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Original Article

Evaluation of illness perceptions and their associations with glycaemic control, medication adherence and chronic kidney disease in type 2 diabetes mellitus patients in Malaysia

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ABSTRACT

Background: Illness perceptions (IP) involve coping strategies and behavioural responses that can influence glycaemic control. Despite the importance of good glycaemic control, the majority of patients in Asia are not achieving glycaemic targets. An evaluation of IP in association with glycaemic control, medication adherence and chronic kidney disease (CKD) in Type 2 diabetes mellitus patients (T2DM) was carried out in an outpatient setting in Malaysia

Method: A cross-sectional study was conducted using the Revised Illness Perception Questionnaire in a purposive sample of 384 T2DM patients.

Results: There were 55.7% females, median age was 58.2 years and median duration of diabetes was 13 years. The majority (79.4%) of patients had poor diabetes control (HbA1c $\geq$ 7.0%) and 39.6% of patients had low medication adherence. Patients with good glycaemic control had a higher Timeline Acute/Chronic and Emotional Representations score, hence they held the correct belief that diabetes is chronic and experienced negative emotions. Highly adherent patients had a higher Illness Coherence ($\chi2 = 21.385$, $p < 0.001$) score but a lower Consequences ($\chi2 = 17.592$, $p < 0.001$) and Emotional Representations ($\chi2 = 16.849$, $p < 0.001$) score indicating good understanding and less negative perceptions of disease burden. Patients in a more advanced stage of CKD had a significantly higher Timeline Cyclical score ($\chi2 = 18.718$, $p = 0.001$), believing that diabetes was unpredictable.

Conclusion: Dimensions of IP have been shown to be significantly associated with the assessed variables, therefore intervention studies with education, support and counselling should be conducted in Asia with the ultimate aim of empowering patients through IP-targeted management.

1. Introduction

Illness perceptions (IP) are based on the Common Sense Model of Self-Regulation (CSM): the CSM is a theoretical framework that explains representations or perceptions patients develop as the result of an illness [1–3]. This process includes changes in behaviour such as initiation of self-management as a response to diabetes [4]. IP involve cognitive and emotional representations, which provide an insight into how patients develop coping strategies that ultimately affect clinical outcomes [5–7]; IP education has been found to improve glycaemic control in poorly controlled diabetes [8].

Diabetes is causing an alarming burden on healthcare systems globally with a steadily increasing prevalence [9,10] with Type 2 diabetes mellitus (T2DM) constituting 90–95% of all diabetes cases [11]. Diabetes leads to multiple debilitating complications [12] with the Asian diabetic population especially at risk of complications such as retinopathy, neuropathy and nephropathy [13]. Diabetes is

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the leading cause of chronic kidney disease (CKD) ending in end-stage renal disease (ESRD) [14] with the Asian population at a high risk due to the high prevalence of microalbuminuria [15]. It has been found that self-care behaviour in diabetes is influenced by IP [4]. For example, more coping mechanisms are activated in the later stages of CKD with patients changing their lifestyles to become healthier [16].

Despite the importance of good glycaemic control [17], the situation in Asia is suboptimal with 62.7% of patients not achieving glycaemic targets [18]. A meta-analysis showed associations between IP and glycaemic control in diabetes: poorer glycaemic control in diabetes was significantly associated with patients suffering more consequences, being more concerned, attributing more symptoms, interpreting the illness as cyclical in nature and experiencing more negative emotions [19]. Adherence to diabetic medication can be improved through changing IP such as consequences, personal control and number of symptoms associated with diabetes [20]. IP have an influence on medication adherence [21], glycaemic control [19] and CKD [22] but the relationship between all three variables was yet to be studied together, therefore this study is the first that explored the association between IP and all three variables in an Asian population with the aim of gaining an insight into the importance of illness perception-based psychological management in diabetes. It is essential to understand patients' perceptions to improve patient empowerment and education.

2. Materials and methods

2.1. Study design and participants

This was a cross-sectional study, which was conducted at the outpatient T2DM Clinic of a tertiary referral hospital in Malaysia. This study was conducted after ethical approval had been obtained from the Medical Research and Ethics Committee of the Ministry of Health in Malaysia with the study registration number NMRR-16-228-28927. Patients were selected based on the following inclusion criteria: formal diagnosis of T2DM, 18 years and above, under regular follow-up at the T2DM clinic with at least one previous clinic visit, literate in either English or Malay, available HbA1c results within the preceding three months and available consecutive renal function test (RFT) results. Patients with an established diagnosis of dementia, impaired cognitive abilities or mental disability were excluded as the ability to complete questionnaires could have been impeded.

