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RESEARCH ARTICLE

Patient preferences for the treatment of type 2 diabetes in Australia: a discrete choice experiment

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Abstract

Background Australia has a high proportion of migrants, with an increasing migration rate from India. Type 2 diabetes is a chronic condition common amongst the Indian population. The decision to initiate and continue medication therapy (conventional or ayurvedic medicine) is complex and is influenced by a wide range of factors.

Objective To determine preferences for conventional vs. ayurvedic medicines in Indian migrants with diabetes, and to identify the factors that may influence their preferences.

Methods A discrete choice experiment was conducted with participants in Australia who were migrants from India with type 2 diabetes (n=141). Each respondent evaluated eight choice tasks consisting of eight attributes describing medicines and outcomes of medication taking; and were asked to choose 'conventional', or 'ayurvedic' medicine. A mixed multinomial logit model was used to estimate preferences.

Results Overall, respondents' preference to initiate a medicine was negative for both conventional ($\beta=-2.33164$, $p<0.001$) and ayurvedic medicines ($\beta=-3.12181$, $p<0.001$); however, significant heterogenicity was noted in participants' preferences (SD: 2.33122, $p<0.001$). Six significant attributes were identified to influence preferences. In decreasing rank order: occurrence of hypoglycaemic events (relative importance, RI=24.33%), weight change (RI=20.00%), effectiveness of medicine (RI=17.91%), instructions to take with food (RI=17.05%), side effects (RI=13.20%) and formulation (RI=7.49%). Respondents preferred to initiate a medicine despite potential side effects.

Conclusions There was a greater preference for conventional medicine, though neither were preferred. Medicine attributes and medication-taking outcomes influenced people's preferences for an antidiabetic medicine. It is important to identify individual preferences during healthcare consultations to ensure optimal medication-taking.

Keywords Medicine · Ayurvedic · Diabetes Mellitus · Type 2 · AYUSH · Complementary and alternative medicine · Conventional medicine · Discrete choice experiment · Factors · Indian migrants and patient preference

Introduction

According to the International Diabetes Federation (IDF, 2017), there are 425 million individuals with diabetes worldwide, a number projected to rise to 629 million by 2045 [1]. It is expected that the global health expenditure due to diabetes will grow from US $760 billion to $845 billion between 2019 and 2045 [2]. In Australia, diabetes mellitus (DM) is a leading cause of morbidity and mortality with approximately 1.2 million people affected [3]. A recent study showed that the total estimated economic cost of diabetes was AU$14 billion, including direct health costs and indirect costs, such as loss of productivity, early retirement, leave from work and premature mortality [4].

Australia has a large number of migrants, with 7.5 million (29.7%) Australians born overseas (as at June 2019), of which approximately 660,000 (or about 2.6% of the total Australian population) were born in India [5]. There is a higher rate of migration by Indians to Australia.[5] There appears to be a high prevalence of diabetes among Indian migrants (14.8%) compared to the Australian-born population (7.1%) [6]. and a high rate of diabetes-related

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hospitalisation and complications among Indian migrants [7].

Indians are traditionally known for high use of ayurvedic medicines (AM) [8]. a component of complementary and alternative medicines (CAMs). The use of CAM with conventional medicines can complicate the treatment regimen of patients with diabetes, resulting in reduced adherence to prescribed medicines [9]. Despite the limited evidence to support effectiveness of AM [10] and its safety [11], the use of AM among Indians is on the rise [12]. However, there are limited studies conducted among migrants living in developed countries. A recent qualitative study conducted by Porqueddu et al. (2017) among Indian and Pakistani migrants using CAM for diabetes in the UK showed poor adherence to conventional medicines due to their various side effects [13], and people preferred CAM over conventional medicines because of the belief that CAMs do not have side-effects [13]. Another qualitative study carried out among Indian migrants in the UK showed that conventional medicines were perceived as effective but inherently dangerous because of the side effects [14].

Medication adherence is defined as a patient initiating the first dose of their medicine, taking as prescribed, and continuing to take the medicine for the prescribed duration [15, 16]. Patients need to adhere to their prescribed medicines for effective diabetes management [17]. However, medication adherence is poor and it varies among different people and communities. The incidence of anti-diabetic medication adherence has been reported to range between 38% and 93% [18]. For example, adherence to antidiabetic medications in the United Arab Emirates, Ethiopia, Uganda, Switzerland, Botswana, and India has been reported as 84% [19], 85.1% [20], 83.3% [21], 40% [22], 52% [23], and 82.4% [24], respectively. Dhippayom et al. (2015) conducted a study among Australian patients with type 2 diabetes and found that adherence to anti-diabetic medications was suboptimal at 64.6% [25], Adherence to medications is a growing concern for clinicians, healthcare systems, and other stakeholders (e.g., payers) because of mounting evidence that nonadherence is prevalent and associated with adverse outcomes and higher costs of care [15].

