Diabetes Attitude Scale: Validation in Type-2 Diabetes Patients in Multiple Centers in China

Qingqing Lou1,2, Yufeng Chen3, Xiaohui Guo4✉, Li Yuan5, Tao Chen6, Chun Wang6, Li Shen6✉, Zilin Sun7, Fang Zhao8, Xia Dai9, Jin Huang10, Huiying Yang11, on behalf of Chinese Diabetes Education Status Survey study group

1 Jiangsu Province Hospital on Integration of Chinese and Western Medicine, Nanjing, Jiangsu Province, China, 2 Sir Run Run Shaw Hospital, Zhejiang University Medical School, Hangzhou, Zhejiang Province, China, 3 School of Nursing, Nanjing University of Traditional Chinese Medicine, Nanjing, Jiangsu Province, China, 4 Department of Endocrinology, Peking University First Hospital, Beijing, China, 5 Department of Endocrinology, West China Medical School, West China Hospital, Sichuan University, Chengdu, Sichuan Province, China, 6 Peking University First Hospital, Beijing, China, 7 Institute of Diabetes, Zhongda Hospital, Medical School, Southeast University, Nanjing, Jiangsu Province, China, 8 Department of Endocrinology, China-Japan Friendship Hospital, Beijing, China, 9 First Affiliated Hospital, Guangxi Medical University, Nanning, Jiangsu Province, China, 10 The Second Xiangya Hospital of Central South University, Changsha, Hunan Province, China, 11 The First Affiliated Hospital of Kunming Medical College, Kunming, Yunnan Province, China

Abstract

Objective: The aim of the paper is to report the development and psychometric testing of Diabetes Attitude Scale.

Method: A prospective study was performed. The cultural equivalency and content validity of the Diabetes Attitude Scale were determined by panels of endocrinologists, physiologists, nurses and dieticians. An accurate and usable translation was obtained for each of five subscales examining attitudes on need for special training, the seriousness of type-2 diabetes, the need for controlling the condition, its psychosocial impact and the degree of autonomy given to patients in decision making. The validation was derived from 5961 patients with type-2 diabetes, recruited from 50 centers in 29 provinces throughout China between March 1st and September 30th, 2010.

Results: The modified Diabetes Attitude Scale showed an acceptable level of internal consistency. The strength of the inter-correlations among the domains of five subscales suggests that the instrument measures related but separate domains of patients’ attitudes toward diabetes. Moreover, the test-retest intraclass correlation coefficients were high enough to support the stability of the Chinese version of the third version of the scale.

Conclusions: The psychometric properties of the Chinese version of Diabetes Attitude Scale demonstrated satisfactory validity and reliability and appeared to effectively evaluate attitudes toward diabetes in patients with type-2 diabetes.

Citation: Lou Q, Chen Y, Guo X, Yuan L, Chen T, et al. (2014) Diabetes Attitude Scale: Validation in Type-2 Diabetes Patients in Multiple Centers in China. PLoS ONE 9(5): e96473. doi:10.1371/journal.pone.0096473

Editor: Antony Bayer, Cardiff University, United Kingdom

Received November 7, 2013; Accepted April 9, 2014; Published May 6, 2014

Copyright: © 2014 Lou et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Funding: Funding to support this study was provided by Novo Nordisk (China) Pharmaceutical Co., Ltd (NNCP). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The funding to support this study was provided by Novo Nordisk (China) Pharmaceutical Co., Ltd (NNCP). There are no patents, products in development or marketed products to declare. This does not alter the authors’ adherence to PLOS ONE policies on sharing data and materials.

✉ E-mail: guoxh@medmail.com.cn
* Current address: Beijing Tsinghua Hospital, Beijing, China

