

BMJ Open Association between diabetes-related self-care activities and positive health: a cross-sectional study

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ABSTRACT

Objectives The study aimed to examine the diabetes-related self-care activities (DRSCA) in association with positive health consisting of resilience, subjective well-being (SWB) and disease-related quality of life (DRQoL), and the associations of background information with resilience, SWB and DRQoL.

Design A cross-sectional study.

Methods A convenience sample of people with type 2 diabetes (T2DM) was recruited from two tertiary hospitals in eastern China. Self-reported survey data included DRSCA, resilience, SWB, DRQoL, and background information comprising demographics and social support. Data were analysed using hierarchical multiple regression analyses.

Results Two hundred and forty-six valid questionnaires were analysed. Among the components of positive health, hierarchical multiple regression analysis showed that DRSCA were significantly associated with improved SWB ($\beta=0.140$, $p=0.020$), but not with resilience and DRQoL after adjusting for background information. Participants with higher level of education had higher resilience and men had higher SWB than women. Social support ($\beta=0.186$, $p=0.003$) in Model 1 and resilience ($\beta=0.298$, $p<0.001$) in Model 2 were positively associated with SWB.

Conclusions This study indicated an association between DRSCA and one component of positive health, namely SWB. This finding could help motivate patients to perform DRSCA and to improve SWB in people with T2DM. In addition, the fact that demographics, for example, gender, were associated with SWB and education was associated with resilience also needs to be accommodated when aiming to improve SWB and build resilience.

Trial registration number NCT02594748

INTRODUCTION

Diabetes is a chronic disease and its self-management is complex, time-consuming and life-long, posing a challenge throughout life.^{1,2} Diabetes has increasingly become a public health problem worldwide. More than 425 million people were living with diabetes in 2017 and people with diabetes are predicted to increase to 693 million by 2045.³ In China, the prevalence rate of diagnosed diabetes was estimated to be about 9.7% among people

Strengths and limitations of this study

- This study provided information about the association of diabetes-related self-care activities (DRSCA) with positive health consisting of resilience, subjective well-being (SWB) and disease-related quality of life (DRQoL) and may help encourage the performance of DRSCA and draw attention to improving positive health among people with type 2 diabetes.
- When analysing the association of DRSCA with resilience, SWB and DRQoL, patients' background information was used as a covariate, which made the evaluation more specific.
- Causal association between DRSCA and resilience, SWB and DRQoL cannot be determined because of the cross-sectional design.
- The non-probability sampling method limits the generalisability of the results.

aged 20–79 years in 2017.³ Diabetes can cause long-term complications and also imposes an economic burden on the individuals. In mainland China, there are mainly four types of medical insurance; on average, slightly more than 30% of the total cost of the treatment was paid out-of-pocket by the patients.⁴

Preventing complication of diabetes is an urgent need. Diabetes management can prevent disease complication and diabetes-related self-care activities (DRSCA) are the key component of overall diabetes management. DRSCA refer to an active, effective disease management strategy, self-organisation of one's own life in order to control the disease, mainly including, but not limited to, medication adherence, diet control, blood sugar monitoring, physical activities and foot care.⁵ These five domains that DRSCA cover are essential for self-management. Self-report measuring the domains of DRSCA has been the most commonly used method in research and has proven to be appealing to researchers and clinicians alike.⁶

Successful diabetes management with sufficient DRSCA can control disease progression⁷

and it is thus very important to improve DRSCA. However, it is often difficult for people to engage daily in the self-care activities needed for good glycaemic control.⁸ A cross-sectional study showed that only 13.6% of patients achieved the goal for Haemoglobin A1c level lower than 6.5% which measures glycaemic control.⁹ The overall level of self-care activities index was about 50%–60% in previous studies.^{10 11} The least frequently reported DRSCA was self-monitoring of blood glucose, which may be due to the cost or fear of pain,¹¹ even though self-monitoring of blood glucose is important for monitoring disease control.⁵

The importance of DRSCA for patients has been noted by a number of researchers^{12 13} and the promoting factors of DRSCA have been studied from different perspectives. Encouraging people with type 2 diabetes (T2DM) to improve their DRSCA levels by providing supportive information has gained increasing attention.^{14 15}

To encourage patients to be responsible for their performance of DRSCA, additional information is needed about the influence of DRSCA on positive health. Previously, a qualitative meta-synthesis showed that patients' perceptions of the positive consequences of DRSCA influenced their self-care efforts.¹⁶ In addition, a systematic review indicated that perceived benefits, belonging to the components of the Health Belief Model,¹⁷ were associated with higher level of DRSCA.¹⁸ Therefore, identifying the association of DRSCA with positive health may explain more health benefits of DRSCA and may promote patients to assume more responsibility for their daily DRSCA.

