Diabesity in adults with type 2 diabetes mellitus: A cross-sectional study exploring self-care and its determinants

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Running head: Diabesity and self-care behaviours

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Declarations

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Ethics approval: The study obtained approval from the Institutional Review Boards of participating centres. All procedures performed involving human participants were in accordance with the ethical standards of the institutional and with the 1964 Helsinki declarations and its later amendments or comparable ethical standards.

Consent to participate: Informed consent was obtained from all patients for being included in the study.

Consent to publish: The participants were informed that collected data had the purpose of scientific communications, and they have consented to be enrolled in the study by signing a written informed consent.

Diabesity in adults with type 2 diabetes mellitus: A cross-sectional study exploring self-care and its determinants

Abstract

Objectives: The purposes of this study were to describe self-care maintenance, self-care monitoring, self-care management, and self-care self-efficacy among adults with type 2 diabetes (T2DM) and body mass index (BMI) <30 kg/m^2 and adults with T2DM and BMI ≥30 kg/m^2 (diabesity), and to identify their clinical and socio-demographic determinants. Self-care is one of the main treatments for adults with T2DM. However, self-care has been poorly described in people with diabesity, and differences in clinical and socio-demographic determinants of self-care between patients with diabesity and patients with T2DM and BMI<30Kg/m^2 were never assessed before.

Methods: A secondary analysis of socio-demographic and clinical data of a multicentre observational cross-sectional design was performed, in which 540 adults diagnosed with T2DM were involved with a consecutive and convenience sampling procedure.

Results: Self-care maintenance and management were significantly lower among patients with diabesity (respectively, p <0.001and p = 0.025). Among patients with diabesity, low income (RR=3.27; p=0.01) and the presence of diabetic neuropathy (RR=4.16; p=0.03) were strongly associated with inadequate self-care maintenance; educational qualification higher or equal to high school diploma (RR=0.45; p=0.01), the availability of a family caregiver (RR=0.52; p=0.04), and the use of insulin as the main treatment (RR=2.09; p=0.01) decreased the likelihood of inadequate self-care monitoring.

Conclusions: The unfavorable behavioral profile of patients with diabesity could be further worsened by their lower level of confidence in performing adequate self-care.

Keywords. Diabetes Mellitus; Type 2 Diabetes Mellitus; Diabesity; Self-care; Self-management; Obesity

Introduction

Type 2 diabetes (T2DM) and obesity are chronic diseases with an increasing prevalence, having a worldwide impact on people's well-being with a dramatic mutual influence (1,2). T2DM accounts for 90–95% of all diabetes cases (3). The global T2DM prevalence is nearly doubled since 1980 (3). T2DM is rising to a prevalence of 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045 (1). About 85% of the patients with T2DM have a body mass index (BMI) above 25 kg/m^2, and roughly 70% above 30.0 kg/m^2 (4–6). Overweight and obesity are considered crucial modifiable risk factors for the development of T2DM (1,7–9). Given the association between T2DM and obesity (10,11), the term "diabesity" has become widely adopted for describing their simultaneous presence within a single individual (12–16).

Self-care is one of the main treatments for T2DM (8,17,18). It is the "process of maintaining health through health-promoting practices and managing illness" (19,20). The key components of the self-care process are self-care maintenance, self-care monitoring, and self-care management. Self-care maintenance includes behaviors used to maintain physical and emotional stability. Self-care monitoring includes behaviors aimed at assessing health status changes and recognizing any signs and symptoms of a disease's clinical exacerbations (or changes regarding a healthy status). Self-care management includes the ability to address signs and symptoms and to solve health problems when they occur. Overall, self-care maintenance, self-care monitoring, and self-care management are influenced by self-care self-efficacy, which is the level of confidence people have in their ability to perform adequate self-care (19,21,22).

Self-care is a critical aspect to enhance patients' self-resources (23), optimize glycaemic control (24), and decrease disease complications (21,25) and mortality (26), reducing hospitalizations (8,27,28) and costs of healthcare systems (26) for adults with and without diabesity. Despite these self-care-related advantages, several studies showed how self-care could be difficult for patients with T2DM (21,23,24,29–33). In people with diabesity, self-care could be even more difficult. In fact, obesity could have diverse multifactorial causations, such as an age-related reduction in muscle mass, behaviors (e.g., physical activity and food intake habits), social and cultural factors (e.g., socioeconomic status), and genetic factors (e.g., the genetic-controlled regulation of energy expenditure) (6,16,34–37). However, self-care has been poorly described in people with diabesity by employing precise analytical approaches for avoiding masking some diabesity-related patterns in the relationships from determinants to behavioral outcomes (self-care) (38). Furthermore, although determinants of self-care in T2DM patients have been widely investigated (21,31), differences in clinical and socio-demographic determinants of self-care between patients with diabesity and patients with type 2 diabetes and BMI<30Kg/m^2 were never assessed before. In other words, This information could be important to identify those patients at risk of inadequate self-care and tailor effective interventions in this specific population (21,29).

Coherently with these gaps, the aims of this study were: [a] to describe self-care maintenance, self-care monitoring, self-care management, and self-care self-efficacy in adults with diabesity and adults with type 2 diabetes and BMI<30Kg/m^2; [b] to identify clinical and socio-demographic determinants of self-care maintenance, monitoring, and management in adults with diabesity and adults with type 2 diabetes and

BMI<30Kg/m^2; [c] to investigate if the presence of obesity modifies the association between clinical and socio-demographic patients' characteristics and self-care maintenance, monitoring, and management in adults with T2DM for corroborating the potential differences emerging from the determinants investigated in the subsample of adults with diabesity and adults with type 2 diabetes and BMI<30Kg/m^2.

Methods

Study design and sample

This study was a secondary analysis of a previous cross-sectional study aimed to identify self-care determinants in T2DM adults from six clinics in the north of Italy.(21) The parent study used a consecutive sample of 540 adults with T2DM and this study included all of the participants of the parent study. The inclusion criteria were: T2DM diagnosis (39), age higher to or equal to 18 years. The exclusion criteria were: inability to read or cognitive impairment, and type of diabetes different from T2DM.(39) The study obtained approval from the Institutional Review Boards of participating centers, and signed informed consent was obtained from every patient enrolled. The study procedure was consistent with the ethical standards of the responsible ethics committee and the Declaration of Helsinki. The reporting of the study was guided by the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Checklist.