Patient preference is considered to be a significant factor that impacts medication taking and adherence in patients with type 2 diabetes [26]. Negative experiences due to medication use for people with type 2 diabetes include side effects, weight gain and hypoglycemic effects, while positive experiences include efficacy and weight loss [26, 27]. The final decision to initiate a medicine is not simple, as people balance the benefits and drawbacks of various factors that influence their decision to initiate. Although some studies have investigated adherence during the initiation phase, the initiation rate is not optimal. Sinclair et al., reported that only 51% of people with type 2 diabetes had initiated medications over a 2-year period after diagnosis [28]. Similarly, a study conducted among Dutch people with type 2 diabetes, reported that 70% initiated medications within 2 years of diagnosis [29].

Limited studies have been conducted to evaluate and quantify the influence of factors on the decision of people with type 2 diabetes to initiate medication [28]. Important factors identified, such as control blood sugar levels (effectiveness), side effects (e.g. hypoglycemia), medication beliefs, social stigma and the relationship with their physician, may influence the decision to adhere to medication [26, 27]. Previous research has not measured the relative importance of influencing factors, potential interactions between factors, and the extent to which Indian migrants with type 2 diabetes balance the different medicine attributes when deciding whether or not to start medication [30–33]. Understanding the relative importance (RI) of factors can assist in understanding patients' preferences for several medication attributes. In order to elicit preferences, it may be useful to determine the relative importance of factors that influence a person's decision to initiate medications. This, in turn, may help to develop an intervention that may address a specific factor identified by a patient's decision to initiate or delay the initiation of a conventional or ayurvedic medicine.

Recently, medical researchers have begun to use an established preference survey, such as discrete choice experiments (DCEs), to determine patient preferences for the characteristics of health interventions [31]. The DCE method is a widely accepted approach to evaluate patients' healthcare preferences [34]. DCE methods have been applied to evaluate patient preferences for different diabetes treatment options, based on various medicine qualities (attributes) [31–33].

A recent systematic review examined the preferences of doctors and patients for type 2 diabetes medicines. Seventeen studies from 2009 to 2017 were included in the final analysis, and 27 attributes of anti-diabetic medicines were identified [35]. The important attributes were changes in blood glucose and HbA1c levels, weight changes, hypoglycemic events, cardiovascular effects, gastrointestinal complications, mode of administration, dosage form and medication cost. Physicians and patients preferred medicines that effectively reduced blood glucose and HbA1c levels and had fewer side effects [35]. However, there is no research that explicitly examines the preferences of people with type 2 diabetes for ayurvedic and conventional medicines for diabetes management. Hence, the objective of this study was to assess patients' preferences for conventional and ayurvedic medicines and the factors influencing those preferences in Indian migrants with type 2 diabetes in Australia.

Methods

DCEs and study process

The online survey was built using Qualtrics, an online survey tool. The survey was divided into 2 parts: DCE questions and demographic questions. Respondents were required to complete the eligibility questions and, if eligible, provided with the Participant Information Statement (PIS) online. Consenting respondents then completed 8 choice tasks and answered the demographics questions. In the choice tasks, they were asked to choose their preferred medicine (conventional vs. ayurvedic medicine) or a 'no medicine' option. Each of the choice tasks differed in terms of medicine qualities (attributes and their levels). If they chose 'no medicine,' a supplementary question asked which medicine they would prefer if they had to choose between a conventional and ayurvedic medicine. Respondents were given a practice choice task prior to the real choice tasks to become familiar with choice task completion.

Identification of attributes and levels

In decision making research, the choice of vital attributes and relevant levels is one of the most important steps. In this study, the attributes were chosen systematically. This was done via a literature review and qualitative research. A literature review was conducted to identify a list of potential attributes. Next, a qualitative study was conducted with 23 Indian migrants in Australia, and social, cultural, and religion-related factors that may affect their choice to select attributes related to an ayurvedic medicine or a conventional medicine for diabetes management was identified. The top eight attributes selected from the literature review and qualitative study are shown in Table 1. The DCE questions posed a choice between two hypothetical

