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ORIGINAL ARTICLE

Clinical and socio-demographic determinants of inadequate self-care in adults with type 1 diabetes mellitus: the leading role of self-care confidence

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Abstract

Aims To describe self-care maintenance, monitoring, and management behaviors in adults with type 1 diabetes (T1DM), and to identify clinical and socio-demographic determinants of inadequate self-care.

Methods A cross-sectional study was conducted in two diabetes outpatient clinics in Italy. Clinical and socio-demographic characteristics were collected from the medical records of 181 consecutively enrolled T1DM patients. The Self-Care of Diabetes Inventory was used to measure self-care maintenance, self-care monitoring, self-care management and self-care confidence. A standardized 0–100 score was used for each self-care dimension. A score < 70 was considered inadequate self-care. Three multiple logistic regression models were run to find determinants of inadequate self-care maintenance, monitoring, and management.

Results The majority of patients had adequate self-care maintenance (74%; $n = 134$), self-care monitoring (68.5%; $n = 124$) and self-care confidence (87.3%; $n = 158$), while self-care management was adequate for only a minority (34.8%; $n = 63$). The odds of inadequate self-care maintenance increased by 4.5 times when self-care confidence was inadequate (OR adjusted 4.589; 95% CI 1.611–13.071; $p = 0.004$). The odds of inadequate self-care monitoring increased four times when patients had inadequate self-care confidence (OR adjusted 4.116; 95% CI 1.457–11.628; $p = 0.008$). Inadequate self-care confidence increased the odds of performing inadequate self-care management more than five times (OR adjusted 5.313; 95% CI 1.143–24.686; $p = 0.033$).

Conclusions Self-care management is commonly inadequate in adults with T1DM. Self-care confidence is the most important determinant of self-care behaviors in this population. Educational interventions are recommended to improve self-care confidence in adults with T1DM.

Keywords Self-care · Self-management · Self-efficacy · Diabetes mellitus · Type 1 diabetes mellitus · Risk factors · Health education

Introduction

Self-care has been defined as a dynamic, naturalistic and complex "process of maintaining health through health-promoting practices and managing illness" [1]. Self-care includes three dimensions: self-care maintenance, self-care monitoring, and self-care management. Self-care maintenance refers to those behaviours that patients use to preserve their health status, improve well-being or maintaining both physical and emotional stabilities (e.g. attending follow-up visits or avoiding alcohol and tobacco). Self-care monitoring refers at the attention given to monitoring and early recognition of signs and symptoms

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(e.g. hypo-/hyperglycaemia early self-detection). Self-care management includes behaviours used to address signs and symptoms and to solve disease-related problems when they occur (e.g. insulin dose adjustment) [1]. Others have found that self-care behaviours are influenced by self-care confidence and self-efficacy, described as the degree of confidence that a person has in her/his ability to perform adequate self-care [2, 3].

Self-care of diabetes includes eating in a healthy way, being physically active, monitoring blood glucose levels, taking medicines, solving problems when they happen, reducing risks of illness, and healthy coping [4]. Self-care is fundamental for type 1 diabetes mellitus (T1DM) patients to maintain health and quality of life over time [5]. Self-care improves quality of life and glycaemic control [6]. It is cost-effective for decreasing complications and optimizing health outcomes [6]. Acknowledging the early diagnosis of the disease and the long-life need to perform adequate self-care to avoid serious diabetes-related complications, the study of self-care behaviours is key to improving T1DM healthcare services.

Recently, a description of the self-care process in the Type 2 Diabetes Mellitus (T2DM) population was provided with the identification of its clinical and socio-demographic determinants [6]. It was found that both clinical and socio-demographic patient characteristics affect self-care behaviours in people with T2DM, providing relevant information needed to identify those at risk of inadequate self-care. However, the self-care process in T1DM remains undescribed and determinants of self-care maintenance, monitoring, and management in this population are unknown.

Consistent with these gaps, the aims of this study were to: (a) describe self-care maintenance, self-care monitoring, self-care management and self-care confidence in patients with T1DM; (b) identify clinical and socio-demographic determinants of inadequate self-care maintenance, self-care monitoring and self-care management in adults with T1DM. Having this knowledge, clinicians could identify patients at risk of inadequate self-care and tailor effective interventions.

Methods

A multicentre cross-sectional study was conducted involving patients with T1DM from two outpatient diabetes clinics in the North of Italy. The study was approved by the Institutional Review Boards of the involved centres. The study protocol was consistent with ethical standards, the International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use and Good Clinical Practice. A written informed consent was obtained from all the enrolled patients.

Sample

To minimize selection bias, we enrolled a consecutive sample of 181 adults with T1DM for the study. Inclusion criteria were: confirmed diagnosis of T1DM consistent with the guidelines criteria [7], age of at least 18 years, and active treatment with insulin. Exclusion criteria were: time from T1DM diagnosis < 1 year; cognitive impairment; inability to read Italian sufficiently to complete the questionnaire; and first visit to a diabetes centre.