On the other hand, there is also a need to identify plausible relationships between DRSCA and positive health from a general perspective. Epidemiological work and public health guidelines focus on preventing and restoring negative functioning while there is less attention on promoting positive health.¹⁹ Poor health behaviours have been shown to be associated with increased mortality or morbidity.²⁰ However, far less is known about the health behaviours associated with positive health.¹⁹ There is a need to examine whether health behaviours such as DRSCA are associated with positive health. Identifying the association of DRSCA with positive health in our study would provide a useful step in guiding future diabetes care research to include positive health as an outcome indicator. It may also provide a basis for further research aimed at improving positive health of people with T2DM to consider including the role of the DRSCA.

Seeman²¹ developed a model of positive health, referring to positive health as effective human functioning and effective coping and response. However, the definition of positive health is ambiguous and there is no instrument for measuring it.²² For example, Locker and Gibson suggested the definition of positive health as covering a broad range of constructs such as well-being, coping and adaptation.²² Cloninger *et al*²³ summarised that positive health comprises wellness and healthy functioning. In addition, Seligman²⁴ suggested that the global notion

of positive health can be broken down into three kinds of independent variables: subjective (a sense of physical well-being, hardiness, confidence and optimism), biological and functional. Therefore, based on the common meaning of positive health from the previous definitions, we used resilience, subjective well-being (SWB) and disease-related quality of life (DRQoL) as components of positive health. Resilience represents coping, adaptation, recovery from hardships and optimistic thinking; SWB represents satisfaction of physical and mental well-being and DRQoL represents physical and social function. In this study, DRSCA are hypothesised to be positively associated with positive health consisting of resilience, SWB and DRQoL, which are discussed below in separate paragraphs.

Resilience is the coping and adapting capacity to recover from impaired function after a challenge or adversity, which helps one to stay optimistic.^{25 26} There has been a growing interest in resilience as it has been shown to protect against psychiatric illness.²⁷ The prevalence of such illnesses is high among patients with diabetes.²⁸ Moreover, resilience has been regarded as an essential factor contributing to longevity and well-being.²⁹ Resilience is not necessarily an intrinsic attribute. Resilience theorists believe that resilience can be learnt, developed and enhanced through an individual's lived experience and activities.^{30 31} A previous empirical study indicated that healthy self-care strategies can promote resilience among veterinary staff.³² Better DRSCA teach people to adopt multiple skills for more self-disciplined lives, which may be helpful in building resilience. However, this association has not been tested in earlier studies.

SWB is the integration of a person's satisfaction of physical, mental health and positive emotions to foster health.³³ High levels of SWB have been found to be beneficial to good health, longevity and optimal human functioning, which has become an important target that practitioners aim to achieve.³⁴ Therefore, SWB has been emphasised as an essential target in health promotion programmes.^{35 36} Self-care strategy, such as physical activities, has been indicated to improve or maintain SWB in Swedish adults.³⁷ Based on the very scarce published data,³⁷ DRSCA was hypothesised to be associated with improved SWB among people with T2DM in this study.

DRQoL has been used to evaluate how diabetes impacts physical and social functions in patients' life domains and the perceived importance of these life domains for them.³⁸ Although previous studies have supported the notion that better DRSCA leads to increased health-related quality of life;^{39 40} to our knowledge, there are no studies about the direct association between DRSCA and DRQoL among people with T2DM conducted in the eastern region of mainland China. Understanding their association in different areas may provide additional information for diabetes care.

The objectives of this study are:

1. To explore whether an association exists between DRSCA and positive health that consists of resilience,

SWB and DRQoL, which provides the premise for their causative relationships before entering into intervention study.

2. To explore how background information is associated with positive health that consists of resilience, SWB and DRQoL. Family history of diabetes and whether the patient experienced symptoms before the diabetes diagnosis were also added to the background information. The reasons for including them were as follows: Family history is an independent risk factor for chronic diseases including T2DM.⁴¹ Patients felt that family members' knowledge of diabetes helped to provide diabetes-specific support.⁴² As for the presence of symptoms before the diabetes diagnosis, we considered that if the person had no symptoms prior to diagnosis on physical examination, he/she may feel that the onset of disease was sudden and there was no psychological preparation. In this case, the adaptation process may be longer compared with those who experienced symptoms before being diagnosed. An inadequate and prolonged adaptive process may cause lower well-being and anxiety.⁴³

This study may provide helpful information both for encouraging patients' DRSCA and for improving resilience, SWB and DRQoL in health promotion programmes.