Table 1 Medicine attribute and attribute levels

Medicine Attributes	Attribute Levels (and explanation)
Side effects of the medicine	Mild: side effects do not interfere with your daily routine or activities (such as exercise, work)
	Moderate: side effects interfere with your daily routine or activities (such as exercise, work) but you are still able to perform routine activities
	Severe: side effects interfere with your daily routine or activities (such as exercise, work) and may be life threatening or cause significant disability and hospitalisation.
Chance that the medicine works well to control blood sugar levels (HbA1c [Glycated hemoglobin])	Low improvement: 100 people out of 1000 people (10%) reach their target HbA1c level
	Medium improvement: 300 people out of 1000 people (30%) reach their target HbA1c level
	High improvement: 500 people out of 1000 people (50%) reach their target HbA1c level
Number of times a day the patient is required to take the medicine	Once a day
	Twice a day
	More than twice a day
The form that the medicine comes in	Tablets or capsules
	Powder form
	Liquid form
Instructions for taking with food	Should be taken with or just after eating
	Can be taken anytime
Hypoglycemic events (hypos or low blood sugar level) caused by the medicine	No hypoglycemic event 1–2 hypoglycemic events per year 1–2 hypoglycemic events per month (12–24 events per year)
Weight changes caused by the medicine	2 kg weight gain in a month
	2 kg weight loss in a month
	No weight change
Cost of a pack of the medicine per month (Australian dollars)	$6.60 per month $25.00 per month $41.00 per month

treatments (conventional vs. ayurvedic medicine) for type 2 diabetes, in which each treatment was described by eight attributes with a level chosen by the software for each attribute (Table 1).

Experimental design

The experimental design created pairs of hypothetical treatments in each of the DCE questions, following the good practice guideline for DCEs recommended by the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) [36]. The experimental design is defined as a systematic plan that determines the number of choice tasks and the variation in the attribute levels of the choice tasks. Effective experimental designs increase the precision of estimated choice-model parameters for a given number of choice queries [36].

A full factorial design is one in which all possible combinations of attribute levels are generated and shown. The size of a full factorial design will depend on the number of attributes and the attribute levels. In the current study's DCE there were two choice alternatives (ayurvedic medicine vs. conventional medicine) and additionally a constant alternative of neither medicine. As a total of 8 attributes were selected, in which 7 attributes had 3 levels and 1 attribute had 2 levels (Table 1), a full factorial design would require the following to be presented to study participants:

- $3^7 \times 2^1$ (= 4374) profiles to be presented to the respondents, in 4374^2 (=19,131,876) choice sets

For obvious practical reasons, it is not feasible to present 19,131,876 choice tasks, and a balance is required to ensure that a large cognitive burden is not placed on respondents to complete a large number of choice tasks [37]; therefore, a fractional factorial design was used. The D-efficient design was used to balance the attribute level and to select a subset of the medication profiles. The design was generated using computer-based Ngene software (ChoiceMetrics Pty Ltd, Sydney, NSW, Australia), which is widely used for generating experimental designs for stated choice surveys [38]. A total of 32 choice tasks were generated by using the D-efficient design; however, 32 choice tasks could be regarded as placing a high cognitive burden on respondents, the survey was blocked in 4 iterations, meaning that each respondent was expected to complete 8 chosen tasks. Each respondent was randomly assigned one block of eight DCE questions and each DCE question asked the respondents to indicate which treatment they would prefer if the two-treatment choice were given to them. The four blocks were randomised and evenly distributed among the respondents by using an online Qualtrics survey tool.

Pre-testing of the survey

Content and face validity tests were performed. The survey was assessed by three quantitative survey methods researchers who assessed the content of the survey, whether the questions and choice tasks were clear and whether the survey addressed the study aims. After making some changes, two Indian migrants with type 2 diabetes and two Indian migrants without diabetes were asked to consider the clarity of the questionnaire and record how long it took to fill out the survey. Minor adjustments were made to the survey based on the feedback provided during the face and content validity testing.

Sample size

Since the priors were not specified at the beginning of this study (it is assumed to be near zero in an efficient design), it was not possible to specify the minimum sample size required to estimate all parameters at the level of statistical significance. Therefore, a D-efficient design was used that required a relatively smaller sample size to provide sufficient power, especially in comparison to other choice designs. Attempts were made to increase the number of participants within the available budget and timeframe [39].

Recruitment

An online survey was created and recruitment was conducted between 27 July and 31 October 2020. The study employed paid and unpaid strategies for recruitment

First, Facebook was paid to advertise posts by showing them on the Facebook feeds of prospective respondents. Paid advertising on Facebook was developed and run from 10 August – 31 October 2020. A total of 11 paid Facebook recruitment posts were produced from the Facebook page created. The first author (AA) closely monitored the Facebook page and the messenger service produced during the recruitment process in order to respond to questions, comments on the post messages regarding the research. Posts were boosted from the Facebook page by paying Facebook a fixed amount over 3–10 days to advertise the post as a 'sponsored post' (advertisement flyer) to the specified population/audience. The overall expense of the promotion was AUD $936.94.