Introduction

Successful control of diabetes greatly depends on patients being able to manage their disease [1]. The patients can, therefore, be regarded as core team members who administer their treatment on a daily basis [2]. Studies show that diabetes patients experience various types of psychosocial and emotional problems [3], therefore, psychological factors are important to diabetes management. Many studies focusing on the effects of psychological problems on diabetes reveal that psychological factors have an impact on diabetes control [4,5,6]. And researchers have also developed different questionnaires to provide valuable insights in patients’ view on their disease e.g. the Diabetes Distress Scale [7,8], the Problem Areas in Diabetes Questionnaire [9,10] or the Empowerment Scale [11,12]. All of these established scales have been used in different studies [13,14,15,16,17,18,19,20,21,22]. Furthermore, they have been translated into Chinese versions [23,24,25,26,27,28], and used in China [29,30,31]. Attitude towards diabetes is very important. According to the attitude behavior model, a patient’s intention to behave in a certain way has two major determinants, one of which is the patients’ attitudes towards the behavior [32]. And it has been shown that attitudes can affect health care behavior [33,34,35], diabetes control and patient outcomes [36,37]. Indeed, it has been proposed that changing patients’ attitudes by monitoring the psychosocial impact of diabetes may provide a cost-effective way to improve disease control outcomes [38]. Unlike many other diseases, diabetes requires ongoing self-management of care, even when patients are...
asymptomatic. In contemporary research, compliance with self-management programs during the asymptomatic period has been reported to be very low, especially in key areas of diet and exercise [39]. In a wide cross-section of international type 2 diabetes patients, patient attitudes, wishes, and needs have been shown to be the foundation for successful care [40]. In Western research, several studies have produced classification systems that allow for clinical stratification of type 2 diabetes patients based on opinions and attitudes that can influence self-care behaviors [41]. It has been demonstrated, however, that diabetes patients’ attitudes and opinions are highly dependent on specific cultural factors, including patients’ social networks, knowledge and opinions of family and friends, and concern about the disease [33]. The rate of diabetic compliance with self-management, including insulin therapy thus varies highly by country [34], potentially as a result of variant patient opinions and attitudes towards their diabetes care. In particular, insulin adherence, a behavior known to detrimentally affect many non-compliant patients, was reported to impact patient financial situation, family and social life, and emotional well-being by the Global Attitudes of Patients and Physicians in Insulin Therapy study of 1530 insulin-treated patients, including 1350 Type 2 diabetes patients in China, France, Japan, Germany, Spain, Turkey, the UK, and the USA [4]. In developing countries, the patient population’s knowledge, attitude, and practice (KAP) of diabetes is generally much worse than those in developed countries, partially due to the lack of training programs for care providers and education programs for patients [42]. Thus, many cultural factors play a role in successful diabetes care by influencing patient attitudes and opinions, and attitudes vary widely between different countries. In fact, increasing evidence suggests that improving patient educations is the most effective way to lessen the complications and costs associated with diabetes and its management [43]; however, targeted and culturally sensitive patient education programs are not possible without improved understanding of diabetic patient attitudes in these developing regions. To assess patient attitudes, we need a specific tool. The original version of the Diabetes Attitude Scale (DAS) was developed by Anderson et al in 1989. The scale which included 31-items arranged in eight subscales, was designed to measure the attitudes of health-care professionals (HCPs) concerning important issues that affect diabetes control [44]. The third version of the scale (DAS-3) published in 1998 was designed to obtain information from patients as well as from HCPs [41]. This version collected data on 33 items within five discrete subscales and was based on the original versions of the DAS [45]. The five subscales examine patient attitudes on need for specialist healthcare training, the seriousness of type-2 diabetes, the need for controlling the condition, its psychosocial impact and the degree of autonomy given to patients in decision making. These items were chosen on the basis that they were important beliefs that were likely to predict the behavior of patients with type-2 diabetes. The items cover a range of issues relevant to the effects of diabetes on everyday life and patients’ well being. However, the vaste cultural differences between China and western countries make applying DAS in Chinese patients a complex task, requiring cultural consideration rather than simply translation to accurately assess psychological attitudes towards diabetes in Chinese patients.

Materials and Methods

Ethics Statements

The study protocol was approved by the Hospital Ethical Committee of West China Hospital, Medical School Sichuan University (approval ID: 2010(10)). Written informed consent was obtained from each patient and the primary caregivers of the minors enrolled.

Methodology

The study incorporated a two-phase design (Fig. 1) that had previously been used by Shiu et al [27] to validate the Diabetes Empowerment Scale. This approach enabled both qualitative and quantitative assessments of the psychometric properties of the C-DAS-3 to be evaluated.

Phase I. Phase I included translation of the English language version of the DAS-3 into Chinese and examination of the Chinese version of DAS-3 (C-DAS-3) for cultural equivalency and content validity. The Chinese translation was guided by the Brislin’s translation model [46]. A bilingual translator who was a medical doctor translated the DAS-3 into Chinese. It was then translated back into English by another physician who was also a bilingual translator. Both the original and back-translated versions were compared to determine the accuracy of the translation. The translated version (C-DAS-3) was then examined by a panel of experts comprising an endocrinologist, three diabetes nurse educators and a dietician. The panel tested whether the translated parameters were equivalent to the original parameters and assessed whether the translated version could be readily understood and tested in a sample population of Chinese patients with type-2 diabetes.

The translated C-DAS-3 was presented to a second panel of experts for content validity assessment. This panel comprised two endocrinologists, a psychologist, five diabetes nurse specialists, and a dietician. Content validity was assessed by asking the members to rate each item as a valid measure of the construct using a three-point scale where: 1 = disagree, 2 = neutral and 3 = agree. The content validity was calculated in this manner for each item and for the overall C-DAS-3. The panel also assessed each translated item individually for accuracy, clarity and for the cultural relevance of the translation. Following minor revisions, a panel-modified version was developed and was pilot-tested in 20 patients with type-2 diabetes to check the data collection procedure and ease of understanding.