Variable definitions

Clinical and socio-demographic characteristics were collected by medical records, including BMI, sex, age, income, time from diagnosis, working status, education, family support, treatment, comorbidities, complications, and disease-specific self-management education. BMI was dichotomized in <30 kg/m^2 and ≥30 kg/m^2 to compare self-care in the two subgroups (patients with diabesity and patients with T2DM and BMI<30Kg/m^2) (40). Individual-level variables were collected following the previous analysis (21,30). The age was dichotomized in <65 and ≥65 years (21,30). According to the Italian national fiscal regulation, income was dichotomized to describe patients who have to pay an extra fee to access public health services and those exempt due to the low income. Time from diagnosis was included as an indicator of the patient experiences; it was dichotomized in <10 and ≥10 years from the diagnosis of T2DM. Working status was collected as a dichotomous variable by considering active workers versus retired or unemployed. Likely, education was recorded as "lower educational background" (primary and lower secondary school) versus "higher educational background" (high school and university). Family support was defined as the self-reported presence of at least one person in the family who supports the patient in managing the disease; accordingly, family support was collected as a "yes/no" record. Treatment was considered as the type of medication at the enrolment (insulin therapy *vs.* oral blood glucose-lowering medication only); comorbidities were reported as "at least one" vs. "none". The presence of microvascular complications of diabetes (retinopathy, nephropathy, diabetic foot, and neuropathy) were also considered in data collection as a "yes/no" record. Finally, disease-specific self-management education was collected as a dichotomous

variable by considering patients who attended at least one diabetes management course versus patients who attended none.

Self-care maintenance, self-care monitoring, self-care management, and self-care self-efficacy were assessed by the Self-Care of Diabetes Inventory (SCODI). The SCODI is a validated self-report instrument (31,32) developed in coherence with the Middle Range Theory of Self-Care of Chronic Illness (19). It is composed of four scales that use a 5-points Likert structure to assess self-care maintenance, self-care monitoring, self-care management, and self-care self-efficacy. Each sub-scale provides a standardized 0-100 score (31,32), enclosing specific dimensions of self-care (32). Precisely, self-care maintenance includes health-promoting exercise behaviors, disease prevention behaviors, health-promoting behaviors, and illness-related behaviors. Self-care monitoring includes body listening and symptoms recognition. Self-care management includes autonomous self-care management behaviors and consultative self-care management behaviors. Lastly, self-care self-efficacy includes task-specific self-care self-efficacy and persistent self-care self-efficacy. The cut-offs of the SCODI scores were estimated in a previous study using glycated hemoglobin as the gold standard for determining adequate disease management (31). In this study, we used those cut-offs to define adequate self-care: adequate self-care maintenance ≥76/100 points; adequate self-care monitoring ≥78/100 points; adequate self-care management in patients with insulin therapy is ≥57/100 points, while, without insulin therapy, the cut-off is ≥61/100 points. More precisely, the dichotomization of self-care maintenance, self-care monitoring, and self-care management allows researchers to get the associations between determinants and the specific unfavorable behavioral features characterized by a score below the previously described cut-offs.

Statistical analysis

In accordance with the first aim of the study, counts and percentages described categorical variables within subgroups of patients with type 2 diabetes and BMI <30 kg/m^2 and patients with diabesity (BMI ≥30 kg/m^2) and were compared by Chi-square tests. Continuous variables were described by the median and interquartile range (IQR) and compared by the Mann-Whitney *U* test as the distribution of self-care scores appeared to be slightly skewed.

Following the second aim, self-care maintenance, self-care monitoring, and self-care management were dichotomized following the cut-offs previously described for ascertaining inadequate *vs.* adequate self-care behaviors (31,32). In the framework of generalized linear models, separate probit regression models were applied on the two subgroups (patients with type 2 diabetes and BMI <30 kg/m^2 and patients with diabesity) to evaluate the associations between clinical and socio-demographic characteristics (independent variables) and self-care maintenance, self-care monitoring, and self-care management (dependent variables) (41). The independent variables included in the models were consistent with previous studies on evaluating determinants of self-care (21,30): sex, age, income, time from diagnosis, working status, education, family support, treatment, comorbidities, complications, disease-specific self-management education, and self-care self-efficacy (task-specific and persistence). The coefficients of probit models were estimated via maximum likelihood estimation. Results were reported as relative risks (RR) and 95% confidence interval (95% CI). In

the model on self-care maintenance, treatment (insulin therapy *vs.* oral blood glucose-lowering medication only) was not included as an independent variable in the model since all the patients classified as inadequate self-care maintenance were in treatment with insulin. Furthermore, to provide evidence supporting that the associations highlighted dichotomizing outcomes are consistent with those derived from keeping outcomes as continuous variables, we provided additional linear regression models using continuous scores as dependent variables (see Supplementary file 1). Overall, the trend of associations derived from the linear models was consistent with asociations emerging from the probit regressions.

In accordance with the third aim, three probit regression models were then employed on the overall dataset (considering both BMI <30 kg/m^2 and BMI ≥30 kg/m^2) to evaluate whether diabesity (yes *vs.* no) modified the associations between independent variables and self-care maintenance, self-care monitoring, and self-care management. The models performed on the overall sample were adopted to corroborate the differences shown by the models performed in the two separate subsamples to answer the aim focused on describing the differences between the two groups. The Omnibus test of goodness-of-fit, the Akaike information criterion (AIC), and the Bayesian information criterion (BIC) were employed for each probit regression model.

Overall, a significant level of 0.05 was set for all the inferential analyses (except for interaction terms in which the significance level was set at 0.1), and the missing data were handled with a pairwise deletion. All the analyses were performed using Statistical Package for the Social Sciences (SPSS) version 22 (IBM Corporation) with the integration plug-in for R 3.2.2 Statistical Package (R Foundation for Statistical Computing).