Purposive sampling was employed in this study. Data were collected from April to August 2016. A total of 457 eligible patients were approached during their follow-up visit with 394 patients giving informed consent. Ultimately, 384 patients with complete data were included in the final analysis.

2.2. Measures

Patients were required to complete self-administered questionnaires. The data collection form was divided into three sections: background information of the respondents, Revised Illness Perception Questionnaire and Eight-Item Morisky Medication Adherence Scale. Demographic data collected included age, weight, gender, ethnicity, level of education and co-morbid conditions. HbA1c results were collected from the preceding 3 months prior to the clinic visit. HbA1c was used as a measure of average glucose control with categories of good or poor control based on HbA1c values of $<7.0\%$ or $\geq 7.0\%$ as categorised by the American Diabetes Association [11]. Two consecutive RFT results prior to the clinic visit were collected. Classification of CKD [23,24] and measurement of estimated glomerular glomerular function (GFR) as a marker of kidney function were performed by using the Modification of Diet in Renal Disease (MDRD) formula [25,26].

2.2.1. The Revised Illness Perception Questionnaire (IPQ-R)

The IPQ-R is a valid and reliable tool for quantitative assessment of IP [2,3] that has been used widely in T2DM [27–31]. A translated and validated Malay version [32,33] was used in this study in addition to the original English version with permission having been obtained for both.

The IPQ-R is a 70-item questionnaire comprising nine dimensions: Identity, Personal Control, Treatment Control, Timeline Acute/Chronic, Timeline Cyclical, Consequences, Illness Coherence, Emotional Representation and Cause [3]. The sum of the yes-rated items for symptoms attributed to diabetes contribute to the Identity dimension. The second section consisting of 38 statements and the final section with 18 possible causes of diabetes are rated based on a 5-point Likert scale (1-strongly disagree, 2-disagree, 3-neither agree nor disagree, 4-agree and 5-strongly agree).

Personal Control indicates how much control the patient has over diabetes, whereas Treatment Control is the belief of how much the treatment can control diabetes. Illness Coherence indicates how much understanding the patient has of diabetes. A higher score in the dimensions above indicates positive beliefs. Conversely, Identity, Timeline Acute/Chronic, Consequences, Timeline Cyclical and Emotional Representations are negative dimensions, where a high score indicates more negative beliefs of the symptoms attributed to diabetes, the chronicity of diabetes, consequences on the patient's life, cyclical nature and emotions elicited by diabetes. The causal subsection includes the patient's view of the possible causes of the illness.

2.2.2. Eight-Item Morisky Medication Adherence Scale (MMAS-8)

The MMAS-8 questionnaire was used as self-report is a commonly accepted means of measuring adherence [34,35]. The original English version of the MMAS-8 was developed in a study population of 1367 patients with hypertension and was shown to be valid and reliable [36], whereas the Malay version of the MMAS-8 was translated and validated in a group of patients with T2DM [37]. The MMAS-8 has 8 questions with a total score which ranges from 0 to 8: low adherence (total score <6.0), moderate adherence (total score 6.0 to <8.0) and high adherence (total score 8.0).

2.3. Data analysis and interpretation

Statistical analysis was performed using SPSS 22.0. Continuous variables are presented as median and interquartile range (IQR) for non-normally distributed data, for example, the scores of the dimensions of the IPQ-R. Categorical data is presented as frequency and percentage. The Mann-Whitney *U* Test was used for comparison between IP dimensions and glycaemic control. The Kruskal Wallis test was utilised to assess the associations of medication adherence and CKD with IP. A Dunn's pairwise post hoc test was conducted to test pairwise comparison where significant differences were found with the p-value adjusted using the Bonferroni correction. Pearson product-moment correlation coefficient test was used to assess the correlations between glycaemic control and medication adherence. Values of $p < 0.05$ were considered to be statistically significant.

3. Results

The median age of the 384 patients in this study population was 58.2 years (IQR 48.0–64.8). The ethnic distribution was as follows: Malays 38.8%, Chinese 31.0%, Indians 28.9% and other races 1.3%.

