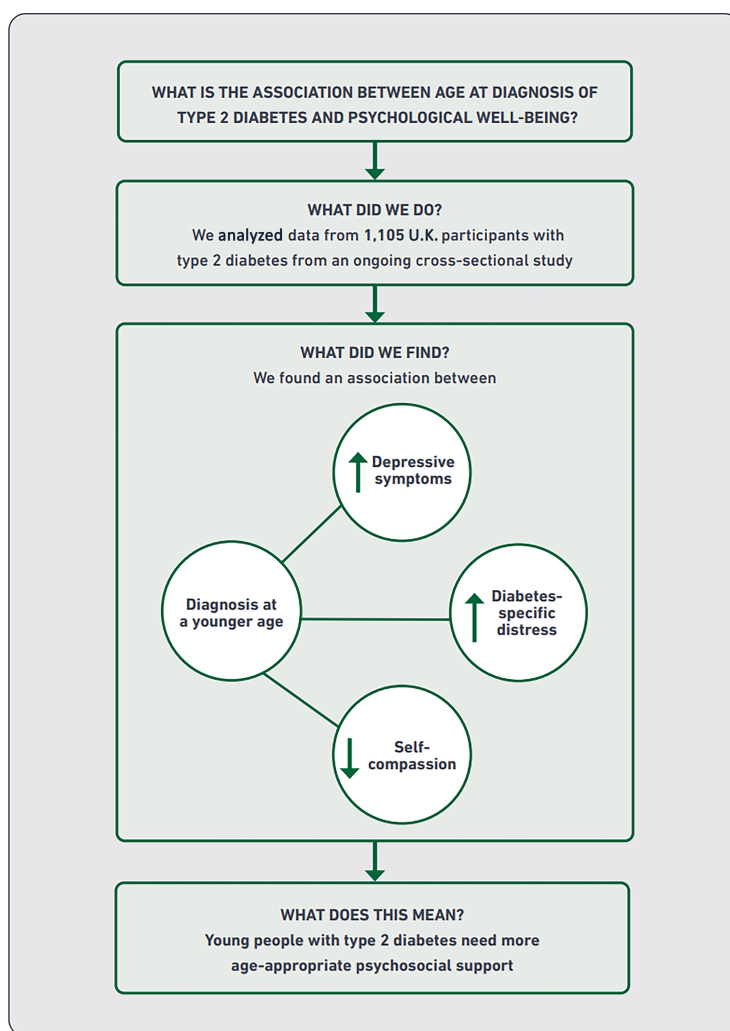


Age at Diagnosis of Type 2 Diabetes and Depressive Symptoms, Diabetes-Specific Distress, and Self-Compassion

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ARTICLE HIGHLIGHTS

- This study investigated the association between age at diagnosis of type 2 diabetes and psychological well-being, namely depressive symptoms, diabetes-specific distress, and self-compassion.
- The results showed that younger age at diagnosis was associated with higher levels of depressive symptoms and diabetes-specific distress and lower levels of self-compassion.
- This highlights the necessity for clinical vigilance in addition to age-appropriate psychosocial support.



Age at Diagnosis of Type 2 Diabetes and Depressive Symptoms, Diabetes-Specific Distress, and Self-Compassion

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OBJECTIVE

To investigate the association between age at diagnosis of type 2 diabetes and depressive symptoms, diabetes-specific distress, and self-compassion among adults with type 2 diabetes.

RESEARCH DESIGN AND METHODS

This analysis used data from the Chronotype of Patients with Type 2 Diabetes and Effect on Glycemic Control (CODEC) cross-sectional study. Information was collected on depressive symptoms, diabetes-specific distress, and self-compassion, measured using validated self-report questionnaires, in addition to sociodemographic and clinical data. Multivariable regression models, adjusted for diabetes duration, sex, ethnicity, deprivation status, prescription of antidepressants (selective serotonin reuptake inhibitors), and BMI were used to investigate the association between age at diagnosis of type 2 diabetes and each of the three psychological outcomes.

RESULTS

A total of 706 participants were included; 64 (9.1%) were diagnosed with type 2 diabetes at <40 years, 422 (59.8%) between 40 and 59 years, and 220 (31.2%) at ≥60 years of age. After adjustment for key confounders, including diabetes duration, younger age at diagnosis was significantly associated with higher levels of depressive symptoms (β_{adj} : -0.18 [95% CI -0.25 to -0.10]; $P < 0.01$) and diabetes-specific distress (β_{adj} : -0.03 [95% CI -0.04 to -0.02]; $P < 0.01$) and lower levels of self-compassion (β_{adj} : 0.01 [95% CI 0.00 to 0.02]; $P < 0.01$).

CONCLUSIONS

Diagnosis of type 2 diabetes at a younger age is associated with lower psychological well-being, suggesting the need for clinical vigilance and the availability of age-appropriate psychosocial support.