Results

Clinical and socio-demographic characteristics of the sample, together with self-care maintenance, self-care monitoring, and self-care management in patients with T2DM and BMI<30 kg/m^2 and patients with diabesity (BMI ≥30 kg/m^2), were reported in **Table 1.** A total of 203 (37.6%) patients had diabesity in our study sample. A higher rate of females was found in the subgroup of patients with BMI≥30 kg/m^2 (50% *vs.* 38%; P=0.004). Patients with diabesity were also slightly younger than patients with BMI<30Kg/m^2 (median [IQR] = 67 (59.0–76.0) years *vs.* median [IQR] = 70 (62.0–77.5) years; P=0.043). Patients with BMI<30Kg/m^2 reported slightly more time from the diagnosis (median [IQR]= 9 (4.0-15.0) years *vs.* median [IQR]= 8 (4.0-12.0) years; P=0.024), slightly better glycaemic control (median [IQR]= 7.1% (6.7–7.9) *vs.* median [IQR]= 7.4 (6.8–8.2) %; P=0.036), and lower frequency of comorbidities (84% *vs.* 92%; P=0.004) when compared with patients with diabesity. Self-care maintenance (median [IQR] = 77.08 (70.83–83.33) vs. median [IQR]= 83.33 (75.00–89.58); P<0.001) and self-care management (median [IQR]= 56.25 (37.50–69.44) vs. median [IQR]= 62.50 (41.15–75.00); P=0.025) were lower among patients with diabesity when compared with patients with T2DM and BMI<30Kg/m^2. No differences were found in self-care monitoring between the two groups.

Specific dimensions of self-care maintenance, self-care monitoring, self-care management, and self-care self-efficacy were reported in **Figure 1**, showing the comparison of each dimension between patients with diabesity and patients with T2DM and BMI<30Kg/m^2. Patients with diabesity reported lower health-promoting exercise behaviors (P<0.001), health-promoting behaviors (P<0.001), autonomous self-care management behaviors (P=0.025), task-specific self-care self-efficacy (P=0.049), and lower persistence self-care self-efficacy (P=0.031).

-----Please add Table 1 here-------

-----Please add Figure 1 here-------

Self-care maintenance

Clinical and socio-demographic determinants of inadequate self-care maintenance were reported in **Table 2**, highlighting determinants for patients with T2DM and BMI <30 kg/m2 and those with diabesity**.** Among patients with diabesity, low income was associated with more than three times higher risk of inadequate self-care maintenance than the absence of low income (RR=3.27; 95% CI= 1.27-8.43; P=0.01). Furthermore, in these patients, the presence of diabetic neuropathy was strongly associated with inadequate self-care maintenance (RR=4.16; 95% CI= 1.14-15.23; P=0.03).

The model employed in the overall sample ($\chi^2_{(35)}$ =110.08, P<0.001; AIC= 330.57; BIC=476.02), including the interaction of diabesity on the association between each independent variable and self-care maintenance, showed that diabesity significantly has interacted with the income (P=0.014), neuropathy (P=0.031), and sex (P=0.054).

Self-care monitoring

Clinical and socio-demographic determinants of inadequate self-care monitoring in patients with T2DM and BMI<30 kg/m^2 and patients with diabesity are shown in **Table 2**. In both subgroups, males reported lower risk of inadequate self-care monitoring than females, with a more marked reduction among patients with diabesity ($RR_{BMI<30\ kg/m2}$=0.73, 95% CI= 0.53-0.99, P=0.05; $RR_{BMI\ \geq 30\ kg/m2}$=0.61, 95% CI= 0.40-0.94, P=0.03). Higher task-specific self-care self-efficacy slightly decreased the risk of inadequate self-care monitoring in both the sub-groups ($RR_{BMI<30\ kg/m2}$=0.98, 95% CI= 0.96-0.99, P<0.01; $RR_{BMI\ \geq 30\ kg/m2}$=0.97, 95% CI= 0.95-0.99, P<0.01). Among patients with BMI<30 kg/m^2, having been diagnosed with T2DM for less than ten years decreased by roughly 30% the risk of inadequate self-care monitoring (RR=0.67; 95% CI= 0.48-0.93; P=0.02). Furthermore, among patients with T2DM and BMI<30 kg/m^2, the following determinants increased the likelihood of inadequate self-care monitoring: receiving at least one diabetes-specific educational intervention in the last year (RR=3.19; 95% CI=1.32-7.75; P=0.01) and having neuropathy (RR = 2.25; 95% CI=1.17-4.32; P=0.02). Conversely, among patients with diabesity, the following determinants decreased the risk of inadequate self-care monitoring: educational qualification higher or equal to high school diploma (RR=0.45; 95% CI=0.25-0.79; P=0.01), and the availability of a family caregiver (RR=0.52; 95% CI= 0.28-0.98; P=0.04). In these patients, the use of insulin as the main

treatment was associated with a higher risk of inadequate self-care monitoring (RR=2.09; 95% CI= 1.23-3.55; P=0.01).

The model performed in the overall sample (χ^2_{34}=155.213, P<0.001; AIC= 631.425; BIC=636.425), showed that diabesity significantly modifies the effect of the following independent variables on self-care monitoring: sex (P=0.026), time from diagnosis (P=0.016), educational level (P=0.006), diabetes-specific education (P=0.010), family support (P=0.043), therapy with insulin (P=0.007), and task-specific self-care self-efficacy (P<0.001).

Self-care management

Clinical and socio-demographic determinants of inadequate self-care management in patients with BMI<30 kg/m^2 and patients with diabesity are reported in **Table 2**. In both subgroups, higher task-specific self-care self-efficacy was associated to a decreased risk of inadequate self-care management ($RR_{BMI<30\ kg/m2}$=0.97, 95%CI= 0.96-0.99, P<0.01; $RR_{BMI\ \geq 30\ kg/m2}$=0.98; 95%CI= 0.96-0.99; P<0.01). In patients with diabesity, the presence of at least one comorbidity was associated with an increase by roughly 18% the likelihood of inadequate self-care management (RR=1.18; 95%CI= 1.01-1.36; P=0.03).

The model performed in the overall sample [$\chi^2_{(34)}$=121.995, P<0.001; AIC= 693.755; BIC=843.699] showed that diabesity significantly interacted with having a diabetic foot (P=0.053), having at least one comorbidity (P=0.033), and task-specific self-care self-efficacy (P<0.01).