Females constituted 55.7% of the study population with 23.7% elderly patients (>60 years old). The median duration of diabetes was 13 years (IQR = 8–20). The median HbA1c level was 8.0 (IQR = 7.1–9.6). The majority of patients (79.4%) had poor glycaemic control. Only 23.7% of participants had high medication adherence. Table 1 shows the socio-demographic and clinical data.

In the IPQ-R, 38.8% of patients rated hereditary factors as the most important cause for their diabetes. The second highest ranked cause (27.9%) was diet or poor eating habits, whereas 23.7% of patients could not attribute a cause. Table 2 depicts the detailed overview of how the patients answered every individual question in each dimension.

Table 1
Socio-demographic characteristics and clinical data of patients.

Demographic characteristics	Number of participants (%)
Age, median + IQR[a]	58.2 (48.0–64.8)
<65 years	293 (76.3)
≥65 years	91 (23.7)
Gender	
Male	170 (44.3)
Female	214 (55.7)
Ethnicity	
Malay	149 (38.8)
Chinese	119 (31.0)
Indian	111 (28.9)
Others	5 (1.3)
Duration of illness, median + IQR	13 (8–20)
BMI (kg/m^2), n = 359, median + IQR	27.8 (24.2–31.4)
Educational level	
Primary school	72 (18.7)
Secondary school	232 (60.4)
Tertiary education	79 (20.6)
Marital Status	
Single	50 (13.0)
Married	317 (82.6)
Widowed	8 (2.1)
Divorced	8 (2.1)
Employment status	
Employed	145 (37.8)
Unemployed	131 (34.1)
Retired	107 (27.9)
Glycaemic control	
HbA1c, median + IQR	8 (7.1–9.6)
Good control: HbA1c < 7.0%	79 (20.6)
Poor control: HbA1c ≥ 7.0%	305 (79.4)
Medication adherence	
Low adherence	152 (39.6)
Medium adherence	139 (36.2)
High adherence	91 (23.7)
CKD classification	
Stage 1[b]	90 (23.4)
Stage 2[c]	169 (44.0)
Stage 3[d]	105 (27.3)
Stage 4[e]	13 (3.4)
Stage 5[f]	7 (1.8)
Comorbidities	
Cardiovascular disease	85 (22.1)
Stroke	13 (3.4)
Peripheral vascular disease	1 (0.1)
Hypertension	269 (70.1)
Neuropathy	75 (19.5)
Retinopathy	22 (5.7)
Dyslipidaemia	261 (68.0)
Obesity	120 (33.3)
Cancer	7 (1.8)
Depression	6 (1.6)

[a] IQR: Interquartile range.
[b] No kidney damage or kidney damage with normal or increased GFR.
[c] Kidney damage with mildly decreased GFR.
[d] Moderately decreased GFR.
[e] Severely decreased GFR.
[f] End Stage Renal Disease.

The Timeline Acute/Chronic ($p = 0.048$) and Emotional Representations ($p = 0.028$) scores were significantly higher among patients with good glycaemic control. Patients with good glycaemic control have the perception that diabetes is a disease with a chronic course. The emotions described in the emotional representations section: feeling depressed, upset, angry, worry, anxiety and afraid are more likely to be experienced by patients with good glycaemic control. There were no significant associations found between glycaemic control and socio-demographic variables in this patient group. Medication adherence and HbA1c have a statistically significant linear relationship ($p = 0.001$) and they are negatively correlated ($r = -0.167$). The median scores for the individual IPQ-R dimensions and in association with glycaemic control are presented in Table 3.

The Identity ($\chi^2 = 15.25$, $p < 0.001$) and Timeline Cyclical ($\chi^2 = 16.370$, $p < 0.001$) scores were significantly higher in patients with low adherence (Table 4). There was a significantly lower Consequences ($\chi^2 = 17.592$, $p < 0.001$) and Emotional Representations ($\chi^2 = 16.849$, $p < 0.001$) score; and a significantly higher Illness Coherence ($\chi^2 = 21.385$, $p < 0.001$) score in patients with high adherence as compared to patients with medium and low adherence.

It was found that there was a statistically significant difference in the Timeline Acute/Chronic score, $\chi^2 = 9.587$, $p = 0.048$ and Timeline Cyclical dimension score, $\chi^2 = 18.718$, $p = 0.001$ between the CKD categories (Table 5) but the post hoc analysis showed that only the Timeline Cyclical score was significant: the more advanced patients are in the stages of CKD, the more likely it is that they have a higher Timeline Cyclical score.