A second pilot study involving 106 patients recruited from a single center (three hospitals) in China, was undertaken to establish the psychometric properties [47] and internal consistency of the translation prior to the large scale assessment of the C-DAS-3. In this second pilot study the overall Cronbach’s alpha coefficient for internal consistency was satisfactory (0.771), but the coefficient for the second dimension consistency was only 0.390. The translation was rechecked under the guidance of the original author of the DAS-3 (Dr. Anderson) and changes were made to the translation of item 21: ‘Type-2 diabetes is a very serious disease’. Content validity was repeated by the same expert panel and a final version was developed.

Phase II. In the second phase of the study we established the test-retest reliability, internal consistency, construct validity, and criterion validity of the final version of the C-DAS-3 in a large number of patients with type-2 diabetes.

Study Population

The sample for Phase II was selected from among 6043 patients (≥ 16 years old), who had been diagnosed with type-2 diabetes for at least 1 year. The patients were selected from 50 centers in 29 provinces in China between March 1st and September 30th, 2010. Demographic characteristics, HbA1c, fasting and 2 h postprandial blood glucose levels were obtained from all patients. To avoid bias a single nurse from each center was trained to administer the C-DAS-3 using a defined protocol. The patients completed the
questionnaires in a comfortable and quiet room. For illiterate participants the C-DAS-3 questions were read by a trained nurse and their answers were recorded.

Instrument
The reliability of the C-DAS-3 was evaluated by estimating internal consistency using Cronbach’s alpha statistic for the overall score and for each subscale. Correlations between the C-DAS-3 subscales and the criterion validity of the total C-DAS-3 score in comparison with HbA1c were examined using Pearson’s correlation statistics, and test-retest consistency was evaluated using intraclass correlation coefficients.

The final Chinese version included translations of all 33 items in the original DAS-3. Five statements evaluated beliefs about the need for special training of healthcare staff, seven items each examined attitudes about the need for tight control of diabetes and seriousness of the disease, six items reviewed the psychosocial impact of diabetes and eight items examined what patients believed about the degree of autonomy they had in decision making. Patients indicated their agreement with each of the 33 statement as: strongly agree (5), agree (4), neutral (3), disagree (2) or strongly disagree (1).

Test-retest reliability was assessed after evaluating internal consistency, in 60 patients who were willing to complete the questionnaire on two occasions 2 to 4 weeks apart. This interval was considered to be long enough for the respondents not to recall their initial answers but not too long for their attitudes to change [48].

Statistical Procedures
SPSS version 15 (IBM, USA) was used to analyze results from psychometric tests and scale analyses. In all analyses, values of $P < 0.05$ were considered statistically significant. The test-retest reliability was evaluated using the paired $t$-test and the Pearson correlation coefficient. The internal consistency of the scale was examined by measuring the item reliability index, performed by calculating the Cronbach’s alpha values for assessing the relatedness of each domain in the questionnaire and of each item in every domain. A principal component analysis with Varimax rotation was used for factor analysis to determine the extent of change in the questionnaire that resulted from the translation. Factors with eigenvalues $\geq 1.0$ were included in the model.

Results
Demographic and Clinical Data
Eighty-two of the initial 6043 questionnaires had missing data, and questionnaires from the remaining 5961 patients (98.6%, male 3233 and female 2728) were included in the analysis. The mean age was 59.5 ± 12.4 years, the mean BMI was 24.49 ± 4.10 kg/m².
and the mean duration of diabetes was 8.75 ± 6.78 years. The majority of patients (71.2%) had at least one complication of chronic diabetes. HbA1c values were obtained from 3480 patients (Table 1).

Psychometric Tests and Scale Statistics

After factor analysis, 6 factors with minimum eigenvalue of 1.0 were extracted, accounted for 59.67% of the total variance. The subscales of the original DAS could not be confirmed in the Chinese population.

Descriptive statistics for the five C-DAS-3 subscales are presented in Table 2. The mean scores ranged from 3.57 ± 0.51 for subscale 3 (‘value of tight control’) to 4.3 ± 0.49 for subscale 1 (‘need for special training’). The reliability (internal consistency) of the subscales based on Cronbach’s alpha statistic ranged from 0.654 for subscale 5 (‘patient autonomy’) to 0.848 for subscale 4 (‘psychosocial impact of diabetes’). The comparison of Cronbach’s alpha of each subscale with the original DAS-3 was also presented in Table 2. Subscale inter-correlations ranged from 0.836 for subscale 1 (‘need for special training’) versus subscale 5 (‘patient autonomy’) to 0.497 for subscale 1 (‘need for special training’) versus subscale 2 (‘seriousness of type-2 diabetes’). This high correlation between the subscales maybe partially due to the fact that the items of the subscales did not load in different factors.

