

Diabetes Health Profile-18 is Reliable, Valid and Sensitive in Singapore

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Abstract

Introduction: The Diabetes Health Profile-18 (DHP-18) measures diabetes-related psychological well-being in patients with type 2 diabetes mellitus (T2DM). It includes 3 subscales: psychological distress (PD), barriers to activity and disinhibited eating. The psychometric properties of the DHP have not been evaluated in Asia. The aim of this study was to determine the psychometric properties of the DHP in multiethnic Singapore. **Materials and Methods:** Patients between the ages of 18 to 65 diagnosed with diabetes (either type 1 or type 2) for at least 1 year were recruited from a diabetes outpatient clinic in a tertiary hospital. They completed a set of self-administered questionnaires including sociodemographic information and the DHP. Validity of the DHP was evaluated using confirmatory factor analysis (CFA) and exploratory factor analysis (EFA). Reliability was assessed with internal consistency and sensitivity was determined by effect size, associated with detecting a statistically significant and clinically important difference between various patient subgroups. **Results:** A total of 204 patients with mean age 45.4 (11.9) years, comprising 64% males and 50% Chinese, 27% Indian and 12% Malay were studied. In CFA, model fit was poor. Forced 3-factor EFA supported the original 3-factor structure of the DHP. Convergent and discriminant validity was demonstrated (100% scaling success). DHP was sensitive across majority of social demographic, clinical and social-functioning determinants (i.e., effect size >0.3). Cronbach's alpha exceeded 0.70 for all subscales. Ceiling effects were negligible but large floor effects were seen for the PD subscale (23%). **Conclusion:** The DHP is valid, reliable and sensitive for measuring well-being in Asian patients with T2DM.

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Introduction

Type 2 diabetes mellitus (T2DM) is a global burden; in Asia, its prevalence will significantly increase in the next few decades.¹ In addition, it is a chronic disease that can have profound effects on the physical, psychological and social well-being of an individual. It is one of the most psychologically demanding chronic diseases as it is a lifelong condition with no cure;² it is a chronic disease that can lead to a multitude of complications associated with significant morbidity and mortality.^{2,3} A significant part of the treatment is focused on self-management, which requires constant monitoring, diet change and lifestyle

modifications.⁴ Hence, to improve clinical outcomes, it is important that the psychological well-being of patients with T2DM be constantly monitored and discussed with patients, to prevent the onset of depression, which will limit treatment adherence and lead to poorer glycaemic control, increased risk for diabetes complications and increased health care costs.⁵⁻⁷

Diabetes-specific instruments such as the Problem Areas in Diabetes (PAID),⁸ the Diabetes Quality of Life Measure (DQOL),⁹ and the Diabetes Health Profile-18 (DHP-18)⁴ are examples of questionnaires that measure the psychological well-being of patients with T2DM. A PubMed search on the

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3 questionnaires showed that PAID is the most published questionnaire to date (22 publications), followed by DQOL and DHP-18 with 4 publications each. Yet, there are several reasons why the DHP-18 is preferred over the PAID and DQOL: 1) DHP-18 is the shortest questionnaire, consisting of 18 items. Respondent burden is becoming the main cause of non-response.¹⁰ Having a short questionnaire will reduce the burden on respondents and encourage participation; 2) DHP-18 measures multiple domains of psychological well-being, such as psychological distress (PD), barriers to activities (BTA) and disinhibited eating (DE); 3) In particular, the DE subscale is not covered by any other instruments despite studies showing that DE is a frequent struggle experienced by many patients with T2DM;¹¹ and 4) Studies in European populations had shown that the psychometric properties of the DHP-18 achieved good internal consistency, validity and measurement equivalence.^{4,12,13} To date, studies on the psychometric properties of the DHP-18 have been performed extensively in Western populations.^{4,12,13} As such, there seems to be a lack of research conducted within the Asian population, whose cultures, values and beliefs are different from the West.¹⁴