Type 2 diabetes, a substantial public health issue now affecting >9% of the world's population, is a complex chronic condition requiring intensive self-management and pharmacotherapy (1). Type 2 diabetes is a prominent risk factor for mental health problems, such as depression and diabetes-specific distress (a negative emotional response to living with diabetes) (2,3). Both depression and diabetes-specific distress are also associated with suboptimal glycemia and an increased risk of diabetes-specific complications and mortality (4–8). Conversely, self-compassion, the

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capacity to treat oneself with kindness and understanding rather than harsh self-criticism, has been shown to be associated with improved psychological health, glycemic outcomes, and self-care behaviors among adults with type 2 diabetes (9,10).

Over recent decades, the prevalence of type 2 diabetes among younger adults (e.g., those diagnosed at <40 years of age; “early-onset adult type 2 diabetes”) has increased rapidly, now constituting 15–20% of all adults with type 2 diabetes globally (11–13). As well as being associated with an increased relative risk of mortality and both microvascular and macrovascular complications (14), early-onset adult type 2 diabetes has recently been shown to be associated with increased hospitalizations for mental illness (15). Consequently, a comprehensive understanding of the effect of age at diagnosis on overall psychological health is crucial in order to support and inform the age-appropriate management of adults living with type 2 diabetes, thereby reducing the psychological burden and improving outcomes in this population.

A small number of studies have indicated an association between younger age and depression/diabetes-specific distress among adults with type 2 diabetes (16–19). However, most of these studies have investigated the age of individuals at study enrollment, as opposed to the age at which individuals are diagnosed with type 2 diabetes. The investigation of the association between age at diagnosis and psychological well-being is important, as the disease phenotype, and therefore lived experience, of adults diagnosed at a younger age may differ from those diagnosed at a later age, even if their age at study enrollment is the same (11). Furthermore, no previous research has explored the relationship between age (either at enrollment or diagnosis) and self-compassion among individuals with type 2 diabetes. Therefore, the aim of this study was to explore the association between age at diagnosis and depression, diabetes-specific distress, and self-compassion among adults with established type 2 diabetes.

RESEARCH DESIGN AND METHODS

Participants

The data used in this analysis were derived from the first 1,105 participants enrolled in the ongoing Chronotype of

Patients with Type 2 Diabetes and Effect on Glycemic Control (CODEC) study. CODEC is a cross-sectional study conducted across the East Midlands, U.K., investigating the association between chronotype (i.e., an individual’s entrained preference for sleep time within the 24-h clock) and glycemic outcomes in adults with type 2 diabetes (20). The CODEC study received ethical approval from the West Midlands-Black Country Research Ethics Committee (reference 16/WM/0457), and all participants provided written informed consent. The current analysis is encompassed by the ethical approval for the main CODEC study.

Detailed methods of the CODEC study, including full eligibility criteria, have been published previously (20). Briefly, individuals are eligible for inclusion if they are aged between 18 and 75 years, with established type 2 diabetes (>6 months since diagnosis), $HbA_{1c} \leq 10\%$ (86 mmol/mol), and $BMI \leq 45 \text{ kg/m}^2$. Individuals are excluded if they have a terminal illness, a known sleep disorder (other than obstructive sleep apnea), or are prescribed medication for wakefulness, sedatives, or cannabis. Individuals are recruited from both primary and specialist care.

Participants were included in this analysis if data were available for age at type 2 diabetes diagnosis and age at recruitment, in addition to the assessment of at least one of the psychological outcomes of interest (depressive symptoms, diabetes-specific distress, and self-compassion). Participants must have been diagnosed with type 2 diabetes at ≥ 16 years of age. Data were collected between January 2017 and March 2020.

Measurement of Outcomes and Covariates

All CODEC data, including demographic information (age at study enrollment, sex, ethnicity, and deprivation status), clinical information (including age at diagnosis, HbA_{1c} , smoking status, family history of type 2 diabetes, prescription medications, and BMI), and psychological variables (depression, diabetes-specific distress, and self-compassion) were collected at a single study visit by trained CODEC researchers using standardized procedures. Ethnicity was categorized into four groups for this study: White, South Asian, mixed/other, and unknown. Deprivation status was measured using the Index of Multiple Deprivation (IMD), based on the home postcode

of each participant. IMD is a composite measure of neighborhood deprivation, comprising seven domains: income, employment, health, education, housing and services, living environment, and crime (21). For the current analysis, IMD scores were categorized into five groups, ranging from the highest to the lowest level of deprivation.

Depressive symptoms, diabetes-specific distress, and self-compassion were assessed using three validated self-report questionnaires by CODEC research staff. The nine-item Patient Health Questionnaire (PHQ-9) was used to measure depressive symptoms (22). The PHQ-9 includes nine items, focused on how frequently individuals have experienced specified thoughts and feelings over the previous 2 weeks. Responses are rated on a 5-point Likert scale from 0 (not at all) to 4 (nearly every day), which are then summed to generate a total score (range 0–27), where higher scores indicate greater severity of depressive symptoms. The threshold for moderate-to-severe depressive symptoms is set at a score of ≥ 10 (22).