Measurements

Clinical and socio-demographic data were collected from medical records. These variables were identified based on previous studies aimed at investigating self-care determinants in chronic diseases [8–12]. Accordingly, the following variables were included: sex, age (clustered in groups), educational level (low = elementary or secondary vs high = college or academic), occupation [clustered as active workers (full or part-time), retired and unemployed], family support (presence of a caregiver), time since diagnosis (indicator of experience in self-care), comorbid conditions (at least one vs none), and specific diabetes education sessions in the last year.

The Self-Care of Diabetes Inventory (SCODI) was used to measure self-care maintenance, self-care monitoring, self-care management and self-care confidence [1]. This instrument was chosen because it is theoretically grounded and psychometrically strong, having been validated with external clinical indicators [11, 13]. The SCODI was developed based on the Middle Range Theory of Self-care of Chronic Illness [1]. In a prior sample, scale dimensionality was shown to be consistent with the theoretical framework. In reliability testing, the SCODI was shown to be internally consistent. The full inventory has 40 items that use a five point Likert scale. Self-care maintenance encompasses four dimensions: health-promoting exercise behaviours, disease prevention behaviours, health-promoting behaviours, and illness-related behaviours. Self-care monitoring has two dimensions: body listening and symptom recognition. Self-care management includes autonomous self-care management behaviours and consultative self-care management behaviours. Finally, self-care confidence encompasses task-specific self-care confidence and persistence self-care confidence. A standardized 0–100 score is used for self-care maintenance, monitoring, management, confidence and their specific dimensions, where higher scores mean better self-care [8]. Scores higher than or equal to 70 points indicate adequate self-care [6, 8].

Statistical analysis

Data were preliminarily checked for possible missing information, erroneous entries or outliers though the frequency distribution analysis. Each quantitative variable was first assessed for normality using skewness and kurtosis evaluation, followed by the Kolmogorov–Smirnov test. Categorical variables have been described by numbers and percentages, and continuous variables—such as self-care maintenance, monitoring, management and confidence—were expressed as mean and standard deviation for normally distributed data. Non-normally distributed variables were expressed as median and interquartile range. A comparison of self-care maintenance, monitoring, management and confidence was performed stratifying the sample by clinical and socio-demographic variables, where educational level and time from diagnosis were, respectively, categorised as: low education = primary or secondary vs high = higher or academic education; less than 10 years from diagnosis vs equal to or higher than 10 years. According to the metrics and the nature of each variable (non-normally distributed), the comparison was performed using χ^2 test, Fisher exact test, Mann–Whitney *U* test or Kruskal–Wallis *H* test. This approach was also used to compare SCODI self-care maintenance, monitoring, management and confidence dimensions.

Clinical and socio-demographic determinants of inadequate self-care were assessed by logistic regression (LR) models for the multivariable analysis. Each dependent variable (i.e. self-care maintenance, monitoring, management) was dichotomized for inadequate and adequate self-care (less than 70 points vs equal or higher than 70). Three LR models were run considering (a) the univariate analysis between the sample sub-groups, (b) the potential role of each independent variable based on the literature [6, 10], (c) precautions to avoid model over-fit, such as the use of dummy explanatory variable for educational level and time from diagnosis, and the checking of the adequacy with linear gradient for each included continuous variables. LR models were controlled for possible collinearity among the independent variables [14]. Statistical significance was evaluated using both Wald's χ^2 and likelihood ratio test. The goodness-of-fit measures for the LR models were omnibus test (χ^2), the Hosmer–Lemeshow test and the analysis of pseudo-R^2 (i.e. Cox and Snell). The independent variables of each LR model were entered simultaneously into the equation. All the tests had a two-tailed null hypothesis with a significance level of 5%. Statistics were run using Statistical Package for the Social Sciences (SPSS) version 22 and R Statistical Package.

Results

The majority of patients ($n = 181$ adults with T1DM) were females (61.3%; $n = 111$), aged between 40 and 50 years (51.9%; $n = 94$), with higher level of education (82.6%; $n = 147$). They were mainly active workers (82.3%; $n = 149$), with a family support (73.5%; $n = 133$), equal or more than 10 years from T1DM diagnosis (68.3%; $n = 123$). Table 1 shows the sample characteristics. Self-care behaviours and self-care confidence are represented in Fig. 1.

Self-care maintenance, monitoring, management and confidence scores are shown in Table 2, highlighting the stratification by the socio-demographic and clinical characteristics. The majority of patients had adequate self-care maintenance (74%; $n = 134$), monitoring (68.5%; $n = 124$) and confidence (87.3%; $n = 158$), while management was adequate only in a minority (34.8%; $n = 63$). Self-care maintenance, monitoring, management and confidence were not

Table 1 Sample characteristics ($n = 181$)

	n	%
Socio-demographic characteristics		
Diabetes centre		
A	58	32
B	123	68
Sex		
Male	70	38.7
Female	111	61.3
Age		
Years (mean; SD)	40.28	13.12
Occupation		
Active worker	149	82.3
Retired	13	7.2
Unemployed	19	10.5
Education		
Elementary	3	1.7
Primary diploma	31	17.1
High school diploma	94	51.9
Academic education	53	29.3
Clinical characteristics		
Years from diagnosis		
Years (mean; SD)	18.05	12.88
Comorbidities		
Any	93	51.4
No	88	48.6
Anthropometry		
Body mass index (mean; SD)	23.73	3.68
Glycaemic control		
Adequate (HbA1c ≤ 7.5%)	123	68
Inadequate (HbA1c > 7.5%)	58	32