Thus, the aim of this study was to determine the validity, reliability and sensitivity of the DHP-18 for the multiethnic population of Singapore. We hypothesise that: 1) we would obtain a 3-factor solution similar to the original design of the instrument; 2) validity would be achieved, where item-scale correlations will attain a correlation of ≥ 0.40 ¹⁵ and items would have significantly higher correlation with its hypothesised scale than with scales measuring other constructs; 3) reliability would be met as item means and standard deviations (SDs) would be similar within each scale; 4) floor and ceiling effect would be minimal ($<15\%$); and 5) known-groups validity, as guided by literature (e.g., those with complications will have poorer health-related quality of life [HRQoL] as compared to those without complications) would be met.

Materials and Methods

Study Design and Participants

This is a secondary analysis of the baseline data of a prospective longitudinal study on outcomes from a convenience sampling of patients with diabetes mellitus (PEAQ DM). This study was approved by the National Healthcare Group Domain Specific Review Board. English-literate patients aged between 21 and 65 years old, who were diagnosed with diabetes (type 1 or 2) for at least 1 year, were recruited from the specialist outpatient clinic of the National University Hospital from 2011 to 2012. Patients were selected at the clinic waiting area. Patients were excluded if there was self-reported or documented

gestational diabetes, unstable and ongoing treatment of heart, kidney, liver and psychiatric conditions and gestational diabetes. The study terms and procedures were explained and written informed consent was obtained from all recruited patients. In the analysis, we only presented data on T2DM patients.

Data Collection

Data on demographic factors were collected from self-administered questionnaires. Ethnic group was classified as Chinese, Malay, Asian Indian or Others. Marital status was classified as “never married”, “currently married” or “separated/divorced/widowed”. Education level was determined based on the number of schooling years and was categorised into <7 (primary education), 7–10 (secondary education) and >10 years (tertiary education). Medical history of comorbidities (such as history of cardiovascular disease, retinopathy, nephropathy, peripheral vascular disease, anaemia, cerebrovascular disease and hepatic disease) was captured through self-reports. Glycaemic control (glycated haemoglobin test [HbA1c]) levels were collected either a few days before the clinic visit (along with the other blood tests) or on the day itself (as a standalone, finger prick test) at baseline at the National University Hospital.

Diabetes Health Profile (DHP)

The DHP-18 consists of 18 items covering 3 subscales: PD (6 items), BTA (7 items) and DE (5 items). Each item in DHP-18 is scored 0 to 3 (“Never” to “Very much”) and subscales are rescored on a 0–100 scale by dividing the raw score for each subscale by the overall score range and multiplying this by 100.¹⁶ High scores indicate poorer well-being. Since its development, the DHP-18 had been translated into 28 languages and could be completed via paper/pencil, interviewer-administered, self-administered, or electronically through handheld devices or internet. The DHP-18 will be referred to as DHP henceforth.

Definitions of Known-Group Variables

Several groups were created based on clinical, sociodemographic (age, gender and ethnicity), socioeconomic status (education and household income) and social functioning determinants for the purpose of evaluating the construct validity of DHP. Glycaemic control was determined by measuring HbA1c. We classified patients with good control of HbA1c as achieving the standard of $\text{HbA1c} \leq 7.0\%$.¹⁷ Medications were classified into treatment types, such as oral, insulin or both. Presenteeism, which is a measure of the effectiveness of an individual who goes to

work despite having an illness, was measured using a single question: “On a scale of 0 to 10, how effective are you at work?” We considered a score ≤ 5 as not effective at work. PAID is a 20-item questionnaire measuring DM-specific psychological distress. PAID scores were dichotomised, with patients scoring 40 and above indicating severe DM-specific emotional distress.¹⁸

Statistical Analysis

For all questionnaires used, individual items were summed and transformed (where necessary) as recommended in the respective user manuals.^{8,19,20} Participants with missing DHP item scores were excluded list-wise from the analysis. Continuous variables were presented as means $\pm$ SDs unless otherwise stated and categorical variables were presented as percentages. Analyses were performed using Stata version 12 (StataCorp LP).