Diabetes-specific distress was measured using the 17-item Diabetes Distress Scale (23), in which participants report the degree to which each item has proved problematic for them in the previous month using a 6-point Likert scale from 1 (no problem) to 6 (serious problem). Items can be subdivided into four subscales: emotional burden, physical-related distress, regimen-related distress, and interpersonal distress. To generate the overall diabetes-specific distress score and the scores for each subscale, the mean value of the relevant items is calculated, in which scores of ≥ 2 are indicative of moderate-to-high distress (23).

Self-compassion was measured using the Self-Compassion Scale (24), containing 26 items, each of which are rated by participants on a 5-point Likert scale from 1 (almost never) to 5 (almost always). The items are also divided into subscales: positive attributes (self-kindness, common humanity, and mindfulness) and negative attributes (self-judgment, isolation, and overidentification). A mean score is calculated for each attribute, with higher scores representing higher frequency of that attribute. An overall mean self-compassion score is also calculated, which includes positive attribute scores and reversed scores for the negative subscale items,

with higher overall scores representing greater self-compassion (24).

Statistical Analysis

Demographic, clinical, and psychological variables were summarized by age at type 2 diabetes diagnosis (<40 years, 40–59 years, and ≥60 years) using median (interquartile range [IQR]) or frequency (percentage), as appropriate. Linear regression models were used to investigate the association between diagnostic age, used as a continuous variable, and the psychological variables (depressive symptoms, diabetes-specific distress, and self-compassion). Logistic regression models were used to investigate associations between diagnostic age and the odds of having moderate-to-severe depressive symptoms or moderate-to-high diabetes-specific distress.

Multivariable adjustment was used to control for confounding. As the duration of type 2 diabetes has been found to be associated with psychological health, diabetes duration was adjusted for in all multivariable models (25,26). Further multivariable models were also adjusted for other important confounding variables (sex, ethnicity, deprivation status, BMI, and prescription of selective serotonin reuptake inhibitors [SSRIs]). SSRI prescriptions are an important confounder, as their use is associated with an increased risk of type 2 diabetes, as well as influencing the psychological outcomes studied (27). Potential effect modification by diabetes duration was assessed using interaction terms. To investigate the possibility of deviations from linearity, models were also conducted using a spline transformation of age at diagnosis. These models were subsequently compared with the linear models using Bayesian information criterion scores; as there was no evidence of nonlinearity, the linear models were used for the analysis. The bootstrap method was used to generate CIs (500 replications).

All analysis was conducted in Stata v17.0; results are reported with 95% CIs, and $P < 0.05$ was deemed indicative of statistical significance.

RESULTS

Participant Demographic and Clinical Characteristics

Of the first 1,105 participants enrolled in CODEC, 706 had data regarding their age at diagnosis of type 2 diabetes, age at study recruitment, and at least one

psychological outcome measure and therefore were eligible for inclusion in this analysis (Supplementary Fig. 1). The age at type 2 diabetes diagnosis of these 706 study participants ranged from 18 to 74 years: 64 participants (9.1%) were diagnosed with type 2 diabetes at <40 years, 422 (59.8%) between 40 and 59 years, and 220 (31.2%) at ≥60 years of age. Demographic, clinical, and psychological variables for all participants are summarized by diagnostic age in Table 1. As expected, the median age at recruitment was lowest among participants diagnosed at <40 years (53 years [IQR 44–58 years]), while the median duration of diabetes was greatest in this group (18 years [IQR 11–26]) (Supplementary Fig. 2). The proportion of men was lower among participants diagnosed at <40 years of age (54.7%) compared with those diagnosed at ≥60 years (66.4%). Participants from the White ethnic group were the most common across all diagnostic age groups; however, the proportion of participants who identified as South Asian was highest among those diagnosed at <40 years (17.2%). In addition, a higher proportion of participants diagnosed at <40 years lived in the most deprived areas (14.1%) compared with those diagnosed between 40 and 59 years (13.5%) or at ≥60 years (10.0%). The proportions of participants who were current smokers and who had a family history of type 2 diabetes were also greater among participants diagnosed at a younger age.

The proportion of participants prescribed glucose-lowering medication was higher among participants diagnosed at <40 years of age, 92.2% of whom were prescribed a glucose-lowering medication, with 53.1% prescribed insulin. The proportion of participants prescribed SSRIs was also higher among participants diagnosed at <40 years (15.6%) compared with those diagnosed between 40 and 59 years (7.1%) or at ≥60 years (8.2%) of age. The median BMI was highest among participants diagnosed at <40 years of age (31.8 [IQR 27.5–34.6]) and lowest among participants diagnosed at ≥60 years (29.2 [IQR 26.4–32.8]). Similarly, the median HbA_{1c} was 7.4% (IQR 6.7–8.4%) (57 [IQR 50–68] mmol/mol) among participants diagnosed at <40 years and 6.5% (IQR 5.6–7.0%) (48 [IQR 38–53] mmol/mol) among those diagnosed at ≥60 years of age (Table 1).