Second, unpaid recruiting occurred via the posts, likes, comments or sharing on the 'Indian migrant in Australia'-specific Facebook pages. Diabetes-related groups and Indian associations/organisations were also contacted by email to circulate study flyers among their members. An invitation to participate, along with an advertising flyer, was displayed on the Facebook pages and groups of Indian migrants living in Australia and diabetes support groups, with an online

link to the PIS and questionnaire, as well as questions that would determine whether the potential participants met the inclusion criteria. People who were interested in participating in the study could click on the survey link, answer the questions on study inclusion, read the PIS (if they met the study inclusion criteria) and then move on to the study questionnaire. Study participants were recruited from within Australia.

The first section of the survey consisted of five questions to determine whether study inclusion criteria were met.

Q1. Are you 18 years of age or older?
Q2. Do you have a diagnosis of type 2 diabetes mellitus?
Q3. Are you taking type 2 diabetes medicine?
Q4. Were you born in India?
Q5. Are you currently living in Australia?

Responding with a "no" to any question or not responding at all to any question made a person ineligible to take part in the study.

Data analysis

Descriptive statistics (standard deviation, mean and frequency) for the socio-demographic characteristics of the sample and other parameters were reported (such as migration history, duration since diagnosis, current medicines and medical conditions, use of ayurvedic medicines) were conducted. The DCE responses were first analysed using a multinomial logit model (MNL), a simple form of logit model commonly used to analyse patient preference (choice) data [40]. However, the MNL model assumes homogeneity (same preference weights apply to all individuals in the data) within a sample, which may not be applicable to medication preferences research [40]. Therefore, a mixed multinomial logit (MMNL) model was used as the MMNL relaxes the assumption of identical distribution and accounts for heterogeneity in preferences between individuals [41].

Initially, all parameters were included in the model and treated as random parameters with a normal distribution; however, in the final model, only the parameters with statistically significant standard deviations were treated as random, while the remaining parameters were considered fixed. Parameters that were not significant, including sociodemographic variables, were removed from the final model. The Halton draws were kept as 500 in the final model analysis.

In DCE, parameter (β) estimates refer to the importance given by the patients to an individual attribute's level. A higher value indicates a higher utility for that individual attribute-level. It is important to note, however, that when interpreted individually, parameter estimates do not provide useful information; instead, they are useful when compared to one another. For example, if the β of the A1 attribute is 4 and the β of A2 is 2, the interpretation is that A1 is twice as important to the respondents compared to A2.

Relative importance (RI) of attributes is helpful in describing the degree of difference each attribute could make in the total utility of a product. The variations (differences) reflect the scope in the utility values of the attribute. The higher the difference between the levels, the more important the attribute will be [42]. To calculate the RI, we first need to calculate the attribute utility range (AUR). The AUR can be calculated by dividing the lowest utility of the attribute-level (lowest part-worth utility) by the highest utility of the attribute-level (highest part-worth utility). Once we calculate the AUR for all the attributes, we need to combine AURs with all attributes. Finally, the RI measures the AUR of the individual attribute by dividing the cumulative AUR and multiplying it by 100 [42]. The computer programme NLogit 6 was used for data analysis [43].

Results

Sample characteristics

The survey was completed by a total of 141 respondents (including incomplete survey responses, which had at least two out of eight choice tasks completed). A summary of the respondents' characteristics is presented in Table 2. The average age was 49.7 years (range 26 to 78). The majority were male (n=92, 65.2%), and "older" migrants (n=90, 63.8%, time since migration > 5 years). Table 2 shows that 24.1% were diagnosed with diabetes more than 10 years ago and 23.4% were diagnosed in the past 1–5 years. Many (n=80, 56. 8%) had co-morbid conditions, mainly cardiovascular disease. The majority (n=114, 80%) were using prescribed oral conventional medicines and 31.2% (n=44) were using ayurvedic medicines for their diabetes.

DCE results

According to the mixed multinomial logit (MMNL) model, several attributes significantly impacted the respondents' decisions to choose conventional vs. ayurvedic medicine. Overall, the preference to use conventional or ayurvedic medicine was negative for both medicine types (conventional (β=−2.33164, p<0.001) and ayurvedic (β=−3.12181, p<0.001)); however, significant heterogenicity was noted in participants' preferences (SD: 2.33122, p<0.001). It was noted that the beta for ayurvedic medicine was more negative (−3.1281) than the beta for conventional medicine (−2.33164); therefore, participants' preference was for conventional compared to ayurvedic medicine, even though both were negative, and the respondents did not want to take either. A summary of the preferences is presented in Table 3.