Validity

Construct validity assesses the degree to which an instrument measures what it was designed to measure. Factor analysis is a well-established method for assessing construct validity.²¹ A confirmatory factor analyses (CFA) was conducted based on the factor structure suggested by the developer.²² A conventional good model fit criteria includes Tucker-Lewis index (TLI) ≥ 0.9 or comparative fit index (CFI) ≥ 0.9 . An unforced exploratory factor analysis (EFA) with varimax orthogonal rotation would be carried out if the model fit for the CFA was poor. Eigen value ≥ 1 was used to determine the number of factors in the unforced EFA.

Spearman rank correlations were performed to assess convergent and discriminant validity where convergent validity referred to high item-scale correlation exceeding 0.4 and be approximately equal within a scale²³ and discriminant validity referred to the item having higher correlation with its hypothesised scale rather than scales measuring other concepts. Scaling success was declared whenever an item correlated more strongly with its hypothesised scale than with a scale measuring a different construct.¹⁵

Reliability

The Cronbach’s alpha coefficient was used to determine internal consistency of the subscales. Good reliability was defined as Cronbach’s alpha ≥ 0.7 for group comparisons and ≥ 0.9 for individual assessments.¹⁵ The percentage of respondents scoring at the floor (domain/total score = 0) and ceiling (domain/total score = 100) was also determined. A floor (ceiling) effect was defined as being present if $>15\%$ of the subjects scored at the minimum (maximum) level respectively.²⁴

Sensitivity

Sensitivity was determined by effect size (ES), derived by dividing the differences in the mean scores between the 2 groups by the pooled standard deviation (PSD).²⁵ A sensitive instrument is able to detect a statistically significant and clinically important difference (ES >0.3) between various patient subgroups.^{26–28} This measurement will concurrently measure known-groups validity, where we expect participants without complications to have lower DHP scores, indicating better psychological well-being.^{29,30}

Results

In total, 406 T1DM and T2DM patients consented to participate in the study, leading to a response rate of 68.9% (Fig. 1). As T1DM and T2DM were confirmed against case notes after enrolment, the response rate could not be stratified by type of diabetes. However, after the various exclusions, the final number of patients with T2DM in the study was 217. Thirteen patients were excluded from the study due to missing information in the DHP and PAID questionnaires. Table 1 describes the sociodemographic and medical history of the 204 patients with T2DM included in the study. The mean SD age of the population was 45.4 (11.9) years with 64% males; 50% of the subjects were Chinese, followed by Indians (27%) and Malays (12%). Most of the subjects had at least one comorbidity with retinopathy (14%), cardiovascular (13%), followed by nephropathy (8%), to name a few. The PAID classified 32% as suffering from severe psychological distress.

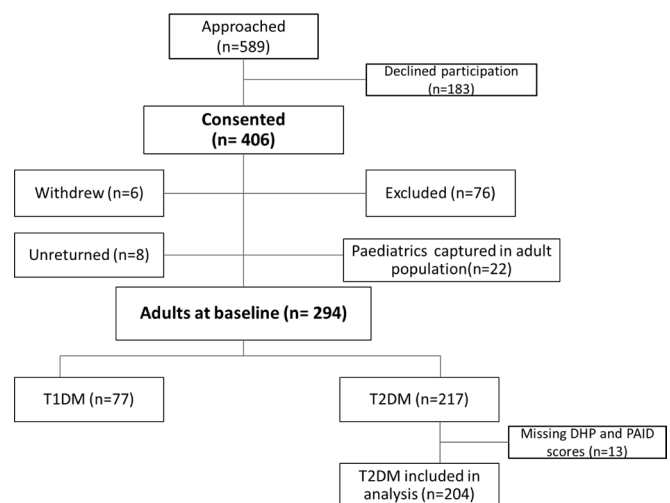


Fig. 1. Flowchart of the recruitment of patients with type 2 diabetes mellitus.