Depressive Symptoms

The median depressive symptom score for the study sample was 3.0 (IQR 1.0–8.0), and 135 (19.9%) participants were categorized as experiencing moderate-to-severe depressive symptoms. The level of depressive symptoms was highest among participants diagnosed at <40 years, with a median depressive symptom score of 6.0 (IQR 3.0–11.0) in participants diagnosed at <40 years, compared with 2.0 (IQR 0.0–5.0) among participants diagnosed at ≥60 years of age (Table 1 and Fig. 1A). Accordingly, 29.5% of participants diagnosed at <40 years were classified as experiencing moderate-to-severe depressive symptoms compared with 13.2% of participants diagnosed at ≥60 years of age (Table 1).

Younger diagnostic age was significantly associated with higher levels of depressive symptoms in the unadjusted and adjusted models (β_{adj} : -0.18 [95% CI -0.25 to -0.10]; $P < 0.01$) (Table 2). After adjusting for all specified confounders, the odds of participants experiencing moderate-to-severe depressive symptoms were 4% lower for each year increase in age at diagnosis (odds ratio adjusted [OR_{adj}] 0.96 [95% CI 0.93–0.98]; $P < 0.01$), indicating a higher risk of depressive symptoms in individuals diagnosed at a younger age (Table 2). As shown in Fig. 2A, the association between younger age of diagnosis and depressive symptoms did not differ by diabetes duration (the interaction between diagnostic age and diabetes duration was not statistically significant).

Diabetes-Specific Distress

The median overall diabetes-specific distress score for the study sample was 1.5 (IQR 1.2–2.2), with 224 (32.6%) participants categorized as experiencing moderate-to-high levels of diabetes-specific distress. These levels were higher among participants diagnosed earlier in life; the median overall diabetes-specific distress score among participants diagnosed at <40 years was 2.0 (IQR 1.6–3.1), compared with 1.4 (IQR 1.1–1.7) among participants diagnosed at ≥60 years of age (Fig. 1B). Accordingly, 50.0% of participants diagnosed at <40 years experienced moderate-to-high levels of diabetes-specific distress compared with 37.1% and 19.3% of participants diagnosed at 40–59 years or ≥60 years of age, respectively. This trend was observed for all four diabetes distress subscales; the largest difference in the median score

Table 1—Demographic, clinical, and psychological variables by diagnostic age category