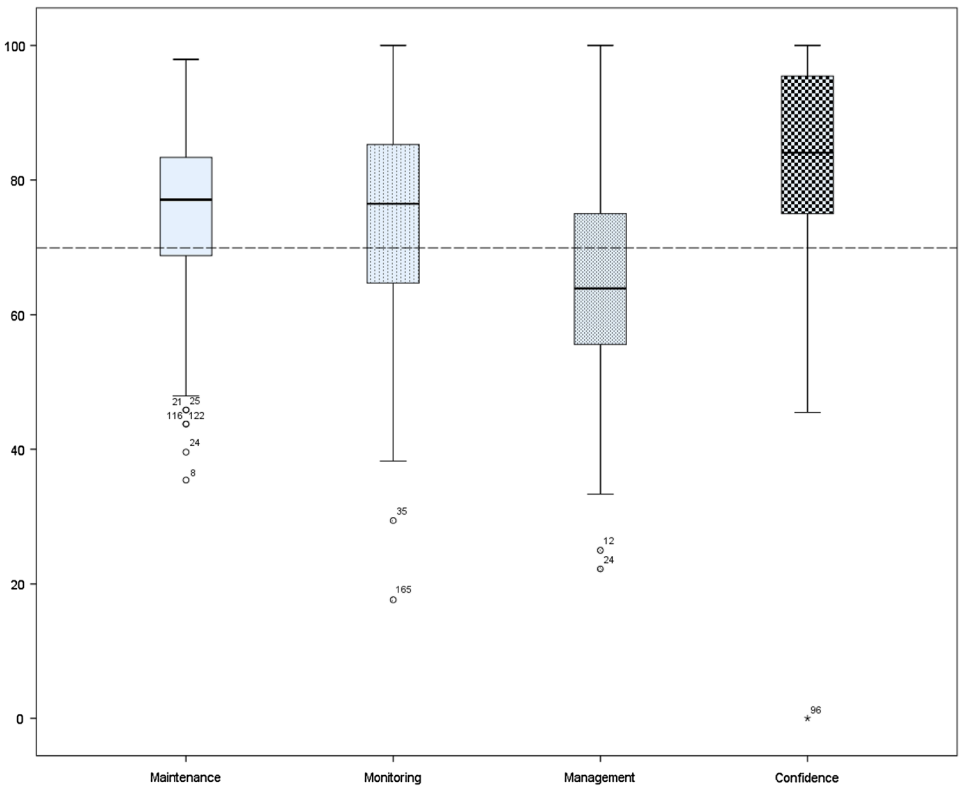

Fig. 1 Box-plot representing self-care maintenance, monitoring, management and confidence distributions

significantly different when the scores were stratified by socio-demographic and clinical characteristic (all $p > 0.05$), with the exception of self-care monitoring, which was higher in patients aged over 60 years ($p = 0.034$).

The dimensions of self-care maintenance, monitoring, management and confidence are compared by clinical and socio-demographic characteristics in Table 3. Within self-care maintenance, health-promoting exercise behaviours were significantly different based on family support and diabetes education sessions. For family support, lower self-care maintenance was observed in patients without support (median 50; IQR 31.25–87.50; $p = 0.032$). For specific diabetes education sessions, those patients who did not attend a diabetes course had higher self-care maintenance values (median 75; IQR 50.00–100.00; $p < 0.001$) compared to those who received education. Also, patients who had not attended a diabetes education session had significantly higher values of disease prevention behaviours (median 83.33; IQR 66.66–100; $p = 0.032$) and health-promoting behaviours (median 80.00; IQR 70.00–85.00; $p = 0.000$). Health-promoting behaviours were significantly higher for patients without comorbid conditions (median 80; IQR 70.00–85.00; $p = 0.000$).

Within self-care monitoring, body listening was significantly higher in active workers (median 70.00; IQR 55.00–80.00; $p = 0.019$), patients without comorbidities (median 70; IQR 60.00–85.00; $p = 0.002$) and those who did not attend diabetes education sessions (median 70; IQR 60.00–85.00; $p = 0.001$). Symptom recognition was higher in patients without family support (median 92.85; IQR 78.57–100; $p = 0.036$), and those who did not attend diabetes education sessions (median 96.42; IQR 80.35–100.00; $p = 0.001$).

In self-care management, patients who did not attend diabetes education sessions reported higher autonomous self-care behaviours (median 100; IQR 91.00–100.00; $p = 0.000$), and consultative self-care behaviours (median 45.00; IQR 35.00–60.00; $p = 0.035$). Consultative self-care behaviours were worse in patients with more than 10 years since diagnosis (median 40.00; IQR 25.00–55.00; $p = 0.000$).