METHODS

Design and participants

A descriptive, cross-sectional study was conducted. The data were collected using convenience sampling among patients with T2DM seeking medical care at two university-affiliated hospitals in Nantong city, Jiangsu Province, located in eastern China between summer 2015 and summer 2016. The following inclusion criteria used in the recruitment of the study sample were reported⁴⁴: age 18+ years; duration of T2DM for at least 3 months; no serious complications or cognition disorders and willing to participate and provide written informed consent. The exclusion criteria were as follows: refusal to participate and serious complications.

Instruments

The instruments used in this study were self-reported measures. This study surveyed what patients had done in their self-care: patients were asked to recall their DRSCA over the past week at home to lessen reactivity where people may modify their behaviour when they know they are being observed.⁴⁵ Equipment for objective measurement of self-care activities has not been in universal use among Chinese patients, and the concept of positive health in the study involved subjective sense and perceptions (eg, positive emotion; perception of the impact of diabetes on daily life); therefore, self-reported measures were used. The instruments included background information, DRSCA and components for positive health comprising resilience, SWB and DRQoL.

The supplemented information about the instruments is shown online supplementary file (Appendices-DRSCA and positive health).

Background information

Background information included demographics and social support. Demographics included age, gender, education, duration of diabetes, whether the patient had received standardised diabetes education, living alone, family history of diabetes and whether the patient had experienced symptoms before diabetes diagnosis, perceived complications (Yes/No), smoking (Yes/No), drinking alcohol (Yes/No) as well as clinical characteristics including systolic blood pressure (SBP), diastolic blood pressure (DBP), height (in cm), weight (in kg). Body mass index (BMI) was calculated as weight/height²(kg/m²).

Social support was measured by the Social Support Rating Scale.⁴⁶ It has 10 items and 3 dimensions: subjective support, objective support and support utilisation. Response option of eight items was from 1 to 4. One item among them has five subquestions and each question was scored from 1 to 4. Two items were scored 0–9 based on the support resources. The Cronbach's α was 0.70 in the present sample. Social support scores ≤ 44 are classified as low support level while those >44 are classified as high support level.⁴⁷

Diabetes-related self-care activities

DRSCA were measured by the Diabetes Self-Management Scale developed by Yin *et al*⁴⁸ which is based on core items of the widely used scale of Summary of Diabetes DRSCA.⁵ The scale consists of eight items and five dimensions including regulating diet, physical activities, medications, blood sugar monitoring and foot care. The participants described on how many days in the past week they had carried out DRSCA following doctor's advice. The items stated: On how many days have you followed the prescription of medication; regulated your diet for diabetes; done physical activities for 30 min or more; exercised (except for homework and work), for example, walking, Tai chi, swimming, jogging or bicycling; tested your blood sugar; tested your blood sugar the times recommended by doctor; checked your feet and dried between your toes after washing in the past week? Items were rated on an 8-point Likert scale, a higher score indicating a better level of self-care. The scale Cronbach's α was 0.68.⁴⁸

Components of positive health

Resilience

Resilience was measured by the 10-item Connor-Davidson Resilience Scale (10-item CD-RISC), modified by Campbell-Sills and Stein⁴⁹ from the original scale developed by Connor and Davidson.²⁵ The 10-item resilience scale is a self-administered questionnaire to measure resilience ability, with five Likert-type response options from 0 (never) to 4 (almost always). It has a single dimension and a total score range between 0 and 40, a higher score

representing a higher level of resilience. Cronbach's α was 0.94 in this study.

Subjective well-being

SWB was evaluated with the WHO-5 Well-Being Index developed from the WHO-10 Well-Being Index.^{50,51} It is a unidimensional scale consisting of five positively worded items scored on a 6-point Likert scale ranging from 0 (not present) to 5 (constantly present). The total raw scores range from 0 to 25. The raw scores are then converted to 0–100 multiplied by 4, from worst thinkable well-being to best thinkable well-being. As a short and generic global rating scale, the WHO-5 Well-Being Index is one of the most widely used instruments measuring SWB covering basic life perceptions of well-being.⁵² In this study, the internal consistency measured with Cronbach's α was 0.84.