The C-DAS-3 test-retest reliability using intraclass correlation coefficients in a sample of 48 patients who completed the questionnaire on two occasions 2 to 4 weeks apart, was 0.82 (95% CI: 0.68–0.89). The coefficients between the two repeat tests among the same subscales ranged from 0.66 for subscale 5 (‘patient autonomy’) to 0.87 for subscale 4 (‘psychosocial impact of diabetes’) (Table 2). Paired t-test was also applied to evaluate the test-retest reliability which shows no statistical difference between the test and re-test ($t = 0.18$, $p = 0.857$).

The norms of the C-DAS-3 in the diabetes patients whose HbA1c, fasting and 2 h postprandial blood glucose levels were successfully controlled were 3.79 ± 0.29, 3.79 ± 0.30, and 3.79 ± 0.29 respectively. The correlation coefficient between the total Chinese version of Diabetes Attitude Scale score and HbA1c was $r = 0.040$ ($p = 0.018$), and weak correlations between 4 subscales (subscale 1, subscale 4) and A1c were also found. The correlation coefficients were $r = 0.033$ ($p = 0.042$), $r = 0.047$ ($p = 0.006$), $r = 0.077$ ($p = 0.000$), $r = 0.066$ ($p = 0.000$), and $r = 0.024$ ($p = 0.153$), respectively.

There were correlations between the C-DAS score and age, education level, duration of diabetes, presence of complications, and accepted diabetes education, but there was no association between the Chinese DAS score and gender, insulin treatment, and BMI. (Table 3)

Discussion

Theoretical Framework

Based on the results presented here, the C-DAS-3 is a validated tool that can be used in the Chinese population with type-2 diabetes. Our findings provide support for the construct validity and test-retest reliability of the C-DAS-3. The internal consistency of the scale was 0.813, which was validated by previously proposed theoretical frameworks [49,50]. The strength of the inter-correlations among the domains of five subscales suggests that the instrument measures related but separate domains of patients’

### Table 1. Demographic data and baseline characteristics of participants.

| Character                                           | n          | Percentage |
|-----------------------------------------------------|------------|------------|
| Sex (female), n                                     | 2728       | 45.8%      |
| Age (mean ± SD), years                             | 59.50 ± 12.48 |            |
| Level of education                                  |            |            |
| No formal education                                 | 365        |            |
| Primary school                                      | 737        |            |
| Middle school                                       | 1509       |            |
| High school                                         | 1611       |            |
| College level or above                              | 1739       |            |
| Diabetes duration (mean ± SD), years                | 8.79 ± 6.85 |            |
| Treatment, n                                        |            |            |
| Oral medication only                                | 2069       | 34.73%     |
| Insulin only                                        | 1399       | 23.48%     |
| Oral medication + insulin                           | 2269       | 38.08%     |
| Neither oral medication nor insulin                  | 221        | 3.71%      |
| At least one diabetic complication, n               | 4238       | 71.2%      |
| BMI (mean ± SD), kg/m²                              | 24.49 ± 4.10 |            |
| HbA1c (mean ± SD; n=3480)                           | 8.27 ± 2.23 |            |
| ≤ 7.0                                               | 1117       | 32.10%     |
| 7.0–8.5                                             | 1086       | 31.21%     |
| ≥ 8.5                                               | 1277       | 36.69%     |
| Total C-DAS-3 score (mean ± SD)                     | 3.76 ± 0.30 |            |

Data are expressed as means ± SD or as numbers and % (n = 5961). doi:10.1371/journal.pone.0096473.t001
Psychosocial Impact, Training, and Patient Well-Being in China

The mean nurse evaluated subscale scores for the C-DAS-3 were all somewhat lower than that in the original DAS-3 (subscale 1: 4.23 versus 4.67; subscale 2: 3.62 versus 4.58; subscale 3: 3.57 versus 4.43; subscale 4: 3.79 versus 4.39; subscale 5: 3.68 versus 4.33) [45]. The reliabilities (‘internal consistency’) of the subscale 1, subscale 3 and subscale 4 of the C-DAS-3 were higher than that in the original DAS-3 (subscale 1: 0.74 versus 0.67; subscale 3: 0.820 versus 0.72; subscale 4: 0.848 versus 0.65) [45] but others of the C-DAS-3 were lower than that in the original DAS-3 (subscale 2: 0.706 versus 0.80; subscale 5: 0.654 versus 0.76) [45]. The results were comparable. Cultural difference is the possible reason for different reliability outcomes in the Chinese and in the western populations. For example, the reliabilities of the subscale 3 (value of tight control) in the C-DAS-3 was higher than that in the original DAS-3. Compared with western patients, Chinese patients are more stressed on value of tight glycemic control, therefore patients tended to give a more homogeneous response pattern in the Chinese version of the DAS tight control than in a western population. In America, diabetes education has evolved from primarily didactic presentations to more theoretically based empowerment models [51] emphasizing on patient autonomy. Therefore Americans tended to give a more homogeneous response pattern in the original version of the DAS patient autonomy. That is why the reliabilities of the subscale 5 (patient autonomy) in the C-DAS-3 was lower than that in the original DAS-3.