Within the self-care confidence dimension, males had higher values in both task-specific (median 95.33; IQR 83.33–100.00; $p = 0.038$) and persistence self-care confidence (median 85; IQR 75.00–100.00; $p = 0.030$) when compared with females. People who were working reported higher specific self-care confidence (median 91.66; IQR 83.33–100.00, $p = 0.040$) than those who were retired or unemployed. Patients with more than 10 years since the diagnosis had higher task-specific self-care confidence (median 95.83; IQR 80.20–100.00, $p = 0.036$), and persistence self-care confidence (median 90; IQR 75.00–100.00, $p = 0.035$), as well as patients without comorbid

Table 2 Self-care maintenance, self-care monitoring, self-care management, self-care confidence scores by socio-demographic and clinical characteristic ($n = 181$)

	All		Self-care maintenance			Self-care monitoring			Self-care management			Self-care confidence		
	n	%	Median	IQR	*p*	Median	IQR	*p*	Median	IQR	*p*	Median	IQR	*p*
Sex														
Female	111	61.3	77.08	(68.75–83.33)	0.204	76.47	(64.71–82.35)	0.644	63.89	(55.56–75.00)	0.465	84.09	(75.00–94.32)	0.092
Male	70	38.7	77.08	(70.83–86.46)		76.47	(63.24–86.76)		63.89	(52.08–75.00)		88.64	(79.55–95.45)	
Age (years)														
< 40	72	39.8	77.08	(63.02–83.33)	0.08	73.53	(61.76–82.35)	**0.034**	63.89	(52.78–75.00)	0.428	84.09	(75.00–95.45)	0.549
40 ≤ age < 60	94	51.9	77.08	(70.83–83.33)		76.47	(70.59–85.29)		63.89	(55.56–72.22)		84.09	(77.27–93.18)	
≥ 60	15	8.3	87.50	(72.92–91.67)		88.24	(69.85–97.06)		69.44	(58.33–77.78)		93.18	(77.24–95.45)	
Educational level														
Lower	31	17.4	77.08	(64.06–83.85)	0.581	72.06	(55.88–86.03)	0.237	69.44	(44.44–77.78)	0.301	81.81	(75.00–93.18)	0.27
Higher	147	82.6	77.08	(68.75–83.33)		76.47	(64.71–85.30)		63.89	(55.56–72.22)		86.36	(75.00–95.45)	
Occupation														
Active workers	149	82.3	77.08	(68.75–83.33)	0.98	76.47	(62.50–82.35)	0.139	63.89	(52.78–75.00)	0.164	84.09	(75.00–93.18)	0.309
Retired	13	7.2	87.5	(75.52–89.58)		85.29	(68.38–93.38)		66.67	(55.56–76.39)		90.91	(73.86–96.59)	
Unemployed	19	10.5	77.08	(59.38–88.54)		79.41	(73.53–85.29)		72.22	(63.89–77.78)		90.91	(81.82–100.00)	
Family support														
Yes	133	73.5	77.08	(68.75–83.33)	0.731	76.47	(64.71–85.29)	0.491	63.89	(55.56–75.00)	0.587	87.5	(75.00–95.45)	0.54
No	48	26.5	75	(67.19–83.33)		76.47	(61.76–82.35)		63.89	(52.78–75.00)		84.09	(77.27–93.18)	
Time from diagnosis														
< 10 years	57	31.7	77.08	(67.71–83.33)	0.923	73.53	(61.76–81.61)	0.063	63.89	(52.78–75.00)	0.721	84.09	(75.00–93.18)	0.432
≥ 10 years	123	68.3	75	(68.75–84.38)		76.47	(64.71–86.03)		66.67	(55.56–75.00)		86.36	(77.27–95.45)	
Comorbidities														
Any	93	51.4	77.08	(68.75–83.33)	0.972	76.47	(64.71–85.29)	0.284	63.89	(55.56–72.22)	0.86	84.09	(72.72–94.89)	0.36
No	88	48.6	77.08	(70.83–83.33)		76.47	(64.71–82.35)		65.28	(52.78–77.78)		86.36	(77.27–95.45)	
Diabetes self-management education														
Yes	65	35.9	79.17	(71.88–86.46)	0.114	76.47	(64.71–82.35)	0.749	63.89	(55.56–72.22)	0.662	84.09	(75.00–93.18)	0.413
No	116	64.1	75	(66.67–83.33)		76.47	(63.97–88.23)		65.28	(52.78–75.00)		86.36	(75.00–97.73)	

Significant differences are shown in bold

Table 3 Dimensions of self-care maintenance, monitoring, management and confidence by socio-demographic and clinical characteristics ($n = 181$)