Disease-related quality of life

DRQoL was measured by the ADDQoL-19 (Audit of Disease-related quality of life), which is designed to assess how individuals perceive the impact of DM on 19 pairs of items representing life domains.¹ For each of these items, respondents first select the impact of diabetes on the applicable domain from –3 (most negative impact) to +1 (positive impact) and then rank the importance of the domain for their QoL from 3 (very important) to 0 (not at all important). A weighted impact score for each domain is given by multiplying impact scores and corresponding importance scores, ranging from –9 (most negative impact) to +3 (most positive impact). The average weighted impact (AWI) score is calculated by summarising the weighted impact scores and dividing the sum by the number of the domains. The AWI ranges from 3 (positive impact) to –9 (most negative impact).¹ The Chinese version of the ADDQoL-19 has a Cronbach's α value of 0.94.⁵³ In this study, the internal consistency measured with Cronbach's α was 0.9.

Ethical considerations

This study adhered to the ethical principles of the Helsinki Declaration and was approved by the Ethical Committee of a University affiliated Hospital (Code: 2015–120). Permission for the study was given by the participating hospitals. Numbers were assigned to participants to ensure anonymity and information was kept confidential. Written informed consent was obtained from participants. The study scales were used with permission by the original authors or authorised coordinator (WHO-5 Well-Being Index) received via email when usage permission was required.

Data collection procedures

Recruitment was conducted at two University affiliated hospitals of Nantong University. The participants who met the inclusion criteria after screening were recruited shortly after being admitted to hospital. The participants in this study came to hospital for help mainly for adjusting

their medication treatment including oral antidiabetic drugs (OADs) alone or OADs in combination with insulin and/or glucagon-like peptide-1 receptor agonist, or using insulin alone, to control glycaemic level and to prevent or treat complication. The potential participants were approached and informed about the purpose, meaning, content and procedures of the study and were asked to sign an informed consent if they agreed to participate. Participation was totally voluntary and the participants were told they could withdraw their participation at any time.

Before data collection, the research assistants were trained by the main researcher to perform the data collection procedure consistently. The training included information about the study, ethical issues, interviewing techniques and questionnaire coding. The main researcher also demonstrated the collection procedure and observed the process of data collection when it was performed for the first time, making corrections if necessary. The data were collected using structured questionnaires. Questions were read out loud to participants with poor vision, for example. For ethical consideration, the anonymity of the data analysis was explained. Each patient was assigned a unique code which was used in the analysis. The required sample size was calculated in G*power statistical software by setting the alpha at 0.05, the effect size at 0.10, the power at 0.90; the number of tested and total predicted factors was set at 15. The sample size for multiple regression analysis was calculated as 249 (fixed model, R^2 increase).⁵⁴ The required sample size was about 300 to allow for 20% invalid response rate. Of the patients who were approached to invite them to participate in the study, 310 (about 70%) took part in the study.

Data analysis

IBM SPSS 23.0 was used to analyse the data. Before analysis, errors such as data transfer errors and extreme outliers of variables in this study were removed.⁵⁵ An extreme outlier was less than first quartile $Q1 - 3 \times IQR$ or greater than $Q3 + 3 \times IQR$. Sensitivity analyses including and excluding these outliers were conducted separately, and the same general conclusion was drawn, except that gender was not significant for resilience in Model 1 in the hierarchical multiple regression analysis when the outliers were included. The general results are not sensitive to the outliers and are robust. Missing values of study variables accounted for no more than 5% except for BMI, SBP and DBP (12%) and were replaced by the Values-Expectation-Maximisation method. Descriptive statistics of frequency, percentage, mean and SD were calculated to express data. Internal consistency reliability was computed for the scales. Pearson's correlation was used to explore the correlation between DRSCA, resilience, SWB and DRQoL as well as the correlation between SBP, DBP, BMI with resilience, SWB and DRQoL. Hierarchical multiple regression analysis was conducted to explore the associations of DRSCA with positive health while adjusting for covariates (background information, see [table 1](#)) based