Both the original and Chinese versions of DAS-3 have validated by the experts, but in the factor analysis, the subscales of the original DAS could not be confirmed in the Chinese population, this may be due to the culture difference, diabetes education qualities, as well as the education levels of the participants between two countries.

We found that the highest inter-correlations were for the relationships between the psychosocial impact of diabetes (subscale 4; 0.768) and the need for special training (subscale 1) and between patient autonomy (subscale 5; 0.836) and the need for special training (subscale 1). These findings suggest that patients’ sense of wellbeing may be related to the degree of specialist training received by medical professionals. However, in the original DAS-3 the highest inter-correlation (0.63) was between the seriousness of diabetes and the need for tight control.

In our study, we found correlations between the C-DAS score and age, education level, duration of diabetes, presence of complications, and accepted diabetes education. Patients with higher education level and those who received diabetes education have more serious attitude on diabetes. On the other hand, younger patients (usually with higher education degrees), and patients with complications and longer diabetes duration take diabetes more seriously.

In China, attitudes towards diabetes have rarely been explored, though limited reports of attitudes towards diabetes complications have been reported. In a study of diabetic glaucoma in rural Chinese patients, Yan et al. [52] reported that misconceptions about the nature of the disease commonly results in poor adherence to routine examination schedules during asymptomatic periods. Furthermore, it was proposed that patient education by trained nurses should be implemented through home contact to improve patient compliance [52]. Similar results were

### Table 2. Descriptive statistics, comparison with the original DAS-3 and test-retest intraclass correlation coefficients for C-DAS-3.

| Number of Items | Mean ± SD (N = 5961) | Cronbach’s alpha of C-DAS-3 (N = 5961) | Test-retest Intraclass Correlation (P-Value) |
|-----------------|----------------------|----------------------------------------|-----------------------------------------------|
| Subscale 1      | 5                    | 4.32 ± 0.49                             | 0.740 (<0.0001)                               |
| Subscale 2      | 7                    | 3.62 ± 0.46                             | 0.760 (<0.0001)                               |
| Subscale 3      | 7                    | 3.57 ± 0.51                             | 0.820 (<0.0001)                               |
| Subscale 4      | 6                    | 3.79 ± 0.53                             | 0.848 (<0.0001)                               |
| Subscale 5      | 8                    | 3.68 ± 0.49                             | 0.654 (<0.0001)                               |
| Total Scale     | 33                   | 3.76 ± 0.30                             | 0.706 (<0.0001)                               |

DAS-3: The third version of diabetes attitude scale.

Subscale 1: The highest inter-correlation (0.63) was between the seriousness of diabetes and the need for tight control. Subscale 2: The second highest inter-correlation (0.59) was between the importance of diet and the seriousness of diabetes. Subscale 3: The third highest inter-correlation (0.53) was between the value of tight control and the seriousness of diabetes. Subscale 4: The fourth highest inter-correlation (0.51) was between the need for tight control and the need for diabetes education. Subscale 5: The fifth highest inter-correlation (0.49) was between the patient autonomy and the need for special training.

China Psychosocial Impact, Training, and Patient Well-Being in the C-DAS-3. correlation coefficients were high enough to support the stability of attitudes toward diabetes. Moreover, the test-retest intraclass correlation coefficients were high enough to support the stability of the C-DAS-3.
demonstrated in a wide cross-section of international diabetic patients by the Diabetes Attitudes, Wishes, and Needs (DAWN) study, which indicated that patient compliance with self-management behaviors, particular diet and exercise, was as low as 2.9% in Type 2 diabetic patients [53]. The findings of the current research combined with these previous indications highlights the need for both improved nursing training that includes specialization in diabetes care and patient education programs, particularly in under-served and rural regions of China.

Limitations

The study is to some degree limited by the relatively small populations used to pilot the questionnaire and identify areas that needed changing in the final version, and also by the relatively small population (48 out of 60 patients) available to evaluate the test-retest reliability, it means only 80% of the patients completed the second questionnaire, therefore, there is a selection bias. It would also be beneficial to compare the validity of this version of the C-DAS-3 in other provinces and regions of China.