Table 2 Demographic information of respondents (n=141)

Variable	Variable characteristics	n (%)
Gender	Male	92 (65.2%)
	Female	49 (34.7%)
Religion	Hinduism	75 (53.2%)
	Islam	19 (13.5%)
	Sikhism	12 (8.5%)
	Christianity	17 (12.0%)
	Others	10 (7.0%)
	I do not want to answer	8 (6.6%)
Migration	New migrants (≤ 5 years)	51 (36.2%)
	Old migrant (> 5years)	80 (56.7%)
	I do not want to answer	10 (7.0%)
Diagnosis	<1 year	15 (10.6%)
	1–5 years	33 (23.4%)
	6-10 years	28 (19.8%)
	>10 years	34 (24.1%)
	I do not remember/I do not want to answer	31 (21.9%)
Medicines used for type 2 diabetes	Conventional medicine	114 (80.8%)
	Insulin	10 (7.0%)
	Ayurvedic medicine	6 (4.9%)
	I do not want to answer	11 (9.0%)
Use of any Ayurvedic medicine in the past for type 2 diabetes	Yes	44 (31.2%)
	No	97 (68.7%)
Source of Ayurvedic medicine recommendation N = 44	A pharmacist (pharmacy shop)	7 (17.0%)
	An ayurvedic doctor	13 (31.7%)
	A friend or relative	16 (39.0%)
	Others/I can't remember	8 (19.5%)
Other medical conditions	No	61 (43.2%)
	Yes	80 (56.7%)
Co-morbidity*		N
	Cardiovascular disease	32
	High cholesterol	18
	Thyroid-related conditions	6
	Neuropathy	6
	Sleep apnoea	4
	Arthritis	4
	Asthma	3
	Gastric reflux	3
	Others- pancreatitis, Crohn's disease, cancer, enlarged prostate, fatty liver, eye disease, metabolic syndrome.	36

*More than one condition was reported by respondents

Six attributes were identified to be significant: glycated haemoglobin, side effects, formulation, instructions for taking with food, hypoglycaemic effect and weight change. The cost of the medicine and the frequency of dosing did not have a significant effect on respondents' choice. Increased effectiveness of a medicine in controlling blood sugar levels (HbA1c [glycated haemoglobin]) increased the respondents' preference for the medicine, with the highest preference for high improvement in HbA1c ($\beta = 4.54600$, $p<0.001$) over medium improvement ($\beta = 2.47628$, $p<0.01$). The preference for a medicine increased with a decrease in the severity of potential side effects (moderate = $\beta = 2.86872$, $p<0.05$; mild = $\beta = 4.39343$, $p<0.0001$). Respondents had a higher preference for the solid dosage form (tablet/capsules) ($\beta = 3.52815$, $p<0.0023$), followed by liquid formulation ($\beta = 3.41694$, $p<0.0023$) in

Table 3 Mixed multinomial logit model

Attributes	Coefficient	Standard error
Conventional medication (constant)	-2.33164***	0.56570
Mean		
Standard deviation	3.40921***	0.92753
Ayurvedic medicine (constant)	-3.12181***	0.67189
Mean		
Standard deviation	2.33122***	0.64655
Glycated haemoglobin (effectiveness)		
Low improvement	Base	
Medium improvement	2.47628**	0.96233
High improvement	4.54600***	0.95154
Side effects		
Severe	Base	
Moderate	2.86872***	1.04425
Mild	4.29336***	0.92067
Formulation		
Powder form	Base	
Liquid form	3.52815***	1.32979
Tablet or capsules	4.39343***	1.44124
Instruction with food		
Should be taken with or just after eating	Base	
Can be taken anytime	1.96965**	0.87844
Hypoglycemic events		
1–2 hypoglycemic events per month	Base	
1–2 hypoglycemic events per year	1.55370*	0.89663
No hypoglycemic event	4.36463***	1.40378
Weight change		
2 kg weight gain in one month	Base	
2 kg weight loss in one month	2.93068***	0.99475
No weight change	5.24250***	1.81615

***, **, * ==> Significance at 1%, 5%, 10% level, respectively

Log likelihood function; −147.47267

Total number of observations= 1335

comparison to powder formulation. Respondents preferred a medicine that could be taken at any time ($\beta = 1.96965$, $p<0.0249$) compared to one which needed to be taken with or just after food. Participants' preferred a medicine that was not associated with hypoglycaemic events (no hypoglycemic event = $\beta = 4.36463$, $p<0.0019$); and no weight change ($\beta = 5.24250$, $p<0.039$) in comparison to a 2 kg weight gain in a month.