Table 1 Association of background information with components of positive health (n=246)

	n (%)	Positive health					
		Resilience		SWB		DRQoL	
		Mean±SD	P value	Mean±SD	P value	Mean±SD	P value
Gender			0.054		0.013		0.704
Male	139 (56.5)	31.3±5.8		75.4±15.3		−1.9±1.6	
Female	107 (43.5)	29.8±5.7		70.2±16.9		−1.8±1.3	
Age			0.377		0.131		0.024
<65 years	149 (60.6)	30.9±5.7		74.4±16.0		−2.0±1.6	
≥65 years	97 (39.4)	30.2±5.9		71.2±16.5		−1.6±1.3	
Diabetes duration			0.164		0.137		0.257
<5 years	79 (32.1)	31.4±4.7		75.4±14.1		−1.7±1.6	
≥5 years	167 (67.9)	30.3±6.2		72.1±17.1		−1.9±1.4	
Education			0.001		0.061		0.043
<College education	185 (75.2)	30.0±5.9		72.0±17.0		−1.7±1.5	
≥College education	61 (24.8)	32.8±5.0		76.5±13.2		−2.2±1.6	
Symptoms prior to diagnosis			0.631		0.232		0.533
Yes	141 (57.3)	30.8±6.2		72.1±16.1		−1.8±1.6	
No	105 (42.7)	30.4±5.2		74.6±16.4		−1.9±1.4	
Received SSCE			0.342		0.060		0.688
No	140 (56.9)	30.4±5.9		74.8±16.4		−1.9±1.4	
Yes	106 (43.1)	31.1±5.7		70.9±15.7		−1.8±1.6	
Family history of diabetes			0.873		0.880		0.931
Yes	65 (26.4)	30.8±5.8		73.4±15.5		−1.9±1.5	
No	181 (73.6)	30.6±5.8		73.1±16.5		−1.8±1.5	
Living alone			0.353		0.979		0.743
Yes	56 (22.8)	30.0±5.9		73.2±14.7		−1.8±1.4	
No	190 (77.2)	30.8±5.8		73.1±16.7		−1.9±1.5	
Perceived complications			0.829		0.541		0.080
Yes	85 (34.6)	30.8±5.8		72.3±15.0		−2.1±1.6	
No	161 (65.4)	30.6±5.8		73.6±16.9		−1.7±1.4	
Smoking			0.050		0.539		0.639
Yes	52 (21.1)	32.1±5.5		74.4±16.4		−1.9±1.7	
No	194 (78.9)	30.3±5.9		72.8±16.2		−1.8±1.4	
Drinking alcohol			0.292		0.465		0.656
Yes	67 (27.2)	30.0±5.8		74.6±16.0		−1.8±1.6	
No	179 (72.8)	30.9±5.8		72.6±16.3		−1.9±1.4	
Social support			<0.001		0.001		0.010
Low	127 (51.6)	29.4±5.9		70.0±16.4		−1.6±1.4	
Higher	119 (48.4)	32.0±5.5		76.5±15.3		−2.1±1.5	
Pearson's correlation analysis							
	Mean (SD)	r	P value	r	P value	r	P value
SBP, mm Hg	132.6 (17.1)	−0.012	0.851	−0.035	0.585	0.019	0.764
DBP, mm Hg	77.0 (9.5)	−0.032	0.620	−0.048	0.450	0.008	0.895
BMI	24.4 (3.9)	0.066	0.303	0.181	0.004	−0.082	0.198

Bold p values were less than 0.05.

BMI, body mass index; DBP, diastolic blood pressure; DRQoL, disease-related quality of life; SBP, systolic blood pressure; SSCE, standardised self-care education; SWB, subjective well-being .

Table 2 Pearson correlation between DRSCA and components of positive health

	Positive health			
	DRSCA	Resilience	SWB	DRQoL
DRSCA				
r	1			
P value				
Resilience				
r	0.165*	1		
P value	0.009			
SWB				
r	0.205*	0.346*	1	
P value	0.001	0.000		
DRQoL				
r	-0.115	-0.091	-0.100	1
P value	0.072	0.154	0.118	

*Correlation is significant at the 0.01 level (2-tailed).

DRQoL, disease-related quality of life; DRSCA, diabetes-related self-care activities; SWB, subjective well-being.

on the results from t-test and Pearson's correlation analysis (see [table 2](#)). $P < 0.05$ indicated statistical significance.

Patient and public involvement (PPI) statement

Patients were not involved in research activities including designing and conducting the study.