-----Please add Table 2 here-------

Discussion

Knowing diabesity-related differences in self-care and its clinical and socio-demographic determinants is relevant to design and implement evidence-informed clinical interventions to support adequate self-care in people with T2DM and BMI≥30 kg/m^2, as they represent a population at particularly high risk for adverse events (38). To the best of our knowledge, this is the first study assessing differences in self-care between people with diabesity and people with T2DM and BMI <30 kg/m^2. Differences in clinical and socio-demographic determinants of self-care between the two sub-groups were also explored for the first time. We found that people with diabesity reported worse self-care maintenance and self-care management when compared to those with T2DM and BMI <30 kg/m^2. No differences in self-care monitoring were found. Self-care self-efficacy, an important predictor of self-care, was lower in patients with diabesity when compared to those with T2DM and BMI <30 kg/m^2. This aspect might have a higher implication for practice, as adults with diabesity should receive in their clinical pathways additional educational and motivational interventions to enhance the level of their self-care self-efficacy. The clinical and socio-demographic characteristics of patients differently influence self-care maintenance, monitoring, and management in the two subgroups, showing a higher impact of social variables, such as family income, education, and family support, in the group of people with diabesity. This result is extremely relevant because health interventions aimed at

supporting self-care in these patients should prioritize social determinants of self-care and not only target individual ones.

Adequate self-care self-efficacy has been shown to be the most important predictor of adequate self-care in people with T2DM (21,25,29). Our results suggest that this effect is slightly less marked in patients with diabesity. This result could mean that the effect of self-care self-efficacy on self-care behaviors could be reduced by other psychological or social variables playing a greater role for patients with diabesity when compared with patients with T2DM and BMI<30Kg/m^2. Future research should better investigate potential barriers undermining the effect of self-care self-efficacy on behaviors among adults with diabesity. However, given that self-care self-efficacy is susceptible to enhancements through education and empowerment of patients, its improvements could positively affect self-care (21). Thus,more strategies to enhance self-care self-efficacy in patients with diabesity are strongly needed. Interventions aimed at addressing social determinants of health and decreasing weight stigma in health care professionals should be considered when an educational plan for these patients is designed (44).

Patients with diabesity showed lower self-care maintenance and self-care management scores when compared to patients with T2DM and BMI <30 kg/m^2. More specifically, looking at self-care maintenance, patients with diabesity reported higher rates of inadequate health-promoting exercise behaviors and health-promoting behaviors. In self-care management, patients with diabesity reported higher rates of inadequate autonomous self-care management behaviors. Furthermore, patients with diabesity reported lower self-care self-efficacy in their ability to perform task-specific self-care behaviors and in their ability to persist in self-care. These results are not surprising because self-care self-efficacy is raised with positive performance achievements (42). Patients with diabesity might have low confidence levels due to negative experiences facing clinical and social challenges, such as dealing with weight stigma (43) and diabetes stigma when trying to lose weight (44). These results are consistent with previous findings confirming that patients with diabesity have an unfavorable behavioral profile associated with social challenges that amplify the metabolic mechanisms by which diabesity affects health status and behaviors (45).

Moreover, previous studies suggest that health professionals tend to evaluate patients with obesity more negatively, considering their likelihood of obtaining positive results from the treatment lower than lower-weight patients (45). Altogether, these results suggest that interventions improve self-care self-efficacy and self-care behaviors in people with diabesity are urgent. Previous research has proven that specific educational interventions could improve neuronal plasticity in brain areas of adults with diabesity (44). Thus, knowing which specific areas of inadequate self-care characterize patients with diabesity could represent a framework to develop new multifactorial interventions to promote self-care in this population. These interventions should consider clinical and socio-demographic determinants of self-care in this particular group of patients because, according to our study results, they differ from the determinants of self-care in patients with T2DM and BMI<30 kg/m^2 (21,30).

Looking at self-care maintenance, we found that low income was significantly associated with inadequate self-care maintenance among patients with diabesity but not among patients with BMI <30 kg/m^2. This finding is consistent with previous research (44), highlighting that low income is associated with higher

rates of obesity and less favorable health behaviors in patients with chronic conditions due to social determinants of health. Furthermore, having diabetic neuropathy was found to be a significant risk factor for inadequate self-care maintenance among patients with diabesity but not among patients with BMI <30 kg/m^2. This result could reflect the difficulty of patients with diabesity to perform activities of daily living (44); in fact, the rates of disabilities are higher in patients with diabesity than in patients with BMI <30 kg/m^2 (45).

Looking at self-care monitoring, having received at least one diabetes-specific educational intervention in the last year was associated with a higher likelihood of inadequate self-care monitoring among patients with BMI<30Kg/m^2 but not among patients with diabesity. This result is not surprising, as previous findings have shown that people with T2DM may be more likely to receive a diabetes-specific educational intervention when diabetes complications are already present (21,29). The use of insulin as the main treatment was associated with a higher risk of inadequate self-care monitoring among patients with diabesity but not among patients with BMI<30Kg/m^2. These results confirm previous studies (21,29), reporting both the trend to include only complex patients in diabetes-specific educational interventions and the medicalization of the treatment of people with BMI≥30 Kg/m^2. Education and family support were significant determinants in patients with diabesity but not in patients with BMI<30Kg/m^2. Again, this result confirms the importance of social determinants of health and self-care in people with diabesity (16).

By looking at self-care management, comorbidity was found to be a significant determinant among patients with diabesity but not among patients with T2DM with BMI<30Kg/m^2. This result could explain the more complex clinical condition of people with diabesity, where obesity might trigger worse diabetes outcomes and the development of other comorbidities or complications, making self-care even more difficult in this group of patients (2,7).

To summarize, diabesity-related differences in self-care at its clinical and socio-demographic determinants suggest an unfavorable behavioral profile that characterizes patients with diabesity. This unfavorable condition could reflect, on one hand, the inflammatory and metabolic consequences of the diabesity (34), such as triggering insulin resistance and lipotoxicity that could result in a higher rate of cardiovascular disease and mortality (35). On the other hand, it could reflect the social phenomenon of weight stigma and its consequences (36). A previous review highlighted that patients with obesity who experience the feeling of being discriminated against as per their weight could, in a vicious cycle, exacerbate their inadequate health behaviors (36). Based on our results, we suppose the same mechanisms could affect self-care of diabetes in people with diabesity. Thus, a greater understanding of the biological, social, and psychological features of patients with diabesity is needed to develop effective interventions in this population.