Hypoglycemic events (RI= 24.33%) was the most important factor that influenced the respondents' preferences for medication, followed by weight change (RI=20.00%), effectiveness (RI= 17.91%), instructions for taking with food (RI= 17.05%), side effects (RI=13.20%) and formulations (RI= 7.49%). The relative importance (RI) of attributes are illustrated in Fig. 1.

Discussion

To the best of our knowledge, this is the first study conducted to identify patient preferences for conventional vs. ayurvedic medicines and factors influencing those preferences among Indian migrants with type 2 diabetes in Australia. Overall, preferences for initiating both conventional and ayurvedic medicines were negative, and participants were more likely not to take ayurvedic compared to conventional medicine. Six significant attributes: glycated haemoglobin, side effects, formulation, food instruction, hypoglycaemic effect, and weight change, were identified that influenced their preferences. Interestingly, dosing frequency and cost did not impact the preferences for the medicines. Likelihood of experiencing a hypoglycaemic event was the most important factor that influenced the respondents' preferences for the medicine, followed by weight change, effectiveness, instruction with food, side effects and formulation.

The results of this research provide important new insights into the preferences of Indian migrants for conventional and ayurvedic medicines for managing their diabetes. Preference for conventional or ayurvedic medicine was increased by some factors, while some factors reduced the preference for the medicine, showing that the preference of Indian migrants with diabetes for the medicine may not be straightforward, but instead involves a weighing of factors as part of the medication-taking journey. The findings are consistent with other studies, which show several factors that influence decision-making relating to antidiabetic medications [44–46]. The study findings can be viewed through the lens of the Necessity-Concerns Framework (NCF), which describes medicine-taking behaviour (adherence to medications) to be determined by a balance between patients' necessity (positive factors) for the medicine and their concerns about medicines (negative factors) [16]. If the necessity (positive factors) for medicines was high compared to their concerns (negative factors), patients would prefer and use their medicines. In this study, respondents' necessity and concerns were heterogeneous; specifically, each respondent may have their individual beliefs and concerns about antidiabetic medicines, and these beliefs and concerns have different magnitudes of influence. As reported in a previous study, when individual patients with the same illness are prescribed the same medicines (conventional or ayurvedic), their individual personal beliefs are different [47]. Some patients may therefore start to take medicines because they think it is necessary to use medication to control blood sugar levels, while others may not want to start, thinking that they do not need it, or that the medicine's negative attributes and/or the outcomes of taking the medicine outweigh the positive impacts of the medicine.

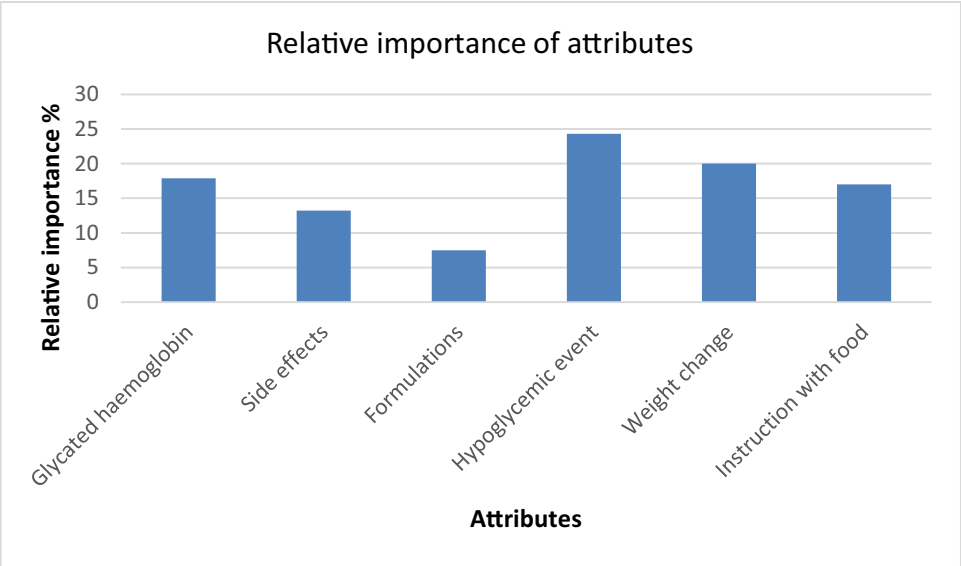

Fig. 1 Relative importance of the discrete choice experiment attributes

Individual patient perceptions and beliefs are further affected by negative factors (concerns), such as side effects or harm from medicine use. From the study findings, positive beliefs (improvement in glycated haemoglobin [HbA1C] level, weight loss or no weight change) had a positive impact on the preference for the medicine, while the respondents' fears (side effects such as hypoglycaemic events, weight gain and other side effects) negatively impacted the perceived need for, and the final decision to choose, a medicine.