		All		Health promoting exercise behaviors			Disease prevention behaviors			Health promoting behaviors		
		n	%	Median	IQR	*p*	Median	IQR	*p*	Median	IQR	*p*
Gender	Female	111	61.3	62.5	(37.5–87.5)	0.581	83.33	(66.67–91.67)	0.806	75	(65.00–85.00)	0.502
	Male	70	38.7	56.25	(25.00–87.5)		83.33	(58.33–100)		75	(65.00–85.00)	
Age (years)	< 40	72	39.8	62.5	(28.12–87.50)	0.641	83.33	(58.33–100.00)	0.263	80	(66.25–88.75)	0.238
	40 ≤ age < 60	94	51.9	62.5	(37.50–87.50)		83.33	(6.66–91.67)		75	(65.00–100.00)	
	≥ 60	15	8.3	75	(50.00–100.00)		75	(50.00–83.33)		70	(70.00–75.00)	
Educational level	Lower	31	17.4	50	(25.00–75.00)	0.109	83.33	(56.25–91.66)	0.855	75	(70.00–85.00)	0.915
	Higher	147	82.6	62.5	(37.5–87.5)		83.33	(66.66–100.00)		75	(65.00–85.00)	
Occupation	Active workers	149	82.3	62.5	(37.50–87.50)	0.878	83.33	(66.66–91.66)	0.325	75	(67.50–85)	0.16
	Retired	13	7.2	65.5	(37.50–93.75)		75	(58.33–87.50)		70	(65.50–77.50)	
	Unemployed	19	10.5	50	(37.50–87.50)		83.33	(75–100)		75	(65–80)	
Family support	Yes	133	73.5	75	(50–100)	0.032	91.66	(66.66–100)	0.233	75	(70–85)	0.422
	No	48	26.5	50	(31.25–87.50)		83.33	(66.66–91.66)		75	(65–85)	
Time from diagnosis	< 10 years	57	31.7	62.5	(25–87.50)	0.929	91.66	(66.66–100)	0.146	75	(70–85)	0.224
	≥ 10 years	123	68.3	62.5	(37.5–87.5)		83.33	(58.33–91.66)		75	(65–85)	
Comorbidities	Any	93	51.4	62.5	(31.25–87.50)	0.08	83.33	(66.66–91.66)	0.332	70	(65–80)	0.000
	No	88	48.6	68.75	(37.50–100)		83.33	(58.33–100)		80	(70–85)	
Diabetes self-management education	Yes	65	35.9	50	(25–68.75)	0.000	75	(58.33–91.66)	0.032	70	(55–77.55)	0.000
	No	116	64.1	75	(50–100)		83.33	(66.66–100)		80	(70–85)	

		Illness-related behaviors			Body listening			Symptom recognition			Autonomous self-care management behaviors		
		Median	IQR	*p*	Median	IQR	*p*	Median	IQR	*p*	Median	IQR	*p*
Gender	Female	100	(87.50–100)	0.513	67.5	(55.00–800)	0.296	92.85	(78.57–100)	0.912	100	(83.33–100)	0.481
	Male	100	(96.87–100)		65	(50.00–80.00)		92.86	(78.57–100)		91.67	(83.33–100)	
Age (years)	< 40	100	(87.50–100.00)	0.824	70	(55.00–85.00)	0.022	92.85	(80.36–100.00)	0.25	100	(83.33–100.00)	0.278
	40 ≤ age < 60	100	(87.50–100.00)		65	(55.00–77.50)		92.85	(73.43–100.00)		91.67	(83.33–100.00)	
	≥ 60	100	(75.00–100.00)		60	(45.00–70.00)		92.85	(78.57–100.00)		91.67	(75.00–100.00)	
Educational level	Lower	100	(87.50–100.00)	0.696	70	(60.00–80.00)	0.295	92.85	(78.57–100.00)	0.574	100	(75–100)	0.808
	Higher	100	(87.50–100.00)		65	(55.00–80.00)		92.85	(78.57–100)		91.66	(83.33–100)	
Occupation	Active workers	100	(87.50–100)	0.626	70	(55–80)	0.019	92.85	(78.57–100)	0.332	100	(83.33–100)	0.735
	Retired	100	(75–100)		60	(45–75)		85.71	(64.28–100)		91.66	(75–100)	
	Unemployed	100	(100–100)		60	(50–65)		85.71	(78.57–92.85)		91.66	(83.33–100)	
Family support	Yes	100	(87.50–100)	0.626	70	(58.75–80)	0.841	85.71	(71.42–100)	0.036	91.66	(83.33–100)	0.814
	No	100	(87.50–100)		65	(55–80)		92.85	(78.57–100)		91.66	(83.33–100)	

Table 3 (continued)

		Illness-related behaviors			Body listening			Symptom recognition			Autonomous self-care management behaviors		
		Median	IQR	*p*	Median	IQR	*p*	Median	IQR	*p*	Median	IQR	*p*
Time from diagnosis	< 10 years	100	(100–100)	0.469	70	(57.50–80)	0.083	92.85	(85.71–100)	0.018	100	(91.67–100)	0.003
	≥ 10 years	100	(87.5–100)		65	(50–80)		92.85	(71.42–100)		91.66	(75–100)	
Comorbidities	Any	100	(87.5–100)	0.217	65	(50–75)	0.002	92.85	(78.57–100)	0.251	91.66	(75–100)	0.264
	No	100	(100–100)		70	(60–85)		92.85	(78.57–100)		100	(83.33–100)	
Diabetes self-management education	Yes	100	(87.5–100)	0.06	60	(50–75)	0.001	85.71	(71.42–100)	0.001	83.33	(75–100)	0.000
	No	100	(100–100)		70	(60–85)		96.42	(80.35–100)		100	(91–100)	