Limitations

This study has some limitations that need to be acknowledged. Firstly, data collection was cross-sectional and involved only centers from northern Italy. This aspect suggests caution with the generalization of results. Secondly, other alternative indices to BMI could be integrated to define obesity (e.g., waist circumference). Lastly, psychological and social variables (e.g., depression, weight stigma perception, and

social isolation) should be investigated to better comprehend self-care in people with diabesity. However, the study was multicentre, and a consecutive sampling controlled possible selection biases, and self-care was measured by using a valid and reliable theoretically grounded tool. Overall, the dichotomizations of the self-care scores and some independent variables (e.g., time from diagnosis and age) could lead to an underutilization of the available information collected by the quantitative scores or measures. However, the adopted approach resulted from the most consistent possible strategy by considering previous studies and the Middle-Range Theory of Self-Care of Chronic Illness (19, 20). Another limitation is given by the fact that some complex social and self-report variables, especially family support, have been measured with a proxy self-report question that might not be able to represent the complexity of these variables. The adopted approach in measuring social variables with proxy questions was determined by the need to reduce the number of the overall items in the study to avoid overwhelming the participants.

Conclusions

Patients with diabesity are at risk of highly negative health outcomes over time. Self-care is a key treatment in the general diabetes population, and it is even more crucial in people with diabesity. However, people with diabesity reported more inadequate self-care maintenance, self-care management, and self-care self-efficacy than patients with BMI<30Kg/m^2. Clinical and socio-demographic determinants of self-care were found to be different in people with diabesity when compared with people with T2DM and BMI<30Kg/m^2. Social determinants of health, like family income, education, and family support, have a stronger effect on the self-care of people with diabesity than on self-care of people with T2DM and BMI<30Kg/m^2.

Clinically, interventions to improve self-care self-efficacy and self-care behaviors of people with diabesity are strongly needed. Complex interventions accounting for social determinants of health in this population should be recommended. Future research is needed to longitudinally investigate self-care and its clinical and socio-demographic determinants in people with diabesity; to assess the impact of social and psychological variables like income, support from others, distress, depression, stigma, and self-stigma on self-care of people with diabesity; to design and to test complex interventions accounting for the social dimensions of diabesity to improve self-care in this group of patients.

References

1. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Res Clin Pract. 2019;157. Available from: https://pubmed.ncbi.nlm.nih.gov/31518657/

2. Doll HA, Petersen SEK, Stewart-Brown SL. Obesity and physical and emotional well-being: Associations between body mass index, chronic illness, and the physical and mental components of the SF-36 questionnaire. Obes Res. 2000;8(2):160–70. Available from: https://pubmed.ncbi.nlm.nih.gov/10757202/

3. World Health Organization. Global report on diabetes. 2016. 88 p. Available from: https://www.who.int/publications/i/item/9789241565257

4. Engin A. The definition and prevalence of obesity and metabolic syndrome. Adv Exp Med Biol. 2017;960:1–17.

5. Bhupathiraju SN, Hu FB. Epidemiology of obesity and diabetes and their cardiovascular complications. Circ Res. 2016 May 27;118(11):1723–35.

6. Gray N, Picone G, Sloan F, Yashkin A. Relation between BMI and diabetes mellitus and its complications among US older adults. South Med J. 2015 Jan;108(1):29–36.

7. Singh GM, Danaei G, Farzadfar F, Stevens GA, Woodward M, Wormser D, et al. The age-specific quantitative effects of metabolic risk factors on cardiovascular diseases and diabetes: A pooled analysis. PLoS One. 2013 Jul 30;8(7).

8. American Diabetes Association. Standards of medical care in diabetes-2020. Vol. 43, Diabetes Care. American Diabetes Association Inc.; 2020.

9. Chawla R, Jaggi S. Medical Management of Diabesity . J Assoc Physicians India. 2019 Dec;67(12):52–6.

10. Chadt A, Scherneck S, Joost H-G, Al-Hasani H. Molecular links between Obesity and Diabetes: "Diabesity." In MDText.com, Inc.; 2018.

11. Anjum Q. Diabesity - a future pandemic. J Pakistan Med Assoc. 2011 Apr;61(4):321.

12. Sims EAH, Danforth E, Horton ES. Endocrine and metabolic effects of experimental obesity in man. Recent Prog Horm Res. 1973;29:457–96.

13. Kumar N, Puri N, Marotta F, Dhewa T, Calabro S, Puniya M, et al. Diabesity: An epidemic with its causes, prevention and control with special focus on dietary regime. Funct Foods Heal Dis. 2017 Jan 1;7(1):1–16.

14. Farag YMK, Gaballa MR. Diabesity: An overview of a rising epidemic. Nephrol Dial Transplant. 2011 Jan;26(1):28–35.

15. Zimmet PZ. Diabetes and its drivers: The largest epidemic in human history? Clin Diabetes Endocrinol. 2017 Jan 18;3(1).

16. Sobal J, Stunkard AJ. Socioeconomic Status and Obesity: A Review of the Literature. Psychol Bull. 1989 Mar;105(2):260–75.

17. Riegel B, Dunbar SB, Fitzsimons D, Freedland KE, Lee CS, Middleton S, et al. Self-care research: Where are we now? Where are we going? Int J Nurs Stud. 2021 Apr 1;116.

18. Lommi M, Matarese M, Alvaro R, Piredda M, De Marinis MG razi. The evolution of the concept of self-care in the healthcare system: a narrative literature review. Prof Inferm. 2015 Apr 1;68(2):155–66.

19. Riegel B, Jaarsma T, Strömberg A. A middle-range theory of self-care of chronic illness. Adv Nurs Sci. 2012 Jul;35(3):194–204.

20. Riegel B, Jaarsma T, Lee CS, Strömberg A. Integrating symptoms into the middle-range theory of self-care of chronic illness. Adv Nurs Sci. 2019 Jul 1;42(3):206–15.

21. Ausili D, Rossi E, Rebora P, Luciani M, Tonoli L, Ballerini E, et al. Socio-demographic and clinical determinants of self-care in adults with type 2 diabetes: a multicentre observational study. Acta Diabetol. 2018 Jul 1;55(7):691–702.