	Age at type 2 diabetes diagnosis			Total sample (N = 706)
	<40 years (n = 64)	40–59 years (n = 422)	≥60 years (n = 220)	
Demographic variables				
Current age, years	52.5 (44.0–57.5)	63.0 (58.0–67.0)	70.0 (67.0–73.0)	65.0 (59.0–70.0)
Diabetes duration, years	18.0 (10.5–26.0)	10.0 (6.0–15.0)	5.0 (3.0–8.0)	9.0 (5.0–15.0)
Sex, n (%)				
Male	35 (54.7)	293 (69.4)	146 (66.4)	474 (67.1)
Female	29 (45.3)	129 (30.6)	74 (33.6)	232 (32.9)
Ethnicity, n (%)				
White	47 (73.4)	364 (86.3)	208 (94.6)	619 (87.7)
South Asian	11 (17.2)	40 (9.5)	5 (2.3)	56 (7.9)
Mixed/other	6 (9.4)	16 (3.8)	7 (3.2)	29 (4.1)
Unknown	0 (0.0)	2 (0.5)	0 (0.0)	2 (0.3)
IMD, n (%)				
1 (most deprived)	9 (14.1)	57 (13.5)	22 (10.0)	88 (12.5)
2	10 (15.6)	52 (12.3)	10 (4.6)	72 (10.2)
3	11 (17.2)	42 (10.0)	29 (13.2)	82 (11.6)
4	7 (10.9)	59 (14.0)	33 (15.0)	99 (14.0)
5 (least deprived)	10 (15.6)	79 (18.7)	55 (25.0)	144 (20.4)
Missing	17 (26.6)	133 (31.5)	71 (32.3)	211 (31.3)
Clinical variables				
Smoking status, n (%)				
Current smoker	6 (9.4)	23 (5.5)	9 (4.1)	38 (5.4)
Ex-smoker	22 (34.4)	200 (47.4)	118 (53.6)	340 (48.2)
Never smoked	36 (56.3)	199 (47.2)	93 (42.3)	328 (46.5)
Family history of type 2 diabetes, n (%)				
Yes	44 (68.8)	217 (51.4)	96 (43.6)	357 (50.6)
No	18 (28.1)	170 (40.3)	106 (48.2)	294 (41.6)
Unknown	2 (3.1)	35 (8.3)	18 (8.2)	55 (7.8)
Glucose-lowering medications, n (%)				
Any glucose-lowering medication	59 (92.2)	377 (89.3)	156 (70.9)	592 (83.9)
Insulin	34 (53.1)	106 (25.1)	8 (3.6)	148 (21.0)
Metformin	43 (67.2)	324 (76.8)	142 (64.6)	509 (72.1)
Sulphonylureas	14 (21.9)	115 (27.3)	31 (14.1)	160 (22.7)
DPP-4 inhibitors	6 (9.4)	74 (17.5)	26 (11.8)	106 (15.0)
GLP-1 agonists	14 (21.9)	25 (5.9)	4 (1.8)	43 (6.1)
SGLT2 inhibitors	18 (28.1)	43 (10.2)	9 (4.1)	70 (9.9)
Other*	3 (4.7)	8 (1.9)	1 (0.5)	12 (1.7)
SSRIs, n (%)				
Yes	10 (15.6)	30 (7.1)	18 (8.2)	58 (8.2)
No	54 (84.4)	392 (92.9)	202 (91.8)	648 (91.8)
BMI (kg/m ²)	31.8 (27.5–34.6)	30.7 (27.6–35.2)	29.2 (26.4–32.8)	30.4 (27.1–34.5)
HbA _{1c} (%) ^a	7.4 (6.7–8.4)	7.0 (6.3–7.8)	6.5 (5.6–7.0)	6.8 (6.1–7.7)
HbA _{1c} (mmol/mol)	57 (50–68)	53 (45–62)	48 (38–53)	51 (43–61)
Psychological variables				
Depressive symptoms (PHQ-9)				
Total depressive symptom score ^b	6.0 (3.0–11.0)	4.0 (1.0–9.0)	2.0 (0.0–5.0)	3.0 (1.0–8.0)
Moderate-to-severe depressive symptoms, n (%) ^b	18 (29.5)	89 (21.9)	28 (13.2)	135 (19.9)
DDS-17				
Overall diabetes distress score ^c	2.0 (1.6–3.1)	1.6 (1.3–2.3)	1.4 (1.1–1.7)	1.5 (1.2–2.2)
Emotional burden score ^c	2.3 (1.5–3.5)	1.6 (1.2–2.4)	1.2 (1.0–1.8)	1.6 (1.2–2.4)
Physician-related distress score ^d	1.5 (1.0–2.8)	1.3 (1.0–2.0)	1.0 (1.0–1.8)	1.3 (1.0–2.0)
Regimen-related distress score ^e	2.4 (1.6–3.2)	1.8 (1.2–2.6)	1.4 (1.0–2.0)	1.8 (1.2–2.4)
Interpersonal distress score ^f	1.7 (1.0–2.7)	1.3 (1.0–2.0)	1.0 (1.0–1.3)	1.0 (1.0–2.0)
Moderate-to-high distress, n (%) ^c	30 (50.0)	152 (37.1)	42 (19.3)	224 (32.6)
Self-Compassion Scale				
Overall self-compassion score ^g	3.1 (2.8–3.6)	3.3 (2.9–3.7)	3.4 (3.0–3.8)	3.3 (3.0–3.7)
Self-kindness score ^h	2.6 (2.0–3.1)	2.6 (2.0–3.4)	2.6 (1.8–3.2)	2.6 (2.0–3.2)
Self-judgment score ⁱ	2.5 (1.8–3.4)	2.2 (1.4–3.0)	2.0 (1.4–2.8)	2.2 (1.4–3.0)
Common humanity score ^j	3.0 (2.3–3.8)	3.0 (2.0–3.8)	2.8 (2.0–3.8)	2.8 (2.0–3.8)
Isolation score ^j	2.5 (2.0–3.5)	2.0 (1.3–3.0)	1.8 (1.0–2.8)	2.0 (1.3–3.0)

Continued on p. 583

Table 1—Continued

	Age at type 2 diabetes diagnosis			Total sample (N = 706)
	<40 years (n = 64)	40–59 years (n = 422)	≥60 years (n = 220)	
Mindfulness score ^k	3.3 (2.5–4.0)	3.3 (2.5–4.0)	3.3 (2.5–4.0)	3.3 (2.5–4.0)
Overidentification score ^l	2.6 (1.8–3.5)	2.0 (1.5–2.8)	1.8 (1.3–2.5)	2.0 (1.5–2.8)

Data are median (IQR), unless otherwise indicated. Medication variables indicate medication prescriptions. SSRIs include citalopram, dapoxetine, escitalopram, fluoxetine, fluvoxamine, paroxetine, and sertraline. DDS-17, 17-item Diabetes Distress Scale (score range 0–6); DPP-4, dipeptidyl peptidase 4; GLP-1, glucagon-like peptide 1; SGLT2, sodium–glucose cotransporter 2. *This includes α -glucosidase inhibitors, thiazolidinediones, and meglitinides. ^aN = 682. ^bN = 680. ^cN = 688. ^dN = 693. ^eN = 692. ^fN = 694. ^gN = 641. ^hN = 664. ⁱN = 672. ^jN = 673. ^kN = 676. ^lN = 671.

by diagnostic age group was observed for the emotional burden score, which was 2.3 (IQR 1.5–3.5) among participants diagnosed at <40 years and 1.2 (IQR 1.0–1.8) among participants diagnosed at ≥60 years of age (Table 1).