4. Discussion

Most research on IP in T2DM has been carried out on European patients [27,38] but there is a paucity of studies on the association between IP and T2DM in Asia, with only one previous study [39] in Malaysia having found that poorer glycaemic control was associated with a more negative perception.

The socio-demographic data in this study are comparable to the findings in the Malaysian National Diabetes Registry (NDR) 2009–2012 [40] and Diabcare 2013 [41], therefore they are generally representative of the Malaysian diabetic population. More women have diabetes globally [9], as also found in this study, and are at risk of developing diabetes [42]. The high median Body Mass Index (BMI) found in this study is alarming as these patients are more at risk of poor glycaemic control [43,44]. Information on gender and weight management are important when strategies for prevention are considered as part of the IP intervention in future studies. As this study population comprises a high number of poorly controlled diabetics and married patients (82.6%), it would be of interest to consider family-based IP education with the aim of improving glycaemic control with the support of spouses and family members.

The high Timeline Acute/Chronic score is expected as diabetes has a chronic course. The high Consequences score could be caused by the changes in the patients' lives: multiple complications, stringent medication regime, exercise, strict diet, possible dependence on friends or family and hospitalisation. The low Identity score could be explained by the fact that the symptoms such as wheeziness, stiff joints and sore throat were not sufficiently diabetes-specific, so the possibility of making the symptoms more diabetes-specific should be considered for a more realistic assessment. The possibility remains that symptoms experienced were due to complications of diabetes, which the patients however did not attribute to diabetes and this is an area where patient education is essential.

Table 2
Descriptive Statistics for the Dimensions of the IPQ-R and how Patients Answered the Individual Questions in the IPQ-R.

Dimension	Question	Frequency (Percentage, %)		
		Disagree[a]	Neither Disagree nor Agree	Agree[b]
Timeline Acute/Chronic	My diabetes will last a short time	331 (86.2)	30 (7.8)	23 (5.9)
	My diabetes is likely to be permanent rather than temporary	60 (15.6)	33 (8.6)	291 (75.8)
	My diabetes will last for a long time	34 (8.9)	32 (8.3)	318 (82.8)
	This diabetes will pass quickly	258 (67.2)	59 (15.4)	67 (17.4)
	I expect to have this diabetes for the rest of my life	45 (11.7)	37 (9.6)	302 (78.7)
	My diabetes will improve in time	97 (25.3)	79 (20.6)	208 (54.2)
Consequences	My diabetes is a serious condition	96 (25)	59 (15.4)	229 (59.6)
	My diabetes has major consequences on my life	130 (33.9)	22 (5.7)	232 (60.4)
	My diabetes does not have much effect on my life	273 (71.1)	27 (7.0)	84 (21.9)
	My diabetes strongly affects the way others see me	258 (67.2)	53 (13.8)	73 (19)
	My diabetes has serious financial consequences	218 (56.8)	36 (9.4)	130 (33.9)
	My diabetes causes difficulties for those who are close to me	288 (75)	27 (7)	69 (18.0)
Personal Control	There is a lot which I can do to control my symptoms	68 (17.7)	33 (8.6)	283 (73.7)
	What I do can determine whether my diabetes gets better or worse	67 (17.4)	37 (9.6)	280 (72.9)
	The course of my diabetes depends on me	99 (25.8)	41 (10.7)	244 (63.5)
	Nothing I do will affect my diabetes	257 (66.9)	63 (16.4)	64 (16.7)
	I have the power to influence my diabetes	81 (21.1)	36 (9.4)	267 (69.5)
	My actions will have no effect on the outcome of my diabetes	263 (68.5)	44 (11.4)	77 (20.1)
Treatment Control	There is very little that can be done to improve my diabetes	244 (63.5)	47 (12.2)	93 (24.2)
	My treatment will be effective in curing my diabetes	131 (34.1)	50 (13.0)	203 (52.9)
	The negative effects of my diabetes can be prevented by my treatment	67 (17.4)	49 (12.8)	268 (69.8)
	My treatment can control my diabetes	21 (5.5)	23 (6.0)	340 (88.5)
	There is nothing which can help my condition	295 (76.8)	42 (10.9)	47 (12.3)
Illness Coherence	The symptoms of my condition are puzzling to me	198 (51.6)	68 (17.7)	118 (30.7)
	My diabetes is a mystery to me	239 (62.2)	56 (14.6)	89 (23.2)
	I don't understand my diabetes	319 (83.1)	20 (5.2)	45 (11.7)
	My diabetes doesn't make any sense to me	331 (86.2)	29 (7.6)	24 (6.2)
	I have a clear picture or understanding of my diabetes	39 (10.2)	22 (5.7)	323 (84.1)
Timeline Cyclical	The symptoms of my diabetes change a great deal from day to day	116 (30.2)	53 (13.8)	215 (56.0)
	My symptoms come and go in cycles	172 (44.8)	86 (22.4)	126 (32.8)
	My diabetes is very unpredictable	188 (49.0)	59 (15.3)	137 (35.7)
	I go through cycles in which my diabetes gets better and worse	186 (48.4)	55 (14.3)	143 (37.3)
Emotional Representations	I get depressed when I think about my diabetes	245 (63.8)	28 (7.3)	111 (28.9)
	When I think about my diabetes I get upset	229 (59.6)	24 (6.3)	131 (34.1)
	My diabetes makes me feel angry	265 (69.0)	35 (9.1)	84 (21.9)
	My diabetes does not worry me	245 (63.8)	29 (7.6)	110(28.6)
	Having this diabetes makes me feel anxious	244 (63.5)	37 (9.6)	103 (26.9)
	My diabetes makes me feel afraid	236 (61.5)	36 (9.4)	112 (29.1)