22. Yu DSF, De Maria M, Barbaranelli C, Vellone E, Matarese M, Ausili D, et al. Cross-cultural

applicability of the Self-Care Self-Efficacy Scale in a multi-national study. J Adv Nurs. 2021 Feb 1;77(2):681–92.

23. Lee YJ, Shin SJ, Wang RH, Lin K Der, Lee YL, Wang YH. Pathways of empowerment perceptions, health literacy, self-efficacy, and self-care behaviors to glycemic control in patients with type 2 diabetes mellitus. Patient Educ Couns. 2016 Feb 1;99(2):287–94.

24. Song MK. Diabetes Mellitus and the Importance of Self-care. J Cardiovasc Nurs. 2010 Apr;25(2):93–8.

25. Ausili D, Bulgheroni M, Ballatore P, Specchia C, Ajdini A, Bezze S, et al. Self-care, quality of life and clinical outcomes of type 2 diabetes patients: an observational cross-sectional study. Acta Diabetol. 2017 Nov 1;54(11):1001–8.

26. Rochfort A, Beirne S, Doran G, Patton P, Gensichen J, Kunnamo I, et al. Does patient self-management education of primary care professionals improve patient outcomes: A systematic review. BMC Fam Pract. 2018 Sep 29;19(1).

27. Powers MA, Bardsley JK, Cypress M, Funnell MM, Harms D, Hess-Fischl A, et al. Diabetes Self-management Education and Support in Adults With Type 2 Diabetes: A Consensus Report of the American Diabetes Association, the Association of Diabetes Care & Education Specialists, the Academy of Nutrition and Dietetics, the American Acad. Diabetes Care. 2020 Jul;43(7):1636–49.

28. Mangou A, Grammatikopoulou MG, Mirkopoulou D, Sailer N, Kotzamanidis C, Tsigga M. Associations between diet quality, health status and diabetic complications in patients with type 2 diabetes and comorbid obesity. Endocrinol y Nutr. 2012 Feb;59(2):109–16.

29. Caruso R, Rebora P, Dellafiore F, Fabrizi D, Riegel B, Ausili D, et al. Clinical and socio-demographic determinants of inadequate self-care in adults with type 1 diabetes mellitus: the leading role of self-care confidence. Acta Diabetol. 2019 Feb 6;56(2):151–61.

30. Caruso R, Rebora P, Luciani M, Di Mauro S, Ausili D. Sex-related differences in self-care behaviors of adults with type 2 diabetes mellitus. Endocrine. 2020 Feb 1;67(2):354–62.

31. Fabrizi D, Rebora P, Luciani M, Di Mauro S, Valsecchi MG, Ausili D. How do self-care maintenance, self-care monitoring, and self-care management affect glycated haemoglobin in adults with type 2 diabetes? A multicentre observational study. Endocrine. 2020 Sep 1;69(3):542–52.

32. Ausili D, Barbaranelli C, Rossi E, Rebora P, Fabrizi D, Coghi C, et al. Development and psychometric testing of a theory-based tool to measure self-care in diabetes patients: The Self-Care of Diabetes Inventory. BMC Endocr Disord. 2017 Oct 16;17(1).

33. Alhaiti AH, Senitan M, Dator WLT, Sankarapandian C, Baghdadi NA, Jones LK, et al. Adherence of Type 2 Diabetic Patients to Self-Care Activity: Tertiary Care Setting in Saudi Arabia. J Diabetes Res. 2020;2020:4817637.

34. Schmidt MI, Duncan BB. Diabesity: An inflammatory metabolic condition. Clin Chem Lab Med. 2003 Sep;41(9):1120–30.

35. Bays HE, González-Campoy JM, Bray GA, Kitabchi AE, Bergman DA, Schorr AB, et al. Pathogenic potential of adipose tissue and metabolic consequences of adipocyte hypertrophy and increased visceral adiposity. Expert Rev Cardiovasc Ther. 2008 Mar;6(3):343–68.

36. Puhl R, Suh Y. Health Consequences of Weight Stigma: Implications for Obesity Prevention and Treatment. Curr Obes Rep. 2015 Jun 1;4(2):182–90.

37. Grundy SM. Multifactorial causation of obesity: Implications for prevention. Am J Clin Nutr. 1998 Mar;67(3 SUPPL.):563s-72s.

38. Dixon JB, Browne JL, Mosely KG, Rice TL, Jones KM, Pouwer F, et al. Severe obesity and diabetes

self-care attitudes, behaviours and burden: Implications for weight management from a matched case-controlled study. Results from Diabetes MILES-Australia. Diabet Med. 2014 Feb;31(2):232–40.

39. American Diabetes Association. STANDARDS OF MEDICAL CARE IN DIABETES-2016. American Diabetes Association Inc., editor. Diabetes Care. 2016 Jan;39.

40. National Institutes of Health. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults - The Evidence Report. Obes Res. 1998 Sep;6(6):51s-209s.

41. Lumley T, Kronmal R, Ma S. Relative Risk Regression in Medical Research: Models, Contrasts, Estimators, and Algorithms. UW Biostat Work Pap Ser [Internet]. 2006 Jul 19 [cited 2021 Jun 10]; Available from: https://biostats.bepress.com/uwbiostat/paper293

42. Bandura A. Self-efficacy: Toward a unifying theory of behavioral change. Psychol Rev. 1977 Mar;84(2):191–215.

43. Phelan SM, Burgess DJ, Yeazel MW, Hellerstedt WL, Griffin JM, van Ryn M. Impact of weight bias and stigma on quality of care and outcomes for patients with obesity. Obes Rev. 2015 Apr;16(4):319–26.

44. Himmelstein MS, Puhl RM. At multiple fronts: Diabetes stigma and weight stigma in adults with type 2 diabetes. Diabet Med. 2021 Jan;38(1):e14387.

45. Cardoso S, Moreira PI. Diabesity and brain disturbances: A metabolic perspective. Mol Aspects Med. 2019 Apr 1;66:71–9.

