What helps and hinders metformin adherence and persistence? A qualitative study exploring the views of people with type 2 diabetes

Lianne Parkin, Karyn Maclennan,
Lisa Te Morenga, Marie Inder, Losa Moata'ane

ABSTRACT

AIM: To explore the views of people with type 2 diabetes who had initiated metformin monotherapy about what influences adherence and persistence.

METHODS: We recruited participants through primary care, using purposive sampling, and undertook face-to-face, audio-recorded, semi-structured interviews with 10 Māori, 10 Pacific, and 10 non-Māori non-Pacific patients who had started metformin monotherapy for type 2 diabetes within the previous two years. A thematic analysis was undertaken using the Theory of Planned Behaviour as the overall theoretical framework.

RESULTS: The perceived benefits of taking metformin included improving glycaemic control, preventing or slowing the progression of type 2 diabetes, and avoiding serious complications. Side effects (predominantly gastrointestinal) were the most commonly cited disadvantage. Participants employed a variety of strategies to help them take metformin regularly. Key reasons for initial sub-optimal adherence and persistence were side effects and not accepting the diagnosis of type 2 diabetes. Subsequently, omitting to take tablets was commonly unintentional (due to 'forgetfulness'). For many Pacific participants, changes in routine related to community and church events, or shift work, contributed to sub-optimal adherence. Some Māori participants would have preferred to use traditional medicines.

CONCLUSION: We identified a number of factors within the scope of healthcare services that may assist healthcare providers to focus on, and address, some of the issues that appear to be of primary importance to people when they are prescribed metformin.

Type 2 diabetes is a major public health issue globally and in New Zealand.[1–5] Findings from the 2018/2019 New Zealand Health Survey suggest that 6.4% of the overall New Zealand population aged >25 years has diagnosed type 2 diabetes,[2] and data from the Virtual Diabetes Register reveal that the number of people with diabetes of any type (the majority of whom would have had type 2 diabetes) increased each year between 2010 and 2019.[3] There are significant inequities in type 2 diabetes prevalence in New Zealand, and Māori, Pacific, and low-income groups are particularly affected.[2,4,5]

Metformin monotherapy has been recommended as the first line pharmacological therapy for type 2 diabetes in New Zealand,[6–8] which is in line with guidelines and consensus statements from the UK National Institute for Health and Care Excellence,[9] the Scottish Intercollegiate Guidelines Network,[10] the European Association for the Study of Diabetes,[11] and the American Diabetes Association.[11]

Internationally, qualitative studies have examined factors that influence adherence to oral hypoglycaemic agents.[12–28] However, only one[28] of these studies focussed specifically on metformin and very few explored

patients' perspectives on barriers to, and enablers of, adherence in the period following initiation of oral hypoglycaemic therapy—a time that may be the most critical for establishing regular use of the drug. No similar studies have been undertaken in New Zealand. We therefore carried out a qualitative study to explore the views of Māori, Pacific, and non-Māori non-Pacific patients with type 2 diabetes about what helps and hinders metformin adherence and persistence after initiating therapy.

Methods

Theoretical framework

The Theory of Planned Behaviour was used as a theoretical framework to explore factors that influence metformin adherence and persistence within the New Zealand context. This theory asserts that the intention of a person to adopt a certain behaviour (eg, medication adherence) is determined by three important constructs:[29]

i. *Attitude toward the behaviour* (eg, perceived advantages and disadvantages of medication adherence)
ii. *Subjective norm* (eg, perceived social pressure regarding medication adherence or non-adherence)
iii. *Perceived behavioural control* (eg, perceived factors that impede or facilitate medication adherence)

Interviews with Māori and Pacific participants were further framed by Te Whare Tapa Whā and the Fonofale model, respectively.[30,31]

Eligibility criteria

Because a recent quantitative study undertaken by our group revealed a drop in adherence and persistence that was particularly marked in the first two years following initiation of metformin monotherapy,[32] we opted to interview people within that two-year period in order to maximise the likelihood that any participants who had not taken metformin as prescribed would still remember what had contributed to sub-optimal adherence or discontinuation. Therefore, to be eligible for inclusion in the study, potential participants needed to have been prescribed metformin monotherapy for type 2 diabetes for the first time within the last two years. Members of this group were eligible for inclusion regardless of their current treatment status (ie, still using metformin monotherapy, using another antidiabetic pharmacological regimen, or not using any antidiabetic pharmacological regimen); we did not exclude people who had discontinued pharmacological treatment or changed regimens, as they may have had different experiences in relation to metformin adherence than those who continued, and it was important to capture that information. In addition, potential participants needed to be at least 18 years of age, able to converse in English, and willing and able to give informed consent.