RESULTS

Characteristics of the sample

Two hundred and forty-nine valid questionnaires were included in this study after excluding incomplete questionnaires and unusable ones reporting hospital care as 1 week's DRSCA. After excluding extreme outliers of variables in this study, the data set for analysis comprised 246 valid questionnaires. The average age of these participants was 59.6 years (SD=13.4, range 22–85). Although the incidence of T2DM is on the rise among young people,⁵⁶ typically T2DM starts in middle or older age.⁵⁷ Therefore, age 65 was chosen as an age cut-off. Older adults (≥ 65 years) accounted for 39.4% of the participants in this study. Slightly less than half (43.5%) of the participants were women. Diabetes duration was on average 9.9 years, ranging from 0.5 to 37 years. Slightly more than half (57.3%) of the participants had experienced symptoms prior to the diagnosis, and about 43.1% had received standardised self-care education in the past. The majority (75.2%) of the participants had less education than a college degree. About one-fourth of the participants had a family history of diabetes (26.4%). About a fourth (22.8%) of those living alone and 48.4% of all participants self-reported that they had high support (score >44) ([table 1](#)).

Level of DRSCA and components of positive health

The scores of self-reported DRSCA, resilience, SWB and DRQoL were at moderate level. DRSCA had a mean score of 34.9 (SD=11.4, score index using actual score divided by possible maximum score, 62%). Resilience had a mean score of 30.7 (SD=5.8, score index, 77%). The mean score of SWB was 73.2 (SD=16.2, score index, 73%) and DRQoL was -1.9 with SD of 1.5 and possible score range of 3(-9).

Association of background information with components of positive health

The independent t-test results showed that men were more likely to have higher SWB compared with women. BMI was correlated with SWB. Participants aged ≥ 65 years were more likely to have higher DRQoL. Participants with higher education seemed to have higher resilience but more impacted DRQoL. Participants with higher social support seemed to have higher resilience, SWB and perceived more impact in DRQoL.

Correlations of DRSCA with components of positive health

Based on correlation analysis, there were low but significant correlations (ranging from 0.165 to 0.346) between DRSCA, resilience and SWB ([table 2](#)).

The association of DRSCA with components of positive health

The association of DRSCA with positive health consisting of resilience, SWB and DRQoL was analysed after adjusting for covariates. Covariates were based on the statistically significant results from t-test and Pearson's correlation analysis ([table 3](#)).

For the dependent variable resilience, statistically significant background information from t-test including education and social support was entered in Step 1 (Model 1), SWB was entered in Step 2 (Model 2) and DRSCA in Step 3 (Model 3). The results showed that in Model 1, education ($\beta=0.182$, $p=0.004$) and social support ($\beta=0.201$, $p=0.001$) were significantly associated with resilience. In Model 2, SWB ($\beta=0.299$, $p<0.001$) was significantly associated with resilience. In Model 3, DRSCA ($\beta=0.069$, $p=0.260$) were not significant after adjusting for the covariates. The model explained 17.3% of the variance of resilience. Excluding the effects of demographics, social support and SWB, DRSCA had a non-significant relation with resilience.

For the dependent variable SWB, gender, BMI and social support were entered in Step 1 (Model 1), resilience in Step 2 (Model 2) and DRSCA in Step 3 (Model 3). In Model 1, gender ($\beta=-0.134$, $p=0.033$), BMI ($\beta=0.142$, $p=0.025$) and social support ($\beta=0.186$, $p=0.003$) were significantly associated factors of SWB. In Model 2, resilience ($\beta=0.298$, $p<0.001$) was significantly associated with SWB, and in Model 3, DRSCA ($\beta=0.140$, $p=0.020$) were also significant. The model explained 18.6% of the variance of SWB. Excluding the effects of demographics, social support and resilience, DRSCA explained a significant part of the variance (1.9%).

Table 3 Hierarchical multiple regression analysis of the association between DRSCA and components of positive health

DV		Model 1			Model 2			Model 3		
Positive health	IV	B	β	P value	B	β	P value	B	β	P value
Resilience										
	Education	2.453	0.182	0.004	2.081	0.155	0.010	2.045	0.152	0.011
	SS	2.340	0.201	0.001	1.683	0.145	0.017	1.562	0.134	0.028
	SWB				0.107	0.299	<0.001	0.103	0.287	<0.001
	DRSCA							0.035	0.069	0.260
SWB										
	Gender	−4.366	−0.134	0.033	−3.233	−0.099	0.100	−3.414	−0.105	0.080
	BMI	0.595	0.142	0.025	0.563	0.134	0.026	0.565	0.134	0.024
	SS	6.034	0.186	0.003	3.878	0.120	0.050	3.141	0.097	0.113
	Resilience				0.832	0.298	<0.001	0.780	0.280	<0.001
	DRSCA							0.199	0.140	0.020
DRQoL										
	Age	0.303	0.100	0.127	0.346	0.114	0.084			
	Education	−0.330	−0.096	0.135	−0.305	−0.089	0.166			
	SS	−0.379	−0.127	0.051	−0.316	−0.106	0.109			
	DRSCA				−0.013	−0.097	0.134			

B, unstandardised coefficients; β , standardised coefficients; BMI, body mass index; DRQoL, disease-related quality of life; DRSCA, diabetes-related self-care activities; DV, dependent variables; IV, independent variables; SS, social support.