Table 1. Social Demographic of Sampled Patients with Type 2 Diabetes Mellitus

	All Races (n = 204)	
	n	%
Age (mean [SD], 95% CI)	45.4 (11.9)	43.8 – 47.1
Gender		
Male	131	64.2
Female	73	35.8
Ethnicity		
Chinese	103	50.5
Malay	24	11.8
Indian	57	27.9
Others	20	9.8
Education		
<7 years	16	8.5
7 – 10 years	65	34.4
>10 years	108	57.1
Marital status		
Single	41	20.1
Married	127	62.3
Divorced/widowed	20	9.8
Comorbidities (yes)		
Retinopathy	28	13.7
Cardiovascular disease	27	13.2
Nephropathy	17	8.3
Neuropathy	14	6.9
Cerebrovascular disease	12	5.9
Anaemia	12	5.9
PVD	6	2.9
Hepatic	5	2.5
Renal	1	0.5
Psychological distress scales		
PAID (mean [SD], 95% CI)	28.8 (21.9)	25.8 – 31.9
Severe distress (yes)	66	32.4
DHP (mean [SD], 95% CI)		
Psychological distress	21.2 (22.0)	18.1 – 24.2
Barriers to activity	27.4 (19.7)	24.7 – 30.1
Disinhibited eating	42.1 (17.5)	39.7 – 44.5
Glycaemic Control		
Good (HbA1c ≤7%)	58	28.4
Poor (HbA1c >7%)	146	71.6

CI: Confidence interval; DHP: Diabetes Health Profile; HbA1c: Glycated haemoglobin; PAID: Problem Areas in Diabetes; PVD: Peripheral vascular disease; SD: Standard deviation

Validity

Table 2 provides the psychometric properties of the DHP subscales. Convergent validity was observed as all item-scale correlations exceeded 0.4 except the item, “Not easy to stop eating”, from the DE subscale which achieved a correlation of -0.24. Nonetheless, the item achieved discriminant validity and hence scaling success for the DHP subscales was 100% for all items.

CFA (Table 3) showed that PD and the DE subscales both met the criteria for a good fit, but not the BTA subscale. This prompted the use of EFA to determine the factor structure of DHP-18 among Asians in Singapore. A 4-factor solution explaining 63% of the total variance of the data was obtained when the EFA was performed (Table 3). When a forced 3-factor EFA was performed, the original factor structure was reproduced (Table 4), accounting for 57% of the variance.

Reliability

Cronbach’s alpha exceeded 0.70 for all subscales (Table 2). Ceiling effects were negligible but large floor effects were seen for the PD subscale (23%). As expected, item mean and SD were similar within the scale (Table 5). The only exception is the subscale BTA, which had a wider range of item means from 0.38 to 1.55.

Sensitivity

Table 6 shows the results of sensitivity and known-group validity. Among the social determinants, DHP subscales did not differentiate well between patients aged 45 years and over and patients younger than 45 years, men and women, across ethnicity and marital status (i.e., not sensitive), except DE which differentiated between the 2 age groups, ethnicity and marital status. The DHP subscales better differentiated across housing types and household income (i.e., more sensitive).

Among the clinical determinants, the subscale BTA was most efficient in differentiating among patients with and without chronic medical conditions (4 out of 6 chronic medical conditions studied: retinopathy, cardiovascular disease, nephropathy and neuropathy). DE was the least efficient (was sensitive in 2 out of 6 chronic medical conditions). All DHP subscales were able to differentiate well between good and poor glycaemic control.

Among the social functioning determinants, all subscales were sensitive across the 4 social functioning determinants studied except DE (sensitive in 2 of 4 determinants studied). Most importantly, DHP subscales were able to differentiate between known-groups based on PAID score and the effect sizes were large.