Only a low level of statistical evidence for a negative relationship between overall C-DAS-3 scores and HbA1c levels was found (r = −0.04). It is theoretically possible that the statistical significance of this correlation may have been due to the large sample size without signifying any clinical significance or importance. However, a previous study undertaken in Argentina study provided evidence to suggest that changing the attitudes of diabetic patients through reeducation contributed to improved care and quality of life and decreases the financial burden of the disease [34]. The attitudes of Chinese patients may be similarly improved through education programs. Before education programs can be designed, however, there is an urgent need for better assessment of attitudes of type-2 diabetes patients, as provided in the current study. Thus, this research provides an essential first step to improving care for diabetes patients in China and potentially implementing education programs in the future.

In conclusion, psychometric properties of a translated version of the C-DAS-3 demonstrated satisfactory validity and reliability and provided an effective measure for evaluating attitudes toward diabetes in a Chinese population with type-2 diabetes. This assessment requires further validation in other populations of Chinese patents with diabetes.

Acknowledgments

We would like to express our gratitude to the participants for their participation.

Prior Presentation

Data from this paper were presented, in part, at the 71st Scientific Sessions of the American Diabetes Association, 24–28 June 2011, San Diego, CA, USA.

Author Contributions

Conceived and designed the experiments: QL. XG. Performed the experiments: QI. XG. LY. TC. CW. LS. ZS. FZ. XD. JH. HY. YC. Analyzed the data: QI. XG. LY. TC. CW. LS. ZS. FZ. XD. JH. HY. YC. Wrote the paper: QL.

Table 3. Correlations between C-DAS-3 and demographic/medical variables.

| Total scale of C-DAS-3 | Pearson’s r | Spearman | Mann-Whitney U | P-value |
|------------------------|-------------|-----------|----------------|---------|
| Gender                 |             |           |                |         |
| Age                    | −0.164      |           | 0.101          |         |
| Diabetes duration      | 0.274       |           | 0.000          |         |
| BMI                    | 0.003       |           | 0.862          |         |
| A1c                    | 0.040       |           | 0.018          |         |
| Education level        | 0.352       |           | 0.000          |         |
| Complications          | 0.387       |           | 0.000          |         |
| Diabetes Education    | 0.226       |           | 0.000          |         |
| Insulin treatment      | −1.213      |           | 0.225          |         |

doi:10.1371/journal.pone.0096473.t003

References

1. Peyrot M, Rubin RR, Lauritzen T, Szklohlud SE, Snoek FJ, et al (2006) Patient and provider perceptions of care for diabetes: results of the cross-national DAWN Study. Diabetologia 49: 279–288.
2. Donnelly MB, Anderson RM (1990) The role related attitudes of physicians, nurses, and dieticians in the treatment of diabetes. Medical Care 28: 175–179.
3. Dziemidok P, Makara-Studzinska M, Jarosz MJ (2011) Diabetes and depression: a combination of civilization and lifestyle diseases is more than simple problem adding - literature review. Am Agric Environ Med 18: 318–322.
4. Ismail K, Winstley K, Rabe-Hesketh S (2004) Systematic review and meta-analysis of randomised controlled trials of psychological interventions to improve glycaemic control in patients with type 2 diabetes. Lancet 363: 1589–1597.
5. Berk KA, Buijks H, Oczan B, Van’t Spijker A, Buschbach JJ, et al. (2012) The prevention of weight regain in diabetes type 2 (POWER) study: the effectiveness of adding a combined psychological intervention to a very low calorie diet, design and pilot data of a randomized controlled trial. BMC Public Health 12: 1026–1039.
6. Eccleston C, Palermo TM, Fisher E, Law E (2012) Psychological interventions for parents of children and adolescents with chronic illness. Cochrane Database Syst Rev doi:10.1002/14651858.
7. Polonsky WH, Fisher L, Earles J, Duhl RJ, Lees J, et al. (2005) Assessing psychosocial distress in diabetes: development of the diabetes distress scale. Diabetes Care 28: 626–631.
8. Fisher L, Glasgow RE, Mullan JT, Skaff MM, Polonsky WH (2008) Development of brief diabetes distress screening instrument. Ann Fam Med 6: 246–252.
9. Polonsky WH, Anderson BJ, Lohrer PA, Welch G, Jacobson AM, et al. (1995) Assessment of diabetes-related distress. Diabetes Care 18: 754–760.
10. Welch GW, Jacobson AM, Polonsky WH (1997) The Problem Areas in Diabetes scale: an evaluation of its clinical utility. Diabetes Care 20: 760–766.
11. Anderson RM, Funnell MM, Fitzgerald JT, Marrero DG (2000) The Diabetes Empowerment Scale: a measure of psychosocial self-efficacy. Diabetes Care 23: 739–743.
12. Anderson RM, Fitzgerald JT, Gruppen LD, Funnell MM, Oh MS (2003) The diabetes empowerment scale-short form (DES-SF). Diabetes Care 26: 1641–1642.
13. Pandit AU, Bailey SC, Curtis LM, Seligman HK, Davis TC, et al. (2014) Disease-related distress, self-care and clinical outcomes among low-income patients with diabetes. J Epidemiol Community Health. In press. doi:10.1136/jech-2013-203063.
Baradaran HR, Mirzhorbami SM, Javanbakht A, Yadollahi Z, Khamseh ME. (2013) Diabetes distress and its association with depression in patients with type 2 diabetes in Iran. Int J Prev Med 4: 380-384.