In all models, younger age at diagnosis was significantly associated with higher levels of overall diabetes-specific distress (β_{adj} : −0.03 [95% CI −0.04 to −0.02]; $P < 0.01$). This trend was also observed for all subscales of diabetes-specific distress (emotional burden, physician-related distress, regimen-related distress, and interpersonal distress). After adjustment for all specified confounders, the odds of moderate-to-high diabetes-specific distress decreased by 6% for each 1-year increase in age at diagnosis (OR_{adj} 0.94 [95% CI 0.92–0.97]; $P < 0.01$), showing a higher risk of diabetes-specific distress among participants diagnosed earlier in life (Table 2). Effect modification by diabetes duration was found for the association between diagnostic age and diabetes-specific distress ($P < 0.05$) (Fig. 2B).

Self-Compassion

The median overall self-compassion score for all participants was 3.3 (IQR 3.0–3.7).

Lower levels of self-compassion were observed among participants diagnosed earlier in life; the median overall self-compassion score was 3.1 (IQR 2.8–3.6) in participants diagnosed at <40 years, 3.3 (IQR 2.9–3.7) in those diagnosed between 40 and 59 years, and 3.4 (IQR 3.0–3.8) in participants diagnosed at ≥60 years of age (Table 1 and Fig. 1C). Participants diagnosed earlier in life also showed higher levels of self-judgment, isolation, and overidentification, representing lower levels of self-compassion (Table 1).

Younger diagnostic age was significantly associated with lower levels of overall self-compassion in all models (β_{adj} : 0.01 [95% CI 0.00–0.02]; $P < 0.01$). Significant associations were also observed between younger diagnostic age and higher levels of self-judgment, isolation, and overidentification (Table 2). Diabetes duration did not modify the association between age at diagnosis and overall self-compassion (Fig. 2C).

CONCLUSIONS

This study investigated the association between age at diagnosis of type 2 diabetes and depressive symptoms, diabetes-specific distress, and self-compassion. Our

findings showed that early-onset adult type 2 diabetes (i.e., diagnosis <40 years) was significantly associated with higher levels of depressive symptoms and diabetes-specific distress, aligning with previous research showing a negative association between younger age and depression/diabetes-specific distress (16–19). However, this study provides further evidence showing that the age at which an individual is diagnosed with type 2 diabetes remains associated with psychological well-being many years after diagnosis.

Younger age at diagnosis of type 2 diabetes was also found to be significantly associated with lower levels of overall self-compassion and higher levels of the negative attributes of self-compassion: self-judgment, isolation, and overidentification. Previous research has shown that societal judgment, blame, and stigma expressed toward people living with type 2 diabetes can become internalized, resulting in self-blame and self-judgment (28–30). These feelings can be experienced more intensely by younger people, who are at an age at which type 2 diabetes is less commonly experienced (30). Feelings of shame and

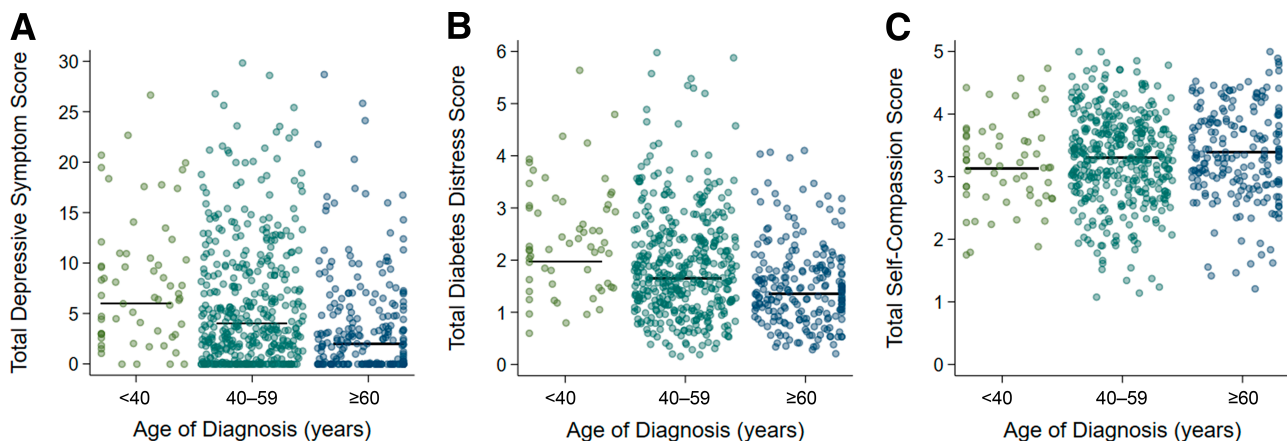


Figure 1—Median values (shown as black lines) and distribution of total depressive symptoms (score range: 0–27) (A), overall diabetes-specific distress (score range: 0–6) (B), and overall self-compassion (score range: 0–5) (C) by age at type 2 diabetes diagnosis.