Table 2. Item Scaling Tests of the DHP in Singaporean Patients with Type 2 Diabetes Mellitus

	Floor (%) Ceiling (%)		Convergent Validity (Range of Correlations)	Discriminant Validity (Range of Correlations)	Cronbach's Alpha
DHP					
Psychological distress	23.53	0.98	0.68 – 0.82	-0.16 – 0.52	0.89
Lose temper over testing/diet					
More arguments at home because of diabetes					
Depressed because of diabetes					
Lose your temper/shout due to diabetes					
Touchy/moody about diabetes					
Lose temper over small things					
Barriers to activity	4.41	0	0.47 – 0.78	-0.05 – 0.52	0.78
Food controls life					
Difficulty staying out late					
Days tied to meal times					
Avoid going out if sugars on the low side					
Worry about colds and flu					
Frightened in busy/crowded shops					
Edgy when out and nowhere to eat					
Disinhibited eating	0	0	-0.24 – 0.80	0.15 – 0.52	0.78
Eat to cheer self up					
Hard saying no to food					
Not easy to stop eating					
Eat something extra when bored					
Wished not so many nice things to eat					

DHP: Diabetes Health Profile

Discussion

In this study to evaluate the psychometric properties of the DHP in Asia (among Chinese, Malay and Asian Indians), we found that the instrument was valid, reliable and sensitive in determining the psychological well-being of individuals with T2DM. Convergent validity with another well-studied diabetes-specific distress scale (PAID) was also supported. However, we found that the psychological distress subscale was limited insofar as the subscale had large floor effect and SD, which was a similar observation in the DHP Danish study and among those who were on oral medications- and diet-treatment in the United Kingdom study.⁴

Our study showed that Malays had the highest levels of psychological distress compared to Chinese, Indians and Others. This could be due to a greater proportion of Malays being older and less educated in our population. Research has shown that older and less educated individuals have lesser knowledge on the availability of resources and services to cope with their levels of distress.^{31,32} This is in contrast to another study of depressive symptoms among Singaporeans

with diabetes using the Center for Epidemiologic Studies Depression (CESD) Scale—the authors reported that Indians with T2DM tended to have higher levels of psychological distress as compared to the other ethnic groups.³³ Perhaps there is an ethnic difference in the prevalence of general depression (as measured by CESD) and diabetes-specific distress (as measured by DHP). This finding requires further investigation.

Interestingly, despite the poor fit of the BTA subscale in the CFA, the forced 3-factors EFA was identical to that suggested by the developer. In fact, the variance accounted for by the forced EFA was higher than that reported by the developer. On closer scrutiny of the items from BTA subscale in the unforced EFA, it appears that items 11, 13 and 14 were more “psychologically” related, given their marginal loadings on the psychological distress factor (Table 4). A similar observation was seen only for item 13 in the study by Goddijn et al,¹² whereby item 13 loaded onto both BTA as well as PD. Nonetheless, since the forced 3-factor EFA replicated the suggested factors by the developer, there is no need to pursue this further.

Table 3. Confirmatory Factor Analyses (CFA) and Forced 3-Factor Exploratory Factor Analysis (EFA) of the DHP-18

Items	EFA Factor Loadings		CFA	
	Factor 1	Factor 2	Factor Loadings	TLI (≥ 0.9) CFI (≥ 0.9)
Psychological distress				
DHP6: Lose temper over testing/diet	0.6285		0.6503858	0.9093 0.9456
DHP8: More arguments at home because of diabetes	0.5455		0.4813783	
DHP15: Depressed because of diabetes	0.7702		0.6290018	
DHP16: Lose your temper/shout due to diabetes	0.8544		0.6528133	
DHP17: Touchy/moody about diabetes	0.8664		0.7362633	
DHP18: Lose temper over small things	0.8494		0.6386526	
Barriers to activities				
DHP1: Food controls life	0.5362		0.4662655	0.693 0.7953
DHP2: Difficulty staying out late	0.7554		0.7004328	
DHP3: Days tied to meal times	0.8263		0.7963153	
DHP4: Avoid going out if sugars on the low side	0.6744		0.5576317	
DHP11: Worry about colds and flu		0.6205	0.3937982	
DHP13: Frightened in busy/crowded shops		0.7512	0.3074122	
DHP14: Edgy when out and nowhere to eat		0.7421	0.3875212	
Disinhibited eating				
DHP5: Eat to cheer self up	0.6757		0.8138619	0.9857 0.9929
DHP7: Hard saying no to food	0.6543		0.7432837	
DHP9: Not easy to stop eating	-0.7617		-0.3998019	
DHP10: Eat something extra when bored	0.7128		0.4920831	
DHP12: Wished not so many nice things to eat	0.5426		0.5310986	