		Consultative self-care management behaviors			Specific self-care confidence			Persistence self-care confidence		
		Median	IQR	*p*	Median	IQR	*p*	Median	IQR	*p*
Gender	Female	45	(30.00–56.25)	0.306	87.5	(75.00–95.83)	0.038	80	(75.00–90.00)	0.03
	Male	45	(30.00–60.00)		95.83	(83.33–100.00)		85	(75.00–100.00)	
Age (years)	< 40	45	(30.00–60.00)	0.052	95.83	(83.33–100.00)	0.028	90	(75.00–100)	0.001
	40 ≤ age < 60	45	(35.00–60.00)		87.5	(75.00–95.83)		80	(70.00–90.00)	
	≥ 60	30	(5.00–50.00)		83.33	(70.00–90.00)		80	(70.00–85.00)	
Educational level	Lower	50	(30–60)	0.328	86.58	(83.33–100)	0.442	90	(75–100)	0.143
	Higher	45.5	(30–60)		87.5	(79.16–95.83)		85	(70–95)	
Occupation	Active workers	45	(35–60)	0.139	91.66	(83.33–100)	0.04	85	(70–95)	0.173
	Retired	45	(15–57.50)		83.33	(77.08–91.66)		80	(72.50–85)	
	Unemployed	35	(15–55)		87.5	(75–91.66)		80	(65–80)	
Family support	Yes	45	(35–55)	0.874	91.66	(71.85–100)	0.686	80	(70–90)	0.617
	No	45	(30–60)		87.5	(83.33–95.83)		85	(70–95)	
Time from diagnosis	< 10 years	55	(42.50–60)	0.000	95.83	(80.20–100)	0.036	90	(75–100)	0.035
	≥ 10 years	40	(25–55)		87.5	(79.16–95.83)		85	(70–90)	
Comorbidities	Any	45.5	(30–53.75)	0.027	87.5	(75–95.83)	0.000	80	(60–85)	0.000
	No	45	(31.25–65)		95.83	(83.33–100)		95	(75–100)	
Diabetes self-management education	Yes	40	(25–55)	0.035	79.16	(66.66–87.50)	0.000	65	(55–70)	0.000
	No	45	(35–60)		95.83	(87.5–100)		90	(85–100)	

conditions (task-specific self-care confidence: median 85.83; IQR 83.33–100.00; $p < 0.0001$; persistence self-care confidence: median 95.00; IQR 75.00–100; $p < 0.0001$), and who did not attended diabetes education sessions (task-specific self-care confidence: median 95.83; IQR 87.50–100.00; $p < 0.0001$; persistence self-care confidence: median 90.00; IQR 75.00–100; $p < 0.0001$).

The odds of inadequate self-care maintenance increased by roughly 4.5 times when patients had inadequate self-care confidence (OR adjusted 4.589; 95% CI 1.611–13.071; $p = 0.004$). The odds of inadequate self-care monitoring increased roughly four times when patients had inadequate self-care confidence (OR adjusted 4.116; 95% CI 1.457–11.628; $p = 0.008$). Finally, inadequate self-care confidence increased the odds of performing inadequate self-care management by more than five times (OR adjusted 5.313; 95% CI 1.143–24.686; $p = 0.033$) (Table 4).

Discussion

This study provides the first description of self-care behaviours in adults with T1DM. Clinical and socio-demographic determinants of self-care maintenance, monitoring and management were identified in T1DM, showing the important role of self-care confidence. This is relevant because investigators have paid less attention to the uniqueness of self-care in adults than children with T1DM [7].

We found that self-care confidence is the leading determinant of self-care in adults with T1DM; inadequate self-care confidence strongly predicted inadequate self-care maintenance, monitoring and management. This finding supports both the theory [1] and previous results [6] showing that self-care confidence is a predictor of self-care behaviours in patients with T2DM. However, in T2DM, also a number of clinical as socio-demographic variables—age, gender, income or time from the diagnosis—were found to be determinants of self-care behaviours. This is relevant because some of these variables represent unmodifiable risk factors of inadequate self-care in T2DM population. Differently, in T1DM, we found that self-care confidence is the only significant determinant of self-care behaviours. We argue this could be due to the lower variability of clinical and socio-demographic characteristics of the T1DM population when compared with the T2DM population [15]. This finding is meaningful because self-care confidence is a factor that can be modified through information, education and empowerment of patients [16, 17]. Thus, assessing and improving patients' self-care confidence could be the most important strategy to improve self-care behaviours of adults with T1DM.

Looking at the description of the self-care process, T1DM patients had inadequate self-care management, especially in the area of consultative self-care management behaviours. This is not a novelty in the field of diabetes because previous studies in T2DM identified self-care management as the poorest dimension of self-care [8, 21–24]. Self-care management requires knowledge, practical skills, problem solving and decision-making skills to appropriately manage high or low blood glucose and to treat symptoms if they occur. Thus, we propose that adults with T1DM could benefit from intermittent diabetes educational sessions to improve their self-care management behaviours. Unfortunately, based on our results, only one third of the patients received diabetes education in the last year.