Table 3
Median scores of individual dimensions of IPQ-R and scores based on glycaemic control.

IPQ-R Dimension	Median (Interquartile Range)	Poor glycaemic control, HbA1c $\geq$ 7.0%	Good glycaemic control HbA1c < 7.0%	†P-value
		n = 305	n = 79	
Identity	2(0–4)	1 (0–4)	2 (0–4)	0.105
Timeline Acute/Chronic	23(21–25)	23 (19–25)	23 (21–26)	*0.048
Consequences	18(14–21)	18 (14–20)	18 (14–21)	0.191
Personal Control	22(19–24)	22 (20–24)	22 (19–24)	0.714
Treatment Control	18(16–20)	18 (17–20)	18 (16–20)	0.626
Illness Coherence	19(17–21)	19 (17–20)	19 (17–21)	0.503
Timeline Cyclical	12(9–14)	12 (8–13)	12 (9–15)	0.072
Emotional Representations	14(12–20)	14 (12–18)	15 (12–20)	*0.028

The high Illness Coherence score indicates that patients believed that they had good understanding of their diabetes. Patients also had a high Personal Control and Treatment Control score, which meant that they held the belief that they could change the outcome of their diabetes through their behaviour and additionally, also believed that treatment could control their disease. However, these perceptions were not necessarily translated into action as proven by the poor glycaemic control and low medication adherence.

The Timeline Acute/Chronic and Emotional Representations dimensions had a significantly higher score for patients with good glycaemic control. Patients who have accepted the chronic course and experience emotions such as fear, anger and anxiety are more likely to take measures to bring their diabetes under control. The interesting link which has to be studied further are how exactly these dimensions are associated with HbA1c over a longer period of time, possibly through a longitudinal study design. A structured group education programme for newly diagnosed T2DM patients in a multicentre trial in the UK showed reductions in the HbA1c level in both the intervention and control groups but no significant differences between these groups, possibly because of the fact that both groups had HbA1c of <7.5% even before the study was started [7]. As opposed to the trial of Davies et al. [7], the glycaemic control is poorer in this study, as well as also previously mentioned, generally in Asia. Therefore, studies such as the intervention to

Table 4
Differences in the score of dimensions of illness perceptions in patients with low, medium and high adherence (n = 382).

IPQ-R Dimension	Low Adherence n = 152	Medium Adherence n = 139	High Adherence n = 91	[a]P-value
Identity	3 (1–5)	2 (0–4)	1 (0–3)	[b]<0.001
Timeline Acute/Chronic	23 (20–25)	24 (21–26)	23 (21–26)	0.899
Consequences	18 (15–22)	18 (15–21)	16 (14–18)	[b]<0.001
Personal Control	22 (19–24)	22 (19–24)	23 (19–24)	0.665
Treatment Control	18 (16–20)	18 (16–20)	18 (16–20)	0.564
Illness Coherence	18 (16–20)	19 (17–21)	20 (18–23)	[b]<0.001
Timeline Cyclical	12 (10–16)	12 (9–14)	10 (8–13)	[b]<0.001
Emotional Representations	16 (21–22)	15 (12–20)	14 (12–16)	[b]<0.001

IPQ Dimension Scores are presented as median and interquartile range.