Recruitment

Recruitment took place through primary care providers in Auckland, Wellington, and Dunedin. The providers included mainstream general practices; a healthcare provider for Māori, Pacific, and low-income families, as well as others who experience barriers to primary care; a Māori primary health organisation; and a Pacific healthcare provider. Practice staff generated a list of potentially eligible participants, along with a minimal set of variables (age, gender, self-identified ethnicity, and concomitant health issues), and used this list to take a purposive sample to facilitate the recruitment of a diverse group of participants. They then sent a letter of invitation and information sheet to the selected patients on our behalf. Recipients of the letter were invited to contact us if they were interested in taking part in the study, or if they required any further information before making a decision about participation. Arrangements were made for a face-to-face interview with each eligible participant at a time and place that suited them. *A priori* we proposed to recruit a total of 30 people—10 Māori, 10 Pacific, and 10 non-Māori non-Pacific.

Interview

Participants took part in one semi-structured, face-to-face interview between June 2018 and April 2019 about type 2 diabetes and their use of metformin. While guided by the Theory of Planned Behaviour, the interviewer asked open-ended questions and allowed for more in-depth enquiries to be made depending on the answers to those questions. An interview guide (see Appendix Table 1), which contained a list of questions and topic areas to be covered,

was developed by the research team. A draft version of the guide was discussed with the project's advisory group and was refined before being used during interviews with study participants. Written consent was obtained by interviewers prior to starting an interview. The interviews varied in duration, with most lasting between 30 and 60 minutes. Following the interview, participants were offered a $40 supermarket voucher as koha.

All interviews were audio-recorded with the permission of the participants, except for two: during one there was a technical problem with the digital recorder, and one participant preferred not to be recorded (comprehensive notes, including verbatim quotes, were taken during both of these interviews). Field notes were taken alongside the audio-recordings. Interviews with Māori participants were mostly undertaken by a Māori member of the research team and interviews with Pacific participants were undertaken by two different Pacific interviewers (one Samoan and one Tongan). Kaupapa Māori and talanoa research approaches were used in interviews with Māori and Pacific participants, respectively.[33,34]

Transcription of interview audio-files

The recorded interviews were transcribed by a professional transcription service. Each interviewer checked and corrected, if required, the transcripts of the interviews they had conducted, removed all potentially identifying information, and added any necessary explanatory notes. In addition, to minimise the potential for error, one researcher independently listened to all the audio-files and made corrections to the transcripts if required.

Analysis

Checked transcripts were uploaded to NVivo version 12 (QSR International, Victoria, Australia) to assist with data organisation and analysis. After six interviews had been completed and transcribed (two each with Māori, Pacific, and non-Māori non-Pacific participants), three members of the research team undertook a preliminary thematic analysis, using the Theory of Planned Behaviour as the overall theoretical framework. The researchers read the six transcripts to familiarise themselves with the data, independently coded themes using a loose coding framework and then met to discuss their provisional coding. Once a consensus on themes and sub-themes was reached, a coding dictionary was developed. The dictionary was used to refine the coding already undertaken and to code subsequent interviews; additional themes were added to the coding dictionary as they were identified. To promote consistency of coding, half the interviews were double-coded. To facilitate an overview of the data, one investigator coded all the interviews, cross-checked against the coding undertaken by other members of the research team, and then selected relevant quotes to illustrate the key themes. The results of this analysis were then circulated to the other members of the research team to be discussed and confirmed. Feedback discussion sessions were also held with participants.

Ethical approval

The study was approved by the University of Otago Human Ethics Committee (Health) (reference H18/058).

Results

Characteristics of participants

The characteristics of the 30 participants are shown in Table 1. We interviewed 10 Māori, 10 Pacific, and 10 non-Māori non-Pacific participants across a broad age range; 22 participants were women. Most participants were taking metformin monotherapy when they were interviewed; some participants had escalated to more intensive treatment or had switched to another oral hypoglycaemic; and a few participants were not taking any antidiabetic agents—for some this was intentional and for others it was because their supply had run out.

Perceived advantages and disadvantages of taking metformin

Initial and subsequent feelings about taking metformin

Typically, metformin was first prescribed at the same time that type 2 diabetes was diagnosed and participants reported a diverse range of feelings about starting the drug, including denial about the diagnosis of type 2 diabetes and the need for treatment, a general reluctance to take any kind of

Table 1: Characteristics of study participants.

Characteristic	Number (n=30)
Age category (years)	
35–39	2
40–44	1
45–49	3
50–54	4
55–59	8
60–64	5
65–69	4
70–74	2
75–79	1
Gender	
Female	22
Male	8
Ethnicity	
Māori	10
Pacific	10
Cook Island Māori	1
Samoan	3
Tongan	3
Niuean	1
Fijian Indian	1
Tuvaluan	1
Non-Māori non-Pacific	10
Treatment regimen at time of interview	
Metformin monotherapy	23
Metformin + gliclazide	1
Metformin + gliclazide + insulin	1
Gliclazide monotherapy	1
None*	4

*One participant had discontinued metformin monotherapy because of reported improvements in glycaemic control following major changes to diet and physical activity levels; one had discontinued because of severe diarrhoea; two had run out of metformin and had not returned to their healthcare provider to obtain a new prescription.

medication, feeling they had no choice, disappointment that lifestyle changes had been insufficient to improve glycaemic control, that it was a 'wake-up call' about the seriousness of type 2 diabetes, relief that insulin was not required, and a willingness to see whether metformin improved glycaemic control and prevented serious complications.