CFI: Comfort fit index; DHP: Diabetes Health Profile; EFA: Exploratory factor analysis; TLI: Tucker-Lewis index

Just like Mulhern and Meadows³⁴ who showed that the DHP was able to discriminate between patients based on the presence/absence of comorbidities, we observed larger ES for the comorbidities that were more severe in nature. Importantly, it was noted that the largest ES were seen in the comparison between patients who had psychological distress with those who did not (as identified by PAID). This was also observed in the paper by Mulher and Meadows.³⁴ This did not come as a surprise for the PD subscale. However, BTA and DE also had the largest ES when comparing between patients who had psychological distress with those who did not. Studies had shown that social stigma was a limiting factor to social activities especially to patients with T2DM who had to inject insulin or refuse food at social gatherings.^{35,36} Similarly, studies had found that distress often led to a loss of one's self control, which resulted in overeating.^{11,37} All these help to explain the large ES observed between patients with no and serious psychological distress in the DHP subscales BTA and DE.

With the availability of DHP-18 on the internet and mobile versions, the DHP-18 can be easily completed while patients wait to see their doctor, with the results ready for clinicians to discuss with the patient during routine clinic session. The study by Chawla et al³⁸ had shown that when

clinicians were able to address specific problem areas that patients face, the clinicians were able to improve patients' metabolic outcomes and satisfaction.

An important strength of this study lies in the consideration of the sensitivity of the DHP. Unlike most studies that focused on the reliability and validity of the instrument, studying the sensitivity of the DHP will provide information on the efficiency of the instrument in detecting differences between subgroups, which is critical in determining sample size requirement for future studies. A second strength lies in the variety of determinants used to assess the ability of the DHP instrument in discriminating various health states. Unlike previous studies that only used medication types,^{4,12,13} we had used clinical (e.g., glycaemic control), social functioning (e.g., effectiveness at/outside work) as well as psychological variables (e.g., PAID questionnaire) to further assess the DHP. This gives us greater confidence on the measurement abilities of the DHP within the population.

This study has a few limitations. Firstly, due to the cross-sectional nature of this study, test-retest reliability and responsiveness of the DHP could not be evaluated. Secondly, we only captured English-speaking patients, thus limiting the generalisability of our findings. However, based on the Singapore Census 2010, 75% of the Singapore resident

Table 4. Factor Loading Patterns from the Forced Exploratory Factor Analysis Using Principal Component

Variable	Factor 1	Factor 2	Factor 3
Psychological distress			
DHP6: Lose temper over testing/diet	0.6173	0.2954	0.3465
DHP8: More arguments at home because of diabetes	0.5193	0.2921	0.2923
DHP15: Depressed because of diabetes	0.7919	0.2098	0.1538
DHP16: Lose your temper/shout due to diabetes	0.8637	0.1332	0.0997
DHP17: Touchy/moody about diabetes	0.8873	0.1324	0.1298
DHP18: Lose temper over small things	0.8302	0.058	0.1354
Barriers to activities			
DHP1: Food controls life	0.1567	0.4492	0.3707
DHP2: Difficulty staying out late	0.2083	0.742	0.2602
DHP3: Days tied to meal times	0.1032	0.8008	0.1052
DHP4: Avoid going out if sugars on the low side	0.2066	0.6733	-0.0784
DHP11: Worry about colds and flu	0.2968	0.5091	0.0896
DHP13: Frightened in busy/crowded shops	0.3824	0.4714	-0.1442
DHP14: Edgy when out and nowhere to eat	0.3771	0.447	0.127
Disinhibited eating			
DHP5: Eat to cheer self up	0.2998	0.3191	0.7147
DHP7: Hard saying no to food	0.3517	0.251	0.6687
DHP9: Not easy to stop eating	-0.0124	0.1027	-0.7513
DHP10: Eat something extra when bored	0.1322	-0.0595	0.6938
DHP12: Wished not so many nice things to eat	0.2912	0.3393	0.5184