[a] Kruskal-Wallis test.
[b] Statistically significant at $p < 0.01$.

Table 5
Differences in the score of dimensions of illness perceptions in patients in the different stages of CKD (n = 384).

IPQ-R Dimension	Stage 1[a]	Stage 2[b]	Stage 3[c]	Stage 4[d]	Stage 5[e]	†P-value
Number of patients	n = 90	n = 169	n = 105	n = 13	n = 7	
Identity	2 (0–4)	2 (0–4)	2 (0–5)	2 (0–3)	2 (0–3)	0.861
Timeline Acute/Chronic	22.5 (20–25)	23 (20–25.5)	24 (22–26)	24 (22.5–24.5)	24 (22–27)	*0.048
Consequences	18 (15–21.25)	18 (14–20)	18 (14–21)	18 (16–20)	19 (14–25)	0.399
Personal Control	22 (19–24)	22 (19–24)	22 (19–24)	22 (20–23)	20 (12–24)	0.966
Treatment Control	18 (16–20)	18 (16–20)	18 (16–20)	17 (15.5–18)	17 (15–20)	0.139
Illness Coherence	18 (16–20)	20 (17–21)	19 (18–21)	18 (15–20)	16 (15–20)	0.101
Timeline Cyclical	12 (10–16)	12 (9–14)	10 (8–13)	13 (8–16)	16 (14–16)	**0.001
Emotional Representations	16 (12–22)	15 (12–19)	14 (12–19)	15 (13–20)	14 (12–22)	0.152

IPQ Dimension Scores are presented as median and interquartile range.
†Kruskal-Wallis test.
*Statistically significant at $p < 0.05$ **Statistically significant at $p < 0.01$.
[a] Kidney damage with normal or increased GFR.
[b] Kidney damage with mildly decreased GFR.
[c] Moderately decreased GFR.
[d] Severely decreased GFR.
[e] , End Stage Renal Disease.

target IP with education, support and counselling in poorly controlled patients by Keogh et al. [8] should be conducted in Asia.

Ross and colleagues found that hypertensive patients who had a lower Consequences score had better adherence [45]. Similarly, in this study with T2DM patients, high adherence was significantly associated with a higher Illness Coherence score but a significantly lower Emotional Representations and Consequences score. This shows that it is important to educate patients on the importance of good adherence as well as promote good understanding of diabetes so that patients are empowered to keep their illness under control.

A cross-sectional study on hypertension found a significant correlation between the Timeline Cyclical dimension and medication adherence ($r = -0.2$, $p < 0.01$) [46]. In this study, patients with low adherence had a significantly higher Identity and Timeline Cyclical score. Poorly adherent patients identified more symptoms with their disease and felt that their disease was cyclical in nature. An IP-based psychological education may help patients to realise the importance of medication adherence despite phases where there are less symptoms.

This study found a significant association between the advanced stages of CKD and the Timeline Cyclical score. A study in Sweden also showed more negative perceptions in the more advanced stages of CKD [47]. Patients initially do not notice the changes in symptoms in the early stages of CKD and only start becoming aware of symptoms in the later stages [16,47]. It is important that coping mechanisms are initiated earlier by providing psychological support with targeted counselling and if negative illness perceptions are corrected early in diabetes, the progression to CKD may be delayed through optimisation of glycaemic control.

The only positive dimension that was significant in this study was Illness Coherence. The more negative beliefs that were found to have significant associations in this study were Identity, Consequences, Timeline Acute/Chronic, Emotional Representations and Timeline Cyclical. These predominantly negative beliefs should be addressed as a basis for targeted IP counselling.

As this study was cross-sectional, causal direction of the associations between IP and the variables being studied cannot be made. Self-reported questionnaires were used to assess adherence and IP; therefore, response bias cannot be excluded.

5. Conclusion

The results of this study are encouraging as dimensions of IP have been shown to be significantly associated with the assessed variables in the Malaysian context but further longitudinal studies are required in Asia. Understanding patients' perceptions will aid in empowering patients and if proven to be effective in changing outcomes such as improved glycaemic control, delay of progression in CKD and higher medication adherence, targeted management of IP dimensions should be included in future T2DM clinical practice guidelines and incorporated into psychological management of T2DM.

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Appendix A. Supplementary data

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