For the dependent variable DRQoL, age, education and social support were entered in Step 1 (Model 1) and DRSCA in Step 2 (Model 2). In Model 1, age ($\beta=0.100$, $p=0.127$), education ($\beta=-0.096$, $p=0.135$) and social support ($\beta=-0.127$, $p=0.051$) were not significantly associated with DRQoL. In Model 2, DRSCA ($\beta=-0.097$, $p=0.134$) were also not significant. The model explained 5.6% of the variance of DRQoL. Excluding the effects of age, education and social support, DRSCA were not significantly associated with DRQoL.

These results showed that after adjusting for covariates, DRSCA were significantly associated with improved SWB, but not with resilience or DRQoL.

DISCUSSION

This study showed the level of DRSCA as well as resilience, SWB and DRQoL, which constitutes positive health. This study also explored the association of the components of positive health with DRSCA as well as with background information.

The score index of DRSCA was not high, supporting earlier findings.^{10 12} However, we found a higher score index of DRSCA than that reported in another Chinese sample,¹¹ showing that the level of DRSCA is in general not optimistic. In the components of positive health, the score index of resilience was similar to a report from a previous study of people with chronic disease,⁵⁸ while the score of DRQoL was similar to previous studies conducted in Argentina⁵⁹ and Australia.⁶⁰ Although the score index of SWB in the study was moderate, it was still higher than

among adolescents with type 1 diabetes.⁶¹ This indicates that further research aimed at enhancing SWB is needed for people with diabetes. These discrepancies might also be influenced by different measures, respondents' living arrangements and situation. The scores of all instruments were not high. The reason for this may be the situation of the participants who came to the hospital to get help to improve their health outcomes and reduce the risk of disease progression. We do not know for sure whether population-level DRSCA impacted the association between DRSCA and positive health. We judge the impact not to be substantial as the range of scores on the variables impacts the correlation⁶² and the study variables including DRSCA, resilience, SWB and DRQoL have some degree of variability (SD).

This study indicated that although DRSCA were positively correlated with resilience in Pearson correlation analysis, the association was non-significant after adjusting for background information. This finding indicates that compared with the association of social support and SWB with resilience, the association between DRSCA and resilience was weak in people with T2DM and different from a previous study conducted among veterinary staff.³² This implies that a high level of social support is more important than DRSCA in building resilience in people with T2DM. This study suggests that providing more social support resources can be a means of enhancing resilience.

DRSCA were not associated with increased DRQoL after adjusting for covariates. This finding showed that

patients' life domains were impacted by diabetes and DRSCA did not increase or relieve the impact perceived by the patients. This result is different from an earlier study.³⁹ In our study, the DRQOL was measured based on individuals' perceptions of the impact of DM on life domains and the importance of these domains for them. The discrepancy between the findings may be caused by the different perspective as compared with previous studies. The association between DRSCA and DRQoL reflected whether DRSCA influenced such perceptions and the result showed that the association between them was not significant. A possible explanation is that DRSCA are related to disease control, so they limit individuals from maintaining their original lifestyle and may therefore be considered demanding. As a result, patients may fail to feel that DRSCA lighten the impact of DM on some life domains in DRQOL, such as freedom to eat as they wish. One study¹ found that if diabetes management and treatment permits dietary freedom and flexibility, it will lead to improved QoL for most people. The finding implied that patients' personal food preferences should be taken into account to create a tailor-made diet when drawing up a nutritional plan.⁶³ Given that the variance of DRQoL accounted for by the model was not high, other factors such as the presence of mental health conditions should be considered² in future studies.

Similar to a previous study in Swedish adults,³⁷ the present analysis showed that DRSCA were positively associated with SWB. This finding strengthens the suggestion of the benefits of DRSCA in improving psychological health in chronic illnesses,⁶⁴ which needs to be confirmed by studies using an intervention design. Although people still feel the impact of diabetes on life domains of DRQoL after the performance of DRSCA, they may experience positive mood and vitality in SWB due to achieving a disciplined lifestyle and self-care. From a public health perspective, SWB has been emphasised as an ultimate goal in health promotion programs,^{35 36} and recognising the association between DRSCA and SWB may contribute to both increased DRSCA and SWB in these programmes.

