹⁶ Possible explanations include the higher levels of emotional distress reported by

women in relation to BED, as well as societal pressures linked to body image.¹⁶ However, the proportion of men reporting BED symptoms in our study was relatively high, underlining that BED in men remains a clinically significant issue that needs further attention.

In contrast to some previous studies,^{14,29} we did not observe significant associations between BED symptoms and HbA1c levels. This may be related to our study population of people with newly diagnosed type 2 diabetes, who may have better treatment adherence. Our findings align with those of a systematic review showing that glycaemic control may not differ significantly between individuals with and without BED and type 2 diabetes.³⁰ One possible explanation for our results could also be the more frequent use of GLP-1 receptor agonists among participants with BED symptoms, which may have attenuated group differences in glycaemic control. The more frequent use of GLP-1 receptor agonists may partly reflect the higher BMI and greater prevalence of obesity among participants with BED symptoms, although information on the individual indication for treatment was unavailable.

A major strength of this study is that it was based on a large and well-characterised Danish cohort of adults with type 2 diabetes, with questionnaire data linked to register-based information on comorbidities, treatment and biomarkers. In addition, BED symptoms were assessed using a validated self report questionnaire, which is feasible in routine clinical settings and may enhance the clinical relevance of the findings. Nonetheless, some limitations should be acknowledged. First, BED symptoms were identified by self report rather than structured diagnostic interviews, and misclassification is therefore possible. Second, binge eating symptoms may have been under-reported due to social desirability bias. Third, the cross-sectional design precludes conclusions regarding temporality or causality between BED symptoms and the associated clinical characteristics.

Our findings highlight a subgroup of adults with type 2 diabetes in whom BED symptoms may be especially relevant to consider, including women, individuals with obesity, those with lower well-being and those diagnosed with diabetes at a younger age. Self report questionnaires may be a feasible first step in identifying BED symptoms in diabetes care. Future studies should examine how BED symptoms can best be recognised and addressed in clinical practice, and whether targeted interventions improve psychological well-being and diabetes-related outcomes.

In this Danish cross-sectional study, BED symptoms were associated with a distinct clinical and psychosocial profile in adults with type 2 diabetes. Hence, BED symptoms were associated with younger age at diabetes diagnosis, higher BMI, female sex and lower well-being.

AUTHOR CONTRIBUTIONS

PFN, JL, MR and SLD conceived and designed the study. SLD performed the data analysis. PFN drafted the manuscript. All authors contributed to manuscript revision, approved the final version and PFN is the guarantor of the work.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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