Self-care maintenance, self-care monitoring, and self-care management were more homogenous in T1DM patients than in those with T2DM [6, 10]. In fact, when we described self-care behaviours by clinical and socio-demographic characteristics, we found few significant differences. Patients aged over 60 years were more able to recognize symptoms compared with those younger than 40 years. Those younger 40 years were better at body listening, such as monitoring of blood glucose, blood pressure and body weight compared with patients over age 60. This result is coherent with previous results showing that experience influence self-care monitoring [11, 18]. Thus, we argue that experienced T1DM patients may be less likely to perform self-monitoring because are more able to recognize problems when they occur. However, we recommend that healthcare providers focus on both of these aspects during education because body listening should also be performed by experienced patients [19]. Finally, we found that patients who did not receive specific diabetes education performed better in several self-care dimensions compared to those who received specific diabetes education in the last year (see Table 3). This is reasonable, acknowledging the gap in current educational strategies for T1DM patients, where structured education program seems to be provided only for the most problematic patients rather than as usual care for all T1DM patients [20].

Strengths and limitations

This study was limited by sampling from one region of northern Italy (Lombardy). Thus, generalization to another region or Country requires caution. Second, data were collected using a cross-sectional approach, so we do not have information about the direction of the associations identified. Data about the episodes of hypoglycaemia in the last year could have been useful to understand self-care behaviours in this population because the frequency of these episodes could influence how patients perceive the need to perform adequate self-care. Future research should consider collecting data on the number of hypoglycaemia episodes in the prior year. Finally, other psychological variables such as

Table 4 Logistic regression models to identify socio-demographic and clinical determinants of self-care dimensions ($n=181$)

	Self-care maintenance (inadequate vs adequate)				Self-care monitoring (inadequate vs adequate)				Self-care management (inadequate vs adequate)			
	OR adjusted	95% CI		*p*	OR adjusted	95% CI		*p*	OR adjusted	95% CI		*p*
Predictors												
Constant	0.110	–	–	–	0.050	–	–	–	0.103	–	–	–
Gender (male vs female)	1.046	0.467	2.341	0.913	0.935	0.441	1.983	0.86	1.170	0.57	2.401	0.668
Age	1.033	0.994	1.073	0.095	1.028	0.992	1.065	0.130	0.993	0.961	1.027	0.684
Education (lower vs higher)	1.041	0.404	2.688	0.933	1.530	0.609	3.843	0.366	0.413	0.170	1.004	0.052
Occupation (active vs inactive)	0.837	0.479	1.461	0.531	1.574	0.837	2.962	0.159	1.588	0.957	2.635	0.074
Family support (yes vs no)	0.945	0.414	2.158	0.893	1.688	0.725	3.790	0.204	0.805	0.376	1.723	0.576
Years with diagnosis	0.998	0.964	1.034	0.928	1.000	0.966	1.034	0.988	1.016	0.984	1.049	0.336
Comorbidities (presence of any comorbidity vs no comorbidities)	0.555	0.24	1.282	0.168	1.393	0.631	3.077	0.412	0.688	0.328	1.442	0.322
Diabetes self-management education (yes vs no)	2.183	0.957	4.982	0.064	1.239	0.593	3.588	0.569	1.038	0.515	2.093	0.917
Self-care confidence (inadequate vs adequate)	**4.589**	**1.611**	**13.071**	**0.004**	**4.116**	**1.457**	**11.628**	**0.008**	**5.313**	**1.143**	**24.686**	**0.033**
Model												
Test omnibus	0.000				0.000				0.000			
Likelihood test	0.037				0.031				0.041			
Hosmer–Lemeshow test	0.678				0.689				0.672			
Pseudo-R^2 (Cox & Snell)	0.198				0.201				0.199			

Significant determinants are shown in bold

anxiety and depression were not measured but they might have an influence on self-care confidence and self-care behaviours [21]. Main strengths were the control for selection bias through consecutive sampling and the use of valid, reliable, and theoretically grounded measures of self-care. Use of the SCODI allows us to compare study results to those from other chronic illness populations [6, 8–10, 12].

Conclusion

In this study, we demonstrated the unique self-care behaviours of patients with T1DM. We found that self-care maintenance and monitoring were adequate overall but we documented low levels of self-care management behaviours. This issue and the identification of the leading predictive role of self-care confidence suggest the need to promote self-care in both clinical practice and research. Self-care behaviours (i.e. maintenance, monitoring, and management) and self-care confidence should be evaluated systematically to facilitate the ability of clinicians to personalize educational support, and to identify and monitor patients with inadequate self-care. T1DM patients with low self-care confidence should be considered at high risk of inadequate self-care and interventions aimed to improve self-care confidence are strongly recommended. Finally, structured education to improve self-care should be offered to all T1DM patients, not just the most complex patients. Future longitudinal investigations are needed to understand trajectories of self-care over time, to assess self-care determinants with a stronger design, and to study the association between self-care and clinical outcomes in T1DM patients. Finally, research is needed to identify which educational approach is most effective in promoting self-care confidence and self-care behaviours in T1DM patients.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

Human and animal rights All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Informed consent Informed consent was obtained from all patients for being included in the study.