An interesting observation of our study is that people with higher education seemed to have higher resilience. Possible explanations include that people with higher education may have learnt more coping strategies, and coping strategies are linked to resilience.²⁵ Men had higher SWB compared with women, which was in line with previous studies showing women to be more susceptible to emotional distress and emotional burden in their specific social roles than men.⁶⁵ Contrary to what was expected, neither family history nor symptoms prior to diagnosis were associated with positive health. This insignificant association may be explained by the fact that the majority of patients in the study have had diabetes for over 5 years. During the process, they may to a certain extent have learnt how to manage the disease themselves. Individuals are considered to be adapting well when they act in a goal-oriented way during the adaptation process.⁶⁶

In this study, the protective role of social support in resilience and SWB was observed among people with T2DM. Social support has been regarded as a positive factor contributing to mental health and promoting SWB,^{67 68} which should be emphasised in supporting chronic care.⁶⁸ In this study, resilience was also found to be associated with SWB among people with T2DM, implying that resilience can be an important factor contributing to improved SWB. This finding can be interpreted as showing that SWB may benefit from improved social support, resilience and DRSCA. Alternatively, SWB may be a positive stimulus to motivate patients to improve DRSCA.

Limitations

This study provided a useful step in guiding future research aimed at promoting DRSCA and positive health. However, some limitations should be considered. First, the convenience sampling method may limit the generalisability of the results. Although the sample size was adequate for the analysis, the generalisability is limited by having a hospital sample from one district by none-probability sampling method. However, the impact is not assumed to be substantial because of the wide range of ages and approximately gender balance in this study. Random sampling from different districts in China would allow generalisation of the results to a larger population in the future.

Second, the cross-sectional design allows analysis of many variables at the same time but cannot determine causal relationships. We have taken a first step by conducting a cross-sectional study to determine whether an association exists between DRSCA and positive health, which is the premise of causative relationships but not sufficient for establishing a causal effect.⁶⁹ The design of cross-sectional study had no control group and cannot determine causal relationships. Therefore, its validity is low compared with experimental study.⁷⁰ In the future, studies using an intervention design are needed to further evaluate the causal association of DRSCA and positive health.

Third, only a small percentage of variance of dependent variables was explained. More exploration is needed, including other factors associated with positive health consisting of resilience, SWB and DRQoL. Fourth, the clinical characteristics of the study population including haemoglobin A1C (HbA1C), lipid profiles, treatment and neuropathy should have been included. We considered that previous studies have provided evidence of the association of DRSCA with HbA1C and lipid profiles,⁷¹ and only attempted to understand the association of DRSCA with positive health, which is far less known.¹⁹ Thus, these factors were not included but they can provide more confounders and information. Among the participants with type 2 diabetes followed up at one Affiliated Hospital of Nantong University in another observational study,⁷² average HbA1C (%) was 8.7, triglyceride (mmol/L) was 1.71, total cholesterol (mmol/L) was 4.83, high density lipoprotein cholesterol (mmol/L) was 1.07 and low density lipoprotein cholesterol (mmol/L) was 2.67 for those without diabetic peripheral neuropathy (DPN).

The values were 9.5, 1.86, 4.93, 1.06 and 2.60, respectively, for those with DPN.⁷² In this study, the foot care status was surveyed; in future studies, it would be helpful to include neuropathy in order to better understand the outcome of foot care and treatment.

Finally, although self-report measures can provide actionable information as one of the most feasible data collecting methods,⁷³ the self-report survey is subject to response bias.⁷⁴ In future research, considering objective measures is suggested. Based on the guideline, Cronbach's alpha coefficients for the scales ranging from 0.64 to 0.94 were considered acceptable.⁷⁵ Another consideration was that the Cronbach's alpha of DRSCA and social support scales was slightly above the low boundary of the range. The internal consistency of DRSCA and social support scales needs further testing in diversified population.

CONCLUSION

The result about the association between DRSCA and positive health consisting of resilience, SWB and DRQoL may guide intervention development but further research is needed to verify the cause-effect relationship. The results indicate that improving DRSCA, social support and resilience may benefit programmes aimed at enhancing of SWB, which is one component of positive health. The findings may help support patients' motivation to increase the frequency of DRSCA for enhancing SWB. The results also indicate that SWB can be included as an outcome in self-care intervention programmes.

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