Table 2—Results from regression models investigating the effect of age at diagnosis on psychological variables

	Unadjusted models		Models adjusted for diabetes duration		Models adjusted for diabetes duration, sex, ethnicity, deprivation status, BMI, and SSRI prescription	
	Estimate	N	Estimate	N	Estimate	N
Depressive symptoms (PHQ-9)						
Total depressive symptom score	−0.13 (−0.18 to −0.09)**	680	−0.19 (−0.25 to −0.14)**	680	−0.18 (−0.25 to −0.10)**	464
Moderate-to-severe depressive symptoms (OR)	0.97 (0.95–0.98)**	680	0.95 (0.93–0.97)**	680	0.96 (0.93–0.98)**	464
DDS-17						
Overall diabetes distress score	−0.03 (−0.03 to −0.02)**	688	−0.04 (−0.04 to −0.03)**	688	−0.03 (−0.04 to −0.02)**	474
Emotional burden score	−0.03 (−0.04 to −0.02)**	688	−0.04 (−0.05 to −0.03)**	688	−0.03 (−0.04 to −0.02)**	474
Physician-related distress score	−0.02 (−0.03 to −0.01)**	693	−0.03 (−0.04 to −0.02)**	693	−0.03 (−0.04 to −0.01)**	478
Regimen-related distress score	−0.03 (−0.03 to −0.02)**	692	−0.04 (−0.05 to −0.03)**	692	−0.03 (−0.05 to −0.02)**	477
Interpersonal distress score	−0.02 (−0.03 to −0.02)**	694	−0.03 (−0.04 to −0.02)**	694	−0.03 (−0.04 to −0.02)**	479
Moderate-to-high distress (OR)	0.95 (0.94–0.97)**	688	0.93 (0.91–0.95)**	688	0.94 (0.92–0.97)**	474
Self-Compassion Scale						
Total self-compassion score	0.01 (0.00–0.01)**	641	0.01 (0.01–0.02)**	641	0.01 (0.00–0.02)**	435
Self-kindness score	0.00 (−0.01 to 0.00)	664	0.00 (−0.01 to 0.00)	664	−0.01 (−0.02 to 0.01)	455
Self-judgment score	−0.01 (−0.02 to −0.01)**	672	−0.03 (−0.04 to −0.02)**	672	−0.02 (−0.03 to −0.01)**	461
Common humanity score	−0.01 (−0.02 to 0.00)**	673	−0.01 (−0.02 to 0.00)**	673	−0.01 (−0.03 to 0.00)	460
Isolation score	−0.02 (−0.03 to −0.01)**	673	−0.03 (−0.04 to −0.02)**	673	−0.03 (−0.04 to −0.02)**	461
Mindfulness score	0.00 (−0.01 to 0.01)	676	0.00 (−0.01 to 0.01)	676	0.00 (−0.01 to 0.01)	465
Overidentification score	−0.02 (−0.03 to −0.01)**	671	−0.03 (−0.04 to −0.02)**	671	−0.02 (−0.03 to −0.01)**	460

Estimate reported as coefficient (95% CI), indicating the change in the score per 1-unit increase of age at diagnosis. OR indicates the odds ratio of the outcome per 1-unit increase of age at diagnosis. DDS-17, 17-item Diabetes Distress Scale (score range 0–6). ** $P < 0.01$.

exclusion can also result in younger adults with type 2 diabetes concealing their condition from others, making it harder to integrate optimal diabetes self-management into their daily lives (31,32). Additionally, life transitions, which occur more frequently in young adulthood, such as family planning and early career planning, can often result in changes to an adult's diabetes management routine, which can trigger further feelings of guilt, potentially leading to low self-worth, anxiety, and depression (33).

These findings have important implications for the overall care of younger adults with type 2 diabetes, highlighting the need for a holistic approach to diabetes care and the implementation of training for health care professionals to ensure routine assessment of depressive symptoms and diabetes-specific distress in order to improve outcomes for younger adults living with type 2 diabetes (34). Additionally, these results emphasize the necessity for the development of psychosocial interventions tailored to the needs of younger adults with type 2 diabetes.