Whilst the study findings showed that several factors positively influenced the respondents' choice, fear of side effects was an important factor that reduced the perceived utility of medications, i.e., it discouraged Indian migrants with type 2 diabetes from choosing a conventional or ayurvedic medicine. Fear of side effects has been cited as an important factor affecting medication adherence [48]. Our findings are in line with previous findings [44–48] and contribute to the literature that side effects are an important factor impacting Indian migrants' preference for, and therefore potentially the choice of taking either a conventional or ayurvedic medicine. However, and interestingly, the study findings showed that there was a preference for a medicine despite the side effects. On balance, respondents chose a medicine where the side effects were mild, compared to when the side effects were moderate or severe. This indicated that other medicine attributes listed in the choice scenario played a part in the medicine choice and that the respondents were balancing the overall positive vs. the negative medicine attribute options when making their decision about which medicine to take.

Our study supports previous findings [44-46] about hypoglycemic effects and further informs us that the potential risk of experiencing a hypoglycaemic effect is relatively more important to Indian migrants compared to benefits of the medicine when making a choice about a medicine. In a study conducted by Mühlbacher et al. on a hypothetical T2DM oral treatment, the respondents evaluated the side effect 'possible hypoglycemia' as the most significant factor in their treatment decision (patient preference) [44]. In another study conducted by Gelhorn et al. on two different hypothetical oral antidiabetic medication profiles, they found patients gave the highest importance to the hypoglycaemia side effect, [46] and a similar rank was found in another study by Aristides et al. conducted with patients regarding insulin [45]. This may be due to the fact that hypoglycaemia is a common side effect as well as a symptom of the condition in people with diabetes who are on medicines (insulin or other oral medicines) to control their diabetes; and that it is a side effect / set of symptoms that are not favoured by the patients, and they prefer not to experience it.

Another important factor (negative attribute) of 'weight change' was ranked number 2 by the respondents. Indian migrants preferred 'no weight change' over 'weight gain' as a side effect of the medicine. This is in contrast to a study by Mohamed et al., which identified the side effect 'weight variation' to be ranked first,[49] and another study which reported that participants valued possible changes in weight as the least important attribute impacting their preference [5]. Many patients with diabetes tend to struggle with their weight, and recent guidelines as well as physicians often advise patients to maintain current body weight, if within the normal range, or reduce body weight, if overweight, as part of effective diabetes management [44]. Generally, as most antidiabetic medications can increase body weight, patients become more aware of changes in body weight and give importance to controlling body weight in order to achieve optimal glycaemic control [44]. Body weight gain may conflict with patients' expectations (and affect medication adherence) and complicate the management of diabetes

[44]. Therefore, whilst weight loss was also preferred over weight gain, the relative importance of no weight change was far greater for the respondents in their medicine choice.

Impact on glycated haemoglobin (HbA1c) was identified as a relatively important positive attribute of the medicines, being ranked third among all the medicine attributes. Researchers have investigated the importance of the HbAlc attribute and identified it as having a positive impact on patients' medication preference [50, 51]. Overall, the recommendations from treatment guidelines and physicians are for people with diabetes to control HbA1c (HbA1c level <6.5%,[1] which is the ultimate goal of diabetes treatment, [52] in order to avoid long-term complications [53]. Therefore, this is an important factor based on the patient perspective, and evidence-based recommendations support the importance of this attribute.