DHP: Diabetes Health Profile

Table 5. Scale and Item Mean and Standard Deviation of DHP

	Score Range	Mean	SD
Psychological distress			
Lose temper over testing/diet	0,3	0.73	0.95
More arguments at home because of diabetes	0,3	0.56	0.84
Depressed because of diabetes	0,3	0.64	0.78
Lose your temper/shout due to diabetes	0,3	0.51	0.75
Touchy/moody about diabetes	0,3	0.64	0.81
Lose temper over small things	0,3	0.73	0.81
Barriers to activity			
Food controls life	0,3	1.55	0.93
Difficulty staying out late	0,3	0.67	0.86
Days tied to meal times	0,3	1.17	1.02
Avoid going out if sugars on the low side	0,3	0.83	1.00
Worry about colds and flu	0,3	0.62	0.88
Frightened in busy/crowded shops	0,3	0.38	0.76
Edgy when out and nowhere to eat	0,3	0.53	0.84
Disinhibited eating			
Eat to cheer self up	0,3	1.10	1.00
Hard saying no to food	0,3	1.20	0.94
Not easy to stop eating	0,3	1.82	0.78
Eat something extra when bored	0,3	1.45	0.91
Wished not so many nice things to eat	0,3	0.75	0.93

DHP: Diabetes Health Profile; SD: Standard deviation

Table 6. Comparison of DHP Subscales across Social, Socioeconomic, Clinical, Social Functioning and Psychological Determinants

Social determinants	n	DHP							
		Psychological Distress				Barriers to Activities			
		Mean	SD	ES*	Mean	SD	ES*	Mean	SD
Age									
<45 years	86	23.00	23.62		27.80	17.89		45.27	16.59
≥45 years	117	19.80	20.84	0.14	26.54	20.24	0.07	39.66	17.89
Gender									
Male	131	20.65	22.82		25.99	19.86		41.83	17.13
Female	73	22.07	20.60	-0.06	29.88	19.30	-0.20	42.65	18.35
Ethnicity									
Chinese	103	20.93	21.19		27.79	20.50		43.95	17.48
Malay	24	25.69	25.94	-0.22	32.54	22.05	-0.23	41.67	15.39
Indian	57	18.71	22.11	0.10	25.31	18.40	0.12	38.60	17.98
Others	20	23.89	21.33	-0.14	25.00	15.82	0.14	43.33	18.67
Marital status									
Single	41	23.04	20.32	-0.09	26.83	17.65	0.03	48.29	15.55
Married	127	21.04	22.47		27.37	19.89		41.05	18.31
Divorced/widowed	20	21.39	22.02	-0.02	28.81	22.57	-0.07	37.67	15.93
Socioeconomic determinants									
Education									
<7 years	16	21.18	20.31		35.42	23.33		35.83	21.76
7 – 10 years	65	26.24	23.08	-0.22	29.30	20.00	0.30	43.28	19.08
>10 years	108	18.47	20.92	0.13	25.44	19.49	0.50	42.53	16.32
Housing type									
HDB 1 – 4-room flat	88	22.73	21.54		30.09	18.83		43.64	18.36
HDB 5-room/executive maisonette	63	22.31	24.00	0.02	28.34	23.27	0.08	42.75	17.99
Private housing	35	16.35	18.52	0.31	20.82	16.42	0.51	36.38	15.11
Household income									
Low (<4000)	73	23.90	22.64		31.05	21.18		46.67	19.37
Middle (4000 to <8000)	53	19.39	22.53	0.20	23.72	18.34	0.37	38.74	15.25
High (8000 and above)	38	17.98	18.01	0.28	22.43	16.08	0.44	40.88	15.59
Clinical determinants									
None	57	19.01	22.05		25.31	18.82		42.57	17.22
Retinopathy	28	22.02	18.61	-0.14	32.82	20.01	-0.39	41.90	16.62

DHP: Diabetes Health Profile; ES: Effect size; FFM: Family functioning measure; HbA1C: Glycated haemoglobin test; PAID: Problem Areas in Diabetes; SD: Standard deviation
*Calculated by dividing the differences in the mean scores by the pooled standard deviation ($sd_{pooled} = \sqrt{\frac{(n1 - 1)s1^2 + (n2 - 1)s2^2}{n1 + n2 - 2}}$).