Table 1 Sample characteristics: socio-demographics, clinical information, and self-care between patients with T2DM and BMI<30Kg/m^2, and patients with diabesity (N=540)

		Patients with BMI<30Kg/m^2 (n = 337)		Patients with diabesity (n= 203)		*P*
		n	%	n	%	
Socio-demographic data						
Sex						
	Male	210	62.3	101	49.8	**0.004**
Income						
	Low	210	62.3	121	59.6	0.574
Working Status						
	Active Workers	77	22.8	61	30	0.063
Education						
	Lower than high school diploma	280	83.1	168	82.8	0.922
	Equal or higher than high school	57	16.9	35	17.2	
Family Support						
	Yes	281	83.4	166	81.8	0.631
Disease- specific self-management education						
	Yes	18	5.3	14	6.9	0.458
Age						
	Years (median; first-third quartile)	70 (62.00–77.50)		67 (59.00–76.00)		**0.043**
Clinical data						
Time from diagnosis						
	Years (median; first-third quartile)	9 (4.00–15.00)		8 (4.00–12.00)		**0.024**
BMI						
	kg/m^2 (median; first-third quartile)	26.22 (23.96–27.78)		33.32 (31.30–36.29)		---
Treatment						
	insulin (yes)	112	33.2	65	32	0.771
HbA1c						
	% (median; first-third quartile)	7.1 (6.70–7.90)		7.4 (6.80–8.20)		**0.036**
Diabetes-related complications						
	Retinopathy	81	24	38	18.7	0.149

	Nephropathy	46	13.6	29	14.3	0.836
	Foot	18	5.3	6	3	0.193
	Neuropathy	27	8	23	11.3	0.198
Comorbidities						
	At least one	282	83.7	187	92.1	**<0.001**
Self-care						
Self-care behaviours						
	Maintenance (median; first-third quartile)	83.33 (75.00–89,58)		77.08 (70.83–83.33)		**<0.001**
	Inadequate maintenance (<76/100)	36	10.7	31	15.3	**0.031**
	Monitoring (median; first-third quartile)	70.58 (55.88–85.29)		67.65 (52.94–85.29)		0.214
	Inadequate monitoring (<78/100)	200	59.3	131	64.5	0.231
	Management (median; first-third quartile)	62.5 (41.15–75.00)		56.25 (37.50–69.44)		**0.025**
	Inadequate management*	156	46.3	117	57.6	**0.011**
Self-care self-efficacy						
	Score (median; first-third quartile)	81.81 (65.91–95.45)		77.27 (63.64–90.91)		**0.025**

Note: Statistically significant values are shown in bold
Legend: * <57/100 points in patients with insulin therapy and <61/100 points in patients without insulin therapy

Table 2. Determinants of self-care (inadequate *vs.* adequate) in patients with T2DM and BMI<30Kg/m^2, and patients with diabesity.

Self-care maintenance (Inadequate maintenance was defined as <76/100 points)

	Patients with BMI<30Kg/m^2				Patients with diabesity			
Independent variables	RR	95%	CI	*P*	RR	95%	CI	*P*
Sex (males vs. females)	1.07	0.68	1.68	0.75	0.47	0.21	1,05	0,07
Age (<65 years vs. ≥ 65 years)	0.51	0.22	1.11	0.08	0.32	0.08	1,20	0,09
Low Income (yes vs. no)	0.63	0.33	1.16	0.14	**3.27**	**1.27**	**8.43**	**0.01**
Time from diagnosis (<10 years vs. ≥ 10 years)	0.99	0.97	1.03	0.94	0.96	0.34	2.71	0.93
Working status (retired vs. active worker)	0.84	0.32	2.20	0.73	0.59	0.20	1.76	0.35
Education (higher vs. lower)	0.41	0.15	1.12	0.08	1.22	0.34	4.40	0.77
Disease-specific self-management education (yes vs. no)	1.84	0.65	5.25	0.25	0.59	0.04	8.90	0.70
Family support (yes vs. no)	0.90	0.41	1.97	0.80	0.72	0.25	2.08	0.55
Comorbidity (at least one vs. none)	1.16	0.96	1.40	0.12	1.02	0.76	1.36	0.90
Retinopathy (yes vs. no)	0.99	0.53	1.84	0.96	1.60	0.60	4.26	0.35
Nephropathy (yes vs. no)	1.16	0.61	2.21	0.66	0.99	0.38	2.59	0.99
Diabetic foot (yes vs. no)	2.41	0.96	6.05	0.06	2.50	0.47	13.15	0.28
Neuropathy (yes vs. no)	0.87	0.36	2.14	0.76	**4.16**	**1.14**	**15.23**	**0.03**
Task-specific self-care self-efficacy (score)	0.99	0.97	1.03	0.78	1.01	0.98	1.03	0.68
Persistence self-care self-efficacy (score)	0.99	0.97	1.03	0.83	0.99	0.95	1.02	0.42
Model Fit								
AIC	221.31				109.98			
BIC	290.79				175.53			
Omnibus	45.87			<0.001	85.08			<0.001

Self-care Monitoring (Inadequate maintenance was defined as <78/100 points)

	Patients with BMI<30Kg/m^2				Patients with diabesity			
Independent variables	RR	95%	CI	*P*	RR	95%	CI	*P*

Sex (males vs. females)	**0.73**	**0.53**	**0.99**	**0.05**	**0.61**	**0.40**	**0.94**	**0.03**
Age (<65 years vs. >= 65 years)	0.99	0.63	1.56	0.98	0.84	0.46	1.55	0.58
Low Income (yes vs. no)	1.02	0.72	1.43	0.92	1.41	0.90	2.21	0.13
Time from diagnosis (<10 years vs. >= 10 years)	**0.67**	**0.48**	**0.93**	**0.02**	1.09	0.66	1.79	0.75
Working status (retired vs. active worker)	1.21	0.74	1.96	0.45	0.90	0.49	1.68	0.75
Education (higher vs. lower)	0.79	0.52	1.20	0.27	**0.45**	**0.25**	**0.79**	**0.01**
Disease-specific self-management education (yes vs. no)	**3.19**	**1.32**	**7.75**	**0.01**	0.86	0.35	2.09	0.73
Family support (yes vs. no)	1.01	0.67	1.51	0.98	**0.52**	**0.28**	**0.98**	**0.04**
Treatment (insulin vs. other)	1.18	0.83	1.69	0.36	**2.09**	**1.23**	**3.55**	**0.01**
Comorbidity (at least one vs. none)	1.02	0.91	1.14	0.78	0.92	0.79	1.07	0.30
Retinopathy (yes vs. no)	0.71	0.49	1.02	0.07	0.61	0.34	1.08	0.09
Nephropathy (yes vs. no)	1.02	0.64	1.61	0.94	0.99	0.52	1.89	0.97
Diabetic foot (yes vs. no)	1.41	0.71	2.80	0.32	0.43	0.14	1.33	0.14
Neuropathy (yes vs. no)	**2.25**	**1.17**	**4.32**	**0.02**	0.63	0.31	1.27	0.20
Task-specific self-care self-efficacy (score)	**0.98**	**0.96**	**0.99**	**<0.01**	**0.97**	**0.95**	**0.99**	**<0.01**
Persistence self-care self-efficacy (score)	0.99	0.99	1.02	0.63	1.00	0.99	1.02	0.71
Model Fit								
AIC	399.79				230.67			
BIC	464.73				287.00			
Omnibus	85.39			<0.001	67.53		<0.001	