Fishel L, Glasgow RE, Strycker LA (2016) The relationship between diabetes distress and clinical depression with glycemic control among patients with type 2 diabetes. Diabetes Care 39: 1034-1036.

Hendrickx C, Halliday JA, Bowden JP, Colman PG, Cohen N, et al. (2014) Severe hypoglycemia and its association with psychological well-being in Australians with type 1 diabetes attending specialist tertiary clinics. Diabetes Res Clin Prac. In press. doi:10.1016/j.diabres.12.005.

Reddy J, Wilhelm K, Campbell L (2013) Putting PAID to diabetes-related distress: the potential utility of the problem areas in diabetes (PAID) scale in patients with diabetes. Psychosomatics 54: 44-51.

Hayashino Y, Okamura S, Matsumaga S, Tsuji I, Ishii H, et al. (2012) The association between problem areas in diabetes scale scores and glycemic control is modified by types of diabetes therapy: diabetes distress and care registry in Tsuru (DDCRT). Diabetes Res Clin Pract 97: 405-410.

Levy B, Zagaris SE, Allen NA, Welch G (2011) The relative impact of diabetes distress vs depression on glycemic control in Hispanic patients following a diabetes self-management education intervention. Ehn Dvi 21: 322-327.

Anderson RM, Funnell MM, Alkers JE, Krein SL, Fitzgerald JT, et al. (2009) Evaluating the Efficacy of an Empowerment-Based Self-Management Consultant Intervention: Results of a Two-Year Randomized Controlled Trial. Thier Patient Educ 1: 3-11.

Tol A, Baghbanian A, Mohiehli B, Shojaeizadeh D, Azam K, et al. (2013) Empowerment assessment and influential factors among patients with type 2 diabetes. Diabetes Metab Disord 12: 6. Available: http://www.jdmonline.com/content/12/1/6. Accessed 2014 March 11.

Samooshia D, Bruninvels DJ, Elbers NA, Anema JR, van der Beek AJ (2010) Effectiveness of web-based interventions on patient empowerment: a systematic review and meta-analysis. Med Internet Res 12: e23. Available: http://www.jmir.org/2010/2/e23/. Accessed 2014 March 11.

Yang Q, Liao XQ (2010) The reliability and validity of Chinese version of Diabetes Distress Scale. Journal of Nursing (China) 17: 8-10.

Ting RZ, Nan H, Yu MW, Keng AP, Ma RG, et al. (2011) Diabetes-related distress and physical and psychological health in Chinese type 2 diabetic patients. Diabetes Care 34: 1094-1096.

Hsu HC, Chang YH, Lee PJ, Chen SY, Haich CH, et al. (2013) Developing and psychometric testing of a short-form problem areas in diabetes scale in Chinese patients. J Nurs Res 21: 212-216.

Hu BB, Lou QQ, Tian Y, Zhang QW, Zhu JY (2011) Empowerment and its influencing factors of diabetes inpatients. Journal of Nursing (China) 46: 225-229.

Shiu AT, Wong RY, Thompson DR (2003) Development of a reliable and valid Chinese version of the diabetes empowerment scale. Diabetes Care 26: 2817-2821.

Shiu AT, Choi KC, Wong RY (2012) The Chinese version of the Diabetes Empowerment Scale-short form. Patient Educ Couns 87: 250-260.

Kong L, Cai Y, Mei G, Gu R, Zhang X, et al. (2013) Psychological status and diabetes-related distress of Chinese type 1 diabetes patients in Jiangsu province, China. J Biomed Res 27: 309-315.

Zhang J, Xu CP, Wu HX, Xue XJ, Xu ZJ, et al. (2013) Comparative study of the influence of diabetes distress and depression on treatment adherence in Chinese patients with type 2 diabetes: a cross-sectional survey in the People’s Republic of China. Neuropsychiatr Dis Treat 9: 1289-1294.