Although several interventions designed for adults living with type 2 diabetes have been shown to be effective in reducing depressive symptoms and diabetes-specific distress and increasing self-compassion (9,35,36), interventions tailored to the younger population with type 2 diabetes are scarce (37). Previous research exploring education, information, and support needs of younger adults with type 2 diabetes has highlighted the need for younger adults with type 2 diabetes to be able to access age-specific information, gain reassurance from others who encounter similar experiences, and be exposed to positive role models who are of a similar age in order to help minimize feelings of low self-worth and depression (33,38,39). Additionally, as social support has been shown to moderate the relationship between diabetes burden and diabetes-specific distress, the incorporation of age-specific social support in psychosocial interventions for younger adults with type 2 diabetes is fundamental (40). Thus, further research is needed to consider and address the impact of diabetes management on psychosocial factors among young adults with type 2 diabetes and aid the development and

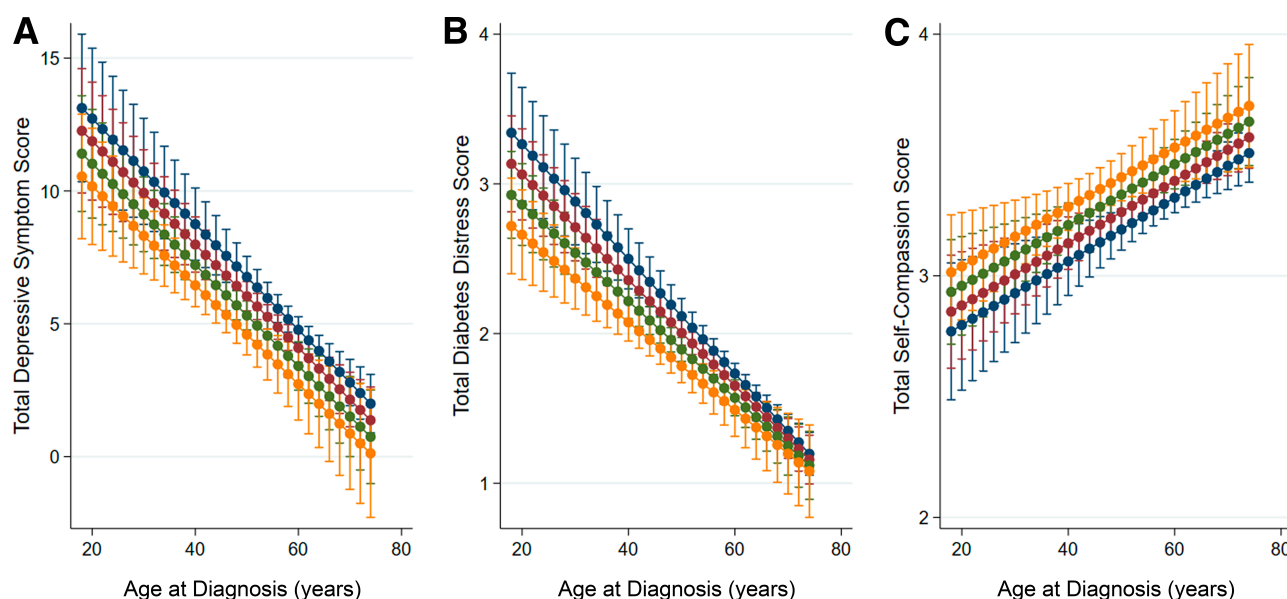


Figure 2—Regression model of association between age of diagnosis and total depressive symptom score (A), overall diabetes distress score (B), and overall self-compassion score (C), by duration of diabetes (blue, 5 years; red, 10 years; green, 15 years; and orange, 20 years).

provision of person-centered and age-appropriate interventions.

This analysis has many strengths. Firstly, the use of age at diagnosis as a continuous (and possibly nonlinear) variable allowed for a more granular investigation of the association between age at diagnosis and psychological well-being among adults with type 2 diabetes than can be afforded using categorized diagnostic age. Additionally, the inclusion of three validated psychological measures of depressive symptoms, diabetes-specific distress, and self-compassion enabled a comprehensive understanding of the psychological well-being of these adults. The adjustment for SSRI prescriptions, which were prescribed more frequently to participants diagnosed at <40 years of age in this analysis, also strengthens the validity of the findings, as they represent a confounder of the association between age at diagnosis of type 2 diabetes and depression/diabetes-specific distress/self-compassion (27).

However, limitations should also be noted. As the analysis was cross-sectional, causality cannot be inferred. Additionally, diagnostic age was self-reported, therefore it is possible that some participants may not have accurately recalled this information. However, research has shown that self-reported age of diabetes diagnosis is a reasonably accurate and valid measure (41). Furthermore, selection bias may have been present, as the participants included

were volunteers who were motivated to undertake the CODEC study. The large amount of missing data for deprivation status reduced the sample size of participants who could be included in the models adjusting for all specified confounders. Furthermore, the analysis is limited by the possibility of unmeasured confounding by factors such as stressful and/or traumatic life events, for which data were not collected in the CODEC study. Finally, as >85% of the participants included in this study were of White ethnic background, further research with a more ethnically diverse sample is required to investigate differences in the association between age at diagnosis and psychological health between ethnic groups.

In conclusion, this analysis demonstrated that younger age at diagnosis of type 2 diabetes is associated with higher levels of depressive symptoms and diabetes-specific distress, along with lower levels of self-compassion. This highlights the need for clinical vigilance and the availability of age-appropriate psychosocial support in order to optimize the psychological well-being of younger adults with type 2 diabetes.

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manuscript. M.M.B. is the guarantor of this work and, as such, had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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