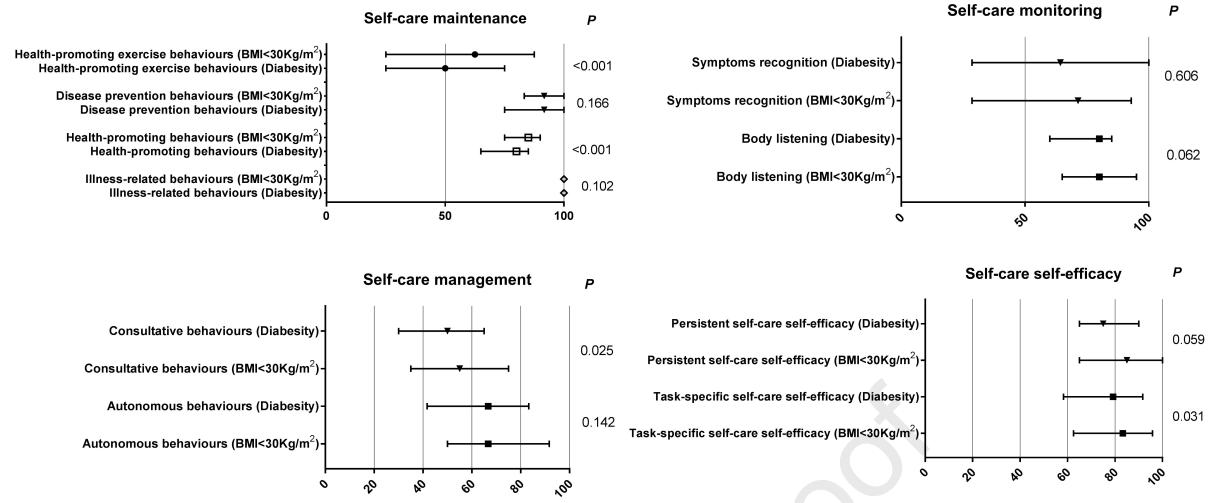
Self-care Management (Inadequate maintenance was defined as <61/100 points)

	Patients with BMI<30Kg/m^2				Patients with diabesity			
Independent variables	RR	95%	CI	*P*	RR	95%	CI	*P*
Sex (males vs. females)	0.81	0.60	1.10	0.17	0.96	0.64	1.45	0.86
Age (<65 years vs. >= 65 years)	1.03	0.68	1.55	0.90	1.10	0.63	1.92	0.74
Low Income (yes vs. no)	1.28	0.92	1.78	0.15	1.14	0.75	1.74	0.54
Time from diagnosis (<10 years vs. >= 10 years)	1.04	0.76	1.43	0.82	1.13	0.71	1.82	0.60

Working status (retired vs. active worker)	0.93	0.59	1.46	0.75	0.69	0.40	1.22	0.20
Education (higher vs. lower)	1.17	0.78	1.75	0.45	0.94	0.54	1.63	0.82
Disease-specific self-management education (yes vs. no)	0.60	0.31	1.17	0.13	0.48	0.21	1.12	0.09
Family support (yes vs. no)	0.82	0.56	1.21	0.31	0.79	0.46	1.37	0.40
Treatment (insulin vs. other)	0.96	0.68	1.35	0.82	1.41	0.86	2.31	0.18
Comorbidity (at least one vs. none)	1.02	0.91	1.13	0.78	**1.18**	**1.01**	**1.36**	**0.03**
Retinopathy (yes vs. no)	0.85	0.59	1.21	0.37	0.61	0.35	1.06	0.08
Nephropathy (yes vs. no)	1.06	0.68	1.66	0.79	1.04	0.55	1.95	0.91
Diabetic foot (yes vs. no)	0.65	0.33	1.26	0.20	0.28	0.08	1.02	0.05
Neuropathy (yes vs. no)	1.08	0.63	1.86	0.79	1.27	0.66	2.44	0.47
Task-specific self-care self-efficacy (score)	**0.97**	**0.96**	**0.99**	**<0.01**	**0.98**	**0.96**	**0.99**	**<0.01**
Persistence self-care self-efficacy (score)	0.99	0.99	1.02	0.63	0.99	0.98	1.01	0.42
Model Fit								
AIC	437.14				254.69			
BIC	502.08				311.01			
Omnibus	60.80			<0.001	54.59			<0.001

Note: Statistically significant values are shown in bold

Figure 1. Specific dimensions of self-care maintenance, self-care monitoring, self-care management, and self-care self-efficacy



Note: The graphs show median and interquartile range for the 4 quadrants regarding self-care maintenance, self-care monitoring, self-care management, and self-care confidence. The comparisons were performed using the Mann–Whitney U test.

Highlights

- Patients with diabesity reported more inadequate self-care maintenance and management than patients with T2DM and BMI <30 kg/m^2
- In patients with diabesity, limited self-care maintenance has been associated with low income and diabetic neuropathy.
- In patients with diabesity, limited self-care monitoring has been associated with higher educational background, insulin as the main treatment, and the availability of a family caregiver.
- These results represent a pivotal first description of self-care behaviours and their determinants in people with diabesity compared to those of people with T2DM and BMI < 30 kg/m^2