Table 6. Comparison of DHP Subscales across Social, Socioeconomic, Clinical, Social Functioning and Psychological Determinants (Con't)

Social determinants	n	DHP									
		Psychological Distress					Barriers to Activities				
		Mean	SD	ES*	Mean	SD	Mean	SD	ES*	Mean	SD
Cardiovascular disease	27	29.42	25.77	-0.45	34.04	26.17	41.23	20.26	-0.41	41.23	20.26
Nephropathy	17	34.31	23.59	-0.68	40.34	21.04	41.96	21.05	-0.78	41.96	21.05
Neuropathy	14	37.70	21.15	-0.85	38.10	14.22	44.29	17.85	-0.71	44.29	17.85
Cerebrovascular disease	12	25.00	23.03	-0.27	26.98	18.42	37.22	15.16	-0.09	37.22	15.16
Anaemia	12	14.35	13.91	0.22	28.17	16.30	35.56	19.76	-0.16	35.56	19.76
Control (HbA1C)											
Yes	58	13.12	14.93		20.61	17.26	37.82	15.36		37.82	15.36
No	146	24.35	23.55	-0.52	30.07	20.01	43.84	18.09	-0.49	43.84	18.09
Social functioning determinants											
Presenteeism											
Effective at work	168	18.95	19.91		25.71	17.33	41.31	16.22		41.31	16.22
Not effective at work	24	35.42	30.73	-0.77	35.32	30.57	45.56	24.05	-0.49	45.56	24.05
Effective outside work											
Yes	145	18.31	20.62		25.32	16.93	41.93	17.05		41.93	17.05
No	50	29.33	24.90	-0.51	32.95	26.47	42.80	18.72	-0.39	42.80	18.72
FFM (support)											
Good	180	20.34	22.32		26.67	19.63	41.48	17.36		41.48	17.36
Poor	21	29.89	18.55	-0.43	34.47	20.31	48.25	18.37	-0.40	48.25	18.37
Psychological determinants											
PAID (≥ 40)											
No problem	138	12.36	13.36		21.12	14.26	36.47	13.29		36.47	13.29
Serious problem	66	39.56	25.06	-1.51	40.48	22.94	53.94	19.45	-1.10	53.94	19.45

DHP: Diabetes Health Profile; ES: Effect size; FFM: Family functioning measure; HbA1C: Glycated haemoglobin test; PAID: Problem Areas in Diabetes; SD: Standard deviation

*Calculated by dividing the differences in the mean scores by the pooled standard deviation ($sd_{pooled} = \sqrt{\frac{(n1-1)s1^2 + (n2-1)s2^2}{n1+n2-2}}$).

population aged 25 to 65 was English-literate.²³ Lastly, patients with severe comorbidities were not included in our study, limiting the range of scores of the DHP. Nonetheless, we were able to detect large effect sizes, suggesting that the DHP was sensitive enough to detect significant and clinically important difference among various patient subgroups.

Conclusion

This paper has established important evidence on the validity, reliability and sensitivity of the DHP in a multi-ethnic Asian population. This adds to the repertoire of patient reported outcomes that have been validated to measure the psychological well-being of patients with T2DM in Singapore. Clinical trials and research may now consider the use of DHP when studying the psychological well-being of patients with T2DM. The findings may also be relevant to other Asian countries with ethnic Chinese, Malays or Indians, such as Malaysia, China, India, Taiwan and Hong Kong.

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