Chen B, Zhang X, Xu X, Lu X, Yao L, et al. (2013) Diabetes education improves depressive state in newly diagnosed patients with type 2 diabetes. Pak J Med Sci 29: 1147-1152.

Ajzen I, Fishbein M (1980) Understanding Attitudes and Predicting Social Behavior. Englewood Cliffs, NJ: Prentice Hall.

Mossner-Pudar H, Hochberg G, Eschwege E, Halimi S, Virally ML, et al. (2010) How patients’ attitudes and opinions influence self-care behaviours in type 2 diabetes. Insights from the French DIABASIS Survey. Diabetes and Metab 36: 476-483.

Peeyot M, Barnett AH, Meneghini LF, Schumann-Draeger PM (2012) Insulin adherence behaviours and barriers in the multinational Global Attitudes of Patients and Physicians in Insulin Therapy study. Diabet Med 29: 682-689.

Anderson RM, Fitzgerald JT, Oh MS (1993) The relationship between diabetes-related attitudes and patients’ self-reported adherence. Diabetes Educator 19: 287-292.

Polly RK (1992) Diabetes health beliefs, self-care behaviors, and glycemic control among older adults with non-insulin-dependent diabetes mellitus. Diabetes Educator 18: 921-927.

Chen A, Huang Z, Wan X, Deng W, Wu J, et al. (2012) Attitudes toward diabetes affect maintenance of drug-free remission in patients with newly diagnosed type 2 diabetes after short-term continuous subcutaneous insulin infusion treatment. Diabetes Care 35: 474-481.

Mahjour MY, Arzaghi SM, Qorhani M, Nabi-Esfahani E, Larjani B (2011) Evaluation of psychometric properties of the third version of the Iranian Diabetes Attitude Scale (IR-DAS-3). Iranian Journal of Diabetes and Lipid Disorders 10: 1-6.

Sadhline JB, Carwell B, Gregg EW, Engelgau MM, Vinicor F, et al. (2006) Improvements in diabetes processes of care and intermediate outcomes: United States, 1980-2002. Ann Intern Med 144: 465-474.

Alberti G (2002) The DAWN (Diabetes Attitudes, Wishes, and Needs) study. Pract Diabetes Int 19: 22-24.

Mani N, Gadis E, Fortuna R (2011) The influence of social networks on patients’ attitudes toward type II diabetes. J Community Health 36: 720-732.

Shah VN, Kamarud PK, Shah N (2009) Assessing the knowledge, attitudes and practice of type 2 diabetes among patients of Saurashtra region, Gujarat. Int J Diabetes Dev Ctries 29: 118-122.

Mazzucaro SA, Moorman NH, Wheeler ML (1986) The diabetes education study: a controlled trial of the effects of diabetes education. Diabetes Care 9: 1-10.

Anderson RM, Donnelly MB, Gressard CP, Dedrick RF (1989) Development of diabetes attitude scale for health-care professionals. Diabetes Care 12: 120-127.

Anderson RM, Fitzgerald JT, Funnell MM, Gruppen LD (1998) The third version of the Diabetes Attitude Scale. Diabetes Care 21: 1403-1407.

Bridin R (1986) The wording and translation of research instruments. In: Loner W, Berry J, editors. Field Methods in Cross-Cultural Research. Newbury Park, CA, pp. 137-164.

Zhou X, Lou Q, Zhang X, Zhu W (2011) Survey on attitude and behavior of patients with diabetes in self-management education. Nursing Rehab 10: 947-949.

Jackson CJ, Farnham A (2000) Designing and analysing questionnaires and surveys: a manual for health professionals and administrators. Whurr Publishers, London.

Indrayan A, Sasmalkashan A (2001) Medical statistics, Marcel Dekker, New York.

MacDougall JD, Wenger HA, Green HJ, CASS (1991) Physiological testing of the high-performance athlete, Human Kinetics Books, Champaign, IL.

Funnell MM, Brown TL, Childs FP, Haas LB, Hoeys GM, et al. (2008) National standards for diabetes self-management education. Diabetes Care 31: S97-S104.

Yao X, Liu T, Gruber L, He M, Congdon N (2012) Attitudes of physicians, patients, and village health workers toward glaucoma and diabetic retinopathy in rural China: a focus group study. Arch Ophthalmol 130: 761-767.

Funnell MM (2006) The Diabetes Attitudes, Wishes, and Needs (DAWN) Study. Clinical Diabetes 24: 154–155.

Gagliardino JJ, Gonzalez C, Caporale JE (2007) The diabetes-related attitudes of health care professionals and persons with diabetes in Argentina. Revista Panamericana de Salud Publica 22: 304-307.