References

1. Riegel B, Jaarsma T, Strömberg A (2012) A middle-range theory of self-care of chronic illness. Adv Nurs Sci 35:194–204. https://doi.org/10.1097/ANS.0b013e318261b1ba
2. Caruso R, Pittella F, Zaghini F et al (2016) Development and validation of the Nursing Profession Self-Efficacy Scale. Int Nurs Rev 63:455–464. https://doi.org/10.1111/inr.12291
3. Riegel B, Dickson VV, Faulkner KM (2016) The situation-specific theory of heart failure self-care. J Cardiovasc Nurs 31:226–235. https://doi.org/10.1097/JCN.0000000000000244
4. Tomky D, Tomky D, Cypress M et al (2008) Aade position statement. Diabetes Educ 34:445–449. https://doi.org/10.1177/0145721708316625
5. Chatterjee S, Davies MJ (2015) Current management of diabetes mellitus and future directions in care. Postgrad Med J 91:612–621. https://doi.org/10.1136/postgradmedj-2014-133200
6. Ausili D, Rossi E, Rebora P et al (2018) Socio-demographic and clinical determinants of self-care in adults with type 2 diabetes: a multicentre observational study. Acta Diabetol 55:691–702. https://doi.org/10.1007/s00592-018-1135-x
7. National Clinical Guideline Centre (2015) Type 1 diabetes in adults: diagnosis and management. National Institute for Health and Care Excellence (UK), UK
8. Ausili D, Barbaranelli C, Rossi E et al (2017) 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 17:66. https://doi.org/10.1186/s12902-017-0218-y
9. Ausili D, Rebora P, Di Mauro S et al (2016) Clinical and socio-demographic determinants of self-care behaviours in patients with heart failure and diabetes mellitus: a multicentre cross-sectional study. Int J Nurs Stud 63:18–27. https://doi.org/10.1016/J.IJNURSTU.2016.08.006
10. Ausili D, Bulgheroni M, Ballatore P et al (2017) Self-care, quality of life and clinical outcomes of type 2 diabetes patients: an observational cross-sectional study. Acta Diabetol 54:1001–1008. https://doi.org/10.1007/s00592-017-1035-5
11. Lu Y, Xu J, Zhao W et al (2016) Measuring self-care in persons with type 2 diabetes. Eval Health Prof 39:131–184. https://doi.org/10.1177/0163278715588927
12. Caruso R, Arrigoni C, Magon A et al (2017) Health determinants in Italian type 2 diabetes mellitus (T2DM) patients: a critical gender differences analysis. J Res Gend Stud 7:93–108. https://doi.org/10.22381/JRGS7220176
13. Caro-Bautista J, Martín-Santos FJ, Morales-Asencio JM (2014) Systematic review of the psychometric properties and theoretical grounding of instruments evaluating self-care in people with type 2 diabetes mellitus. J Adv Nurs 70:1209–1227. https://doi.org/10.1111/jan.12298
14. Dormann CF, Elith J, Bacher S et al (2013) Collinearity: a review of methods to deal with it and a simulation study evaluating their performance. Ecography 36:27–46. https://doi.org/10.1111/j.1600-0587.2012.07348.x
15. Patterson CC, Dahlquist GG, Gyürüs E et al (2009) Incidence trends for childhood type 1 diabetes in Europe during 1989–2003 and predicted new cases 2005–20: a multicentre prospective registration study. Lancet 373:2027–2033. https://doi.org/10.1016/S0140-6736(09)60568-7
16. Caruso R, Magon A, Baroni I et al (2018) Health literacy in type 2 diabetes patients: a systematic review of systematic reviews. Acta Diabetol 55:1–12. https://doi.org/10.1007/s00592-017-1071-1
17. Graffigna G, Barello S, Bonanomi A (2017) The role of patient health engagement model (PHE-model) in affecting patient activation and medication adherence: a structural equation model. PLoS One 12:e0179865. https://doi.org/10.1371/journal.pone.0179865
18. Reddy M, Rilstone S, Cooper P, Oliver NS (2016) Type 1 diabetes in adults: supporting self management. BMJ 352:i998
19. Powers MA, Bardsley J, Cypress M et al (2015) Diabetes self-management education and support in type 2 diabetes: a joint position statement of the American Diabetes Association, the American Association of Diabetes Educators, and the Academy

of Nutrition and Dietetics. Diabetes Care 38:1372–1382. https://doi.org/10.2337/dc15-0730
20. Monaghan M, Helgeson V, Wiebe D (2015) Type 1 diabetes in young adulthood. Curr Diabetes Rev 11:239–250
21. Gao J, Wang J, Zheng P et al (2013) Effects of self-care, self-efficacy, social support on glycemic control in adults with type 2 diabetes. BMC Fam Pract 2013 141 14:1090–1101. https://doi.org/10.1186/1471-2296-14-66