This study also identified that the convenience-related factors (dose frequency, food instruction and formulation (dosage form)) had a significant impact on respondents' preferences for the use of conventional or ayurvedic medicine. Convenience-related factors are especially important in making a choice between conventional and ayurvedic medicines, because of the inherent differences between the products. In the earlier qualitative study [54], it was noted that ayurvedic medicines were used at a specified time; e.g., fenugreek seeds must be soaked overnight in water and then the patient must drink the water the next morning [55, 56]. Similarly, the formulation or dosage form of the medicines is considered by patients to be very important, since many ayurvedic medicines need to be used in their natural form (e.g. leaves, bark, root), and consequently the taste and smell may be unpleasant to many and reduce patient preference for the medicine. The negative attributes of the medicines with regards to needing to be taken with food and the inconvenient formulations, are deemed to be 'everyday problems' which can significantly influence medication taking. This is supported by a previous study that revealed that if patients face any difficulty in taking medications at any point in time, it leads to them omitting, delaying or forgetting medications [57]. Thus, Indian migrants put the most importance on 'can be taken anytime' over 'should be taken with or just after eating' and also on the preferred formulation of the tablet/capsule over the liquid form, as it is easy to use. These study findings also demonstrate that patients are not always only looking at the benefits and harms of medicines, but also give equal importance to how convenient they are to take. These factors should therefore be considered in selecting medications for patients, to ensure that they are not acting as barriers to medication taking.

Unlike the current research, some previous studies did not include formulations and instructions for taking with food in their studies, presumably because they were not significant relative to other factors. It is also possible that these factors were not examined in other studies because they were conducted only between conventional medicines, whereas we explored the preference between conventional and ayurvedic medicines, and therefore it was necessary to include them.

Limitations

The methods of DCEs are widely used in health economics, but they have some limitations. First, the respondents assessed a hypothetical choice of medicines. The hypothetical choice is intended to model potential clinical decisions, but does not have the exact economical, clinical or emotional implications of real decisions. As a consequence, variations between the mentioned and the actual choices of the medicine could occur. Efforts have been made in this study to minimise any potential differences by making decisions that are as close as possible to real world trade-offs and using findings of an earlier qualitative study with the same target group. Second, the survey was not completed by a number of respondents (who excluded some of the questions); however, there are no data to indicate that these partial responses are skewed by preference weights or possible conformity predictions. Approximately 1% (n=14) of the responses were incomplete, but were included in the analysis, as two out of eight choice tasks were completed. The parameter estimates were not influenced by the elimination of options with incomplete responses. Third, we had a relatively limited sample size (n=141). The statistical relevance of certain characteristics in the model, however, indicates that the sample size was not an issue. Fourth, a low number of women participated in the survey, which may affect the results, so the study cannot be generalised. Fifth, the study is in a population of Indians in Australia, which may be different to other Indian populations elsewhere.

Conclusion

The present study found that Indian migrant respondents with type 2 diabetes were more likely to not start either conventional or ayurvedic medicine for their diabetes management, though the preference for conventional medicine use was higher. This study found that preferences for conventional and ayurvedic medicine are heterogenous and are influenced by several factors. Potentially experiencing a hypoglycaemic event was the most important and influential factor, followed by weight change, glycated haemoglobin, instructions for taking with food, side effects and formulation of medications. However, Indian migrants with type 2 diabetes indicated preference for a medicine in order to gain the stated benefits despite mild or moderate side effects. It is important to identify factors that help

physicians effectively initiate pharmacological therapy and optimise treatment plans among Indian migrants with type 2 diabetes in Australia.

Clinical practice implications

The current research makes several medical practice-related suggestions to improve physician consultations with Indian migrants living with diabetes in Australia.

1) It is very important that participants' preferences should be understood and integrated into the decision-making process for starting antidiabetic medications. The patient's choice of medications based on their preference can be determined on the basis of their positive and negative beliefs (needs and concerns) and their views on convenience with respect to antidiabetic medications.
2) Physicians need to consult with patients based on the specific phase of medication taking and consider their needs related to medication use. This can improve adherence among patients and can also save time and improve the effectiveness of the consultation.
3) Physicians must consider, as shown in this research, the variations in patient preferences that can occur during the medication-taking phases, and between individuals. For instance, two or more individuals can have different preferences in the same phase of medication taking.
4) The study showed that the patient was willing to use medications if it could cause mild side effects, but still be beneficial. There is a need to identify which medication participants will accept if, despite mild side-effects, improvements in blood sugar levels will occur. This information will help physicians to consult and prescribe medicines tailored to the patient's preferences, and ultimately improve overall medication taking and patient health outcomes.

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Author contributions AA and PA designed the research study. AA analysed all the data and wrote the first draft of the manuscript. MUK and PA contributed significantly to all drafts of the manuscript and its final version. All authors have read and agreed with the final manuscript.

Declarations

Ethical approval Ethical approval to conduct the research project was received from the Human Research Ethics Committee of university on 8 July 2020 (Project No.:2020/321). The survey was performed in compliance with the approved research protocol. Participation in the study was completely voluntary. As an online questionnaire was used, the respondents were in control of completing and submitting the questionnaire. The completion of the online survey was taken as evidence of consent to participate in the study.

Conflict of interest The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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