By the time of the interview, the views of most of those who were initially unhappy about starting metformin had shifted in a positive direction. There appeared to be several explanations for this shift. A few people commented that, although it had taken time, they had come to accept the diagnosis of type 2 diabetes. For some, observing that metformin had improved glycaemic control had played an important role. Other explanations included developing a better understanding of the benefits of taking metformin, finding that any initial side effects spontaneously resolved, developing strategies to mitigate any side effects, incorporating taking metformin into the routines of daily life, and realising that it was still possible to lead a full life while taking metformin.

Perceived benefits of taking metformin

Participants had several responses when asked about the benefits of taking metformin (Table 2). Glycaemic control was the most frequently cited benefit, followed by prevention of long-term complications of type 2 diabetes such as loss of eyesight, loss of limbs, and renal failure requiring dialysis. Prevention of coronary events and stroke was not mentioned.

Things participants disliked about taking metformin

The most commonly discussed negative aspect of taking metformin was the side effects, predominantly gastrointestinal (Table 3). In some instances, the gastrointestinal disturbances were reasonably mild and short lived, although in others they were severe and had a substantial impact on life and work. Participants with severe symptoms often reduced the dose of metformin (either on the advice of their doctor or of their own volition) or changed the time(s) they took metformin, and some stopped taking metformin altogether (either temporarily or longer term).

Perceived views of others about participant taking metformin

Participants identified various people, in addition to their healthcare providers, who approved of them taking metformin, including their partner, other family members, and friends. Conversely, a few participants felt their partners, other family members, or friends disapproved of metformin use. However, these participants reported that the opinions of others did not prevent them from taking metformin, because they felt it was helping them or they were not convinced by proposed alternative approaches.

Perceived facilitators of, and barriers to, taking metformin

Factors that helped participants to take metformin regularly

A key motivation for participants trying to take metformin as prescribed was the desire to remain well for both themselves and their families. Participants also reported a variety of strategies that helped them take metformin regularly (Table 4). Partners, other family members, friends, and work colleagues also played an important role for some participants, but some did not discuss their type 2 diabetes with others or were emphatic that it was their own and no-one else's responsibility to remember to take metformin.

Good relationships with healthcare providers also facilitated use of metformin. Some participants spoke of the importance of 'being known' by their healthcare providers, being able to talk easily, recognising that their healthcare providers genuinely cared about them, appreciating 'straight talking', being able to ask questions, feeling they could relate to their healthcare providers, and generally trusting their healthcare providers to give them the appropriate treatment and advice. Some Māori and Pacific participants also highlighted the importance of having Māori and Pacific healthcare providers who shared their cultural identity and language.

Factors that made it difficult to take metformin regularly

The majority of participants reported they had sometimes missed taking their metformin tablet(s) at the usual time; for

Table 2: Perceived benefits of taking metformin.

Perceived benefits	Illustrative quotes
Improves glycaemic control	I guess it stabilises my blood sugar... because the last time I had my blood test it was 71. And I went down last week [to the medical centre], it was 64. So I guess that's a bonus. I guess I can see the big change of taking the metformin, you know. *[Pacific participant, female]*
Reduces risk of complications of type 2 diabetes	The only thing with the diabetes, it's worth controlling 'cause of losing limbs and eyesight. That's the only thing that worries me. [Māori participant, female] Yeah but I also noticed different types of suffering in my aunties and my father and my uncles went through. Um... some of them lasted up to 80 but there's no problem, they never take, they weren't on insulin or anything. And I thought to myself I want to be like them and be, listen to the doctor and get... Some of them were on insulin very fast and they had bad kidneys and they have um... ...dialysis. So I don't want dialysis. *[Pacific participant, female]* ...and I s'pose it worries me a little bit that... the higher risk of infection and things like that because of diabetes, so… probably what keeps me on the metformin better. *[Non-Māori non-Pacific participant, female]* ...so I see the pills as the reason why I'm not in the ground... and I want to be around to enjoy whatever time, you know, in this world you have... But I know that it does, like I said, it's like putting money in the bank. I know that it's going to keep me here a bit longer. I know that if I went dead cold turkey, my diabetes would come back and I'd be stuffed. [Non-Māori non-Pacific participant, male]
Prevents or slows progression of type 2 diabetes and subsequent need for insulin	I mean I think metformin's a good thing as long as it... you know, it works to make sure that it keeps you off from getting any worse so that it makes you end up going onto the insulin side of things. And if that's what it does and that's what it is, keeps preventing you from getting worse to that stage, then it's all good to me. And there's no way I ever want to get to that stage. *[Non-Māori non-Pacific participant, female]*
Reverses progression of type 2 diabetes	I've been now described officially as pre-pre-diabetic, after a year of working on things. My HbA1c when I was first was diagnosed was 102. Then after… six months, I think, it was cut back to 48. And then the last two readings, I can't remember when they were done… one was just done recently, were both 40, which is pre-diabetic. But I mean that doesn't mean it's the end of the battle, I keep making the changes. *[Non-Māori non-Pacific participant, male]*
Helps with weight loss	But it has helped me to lose the weight... *[Non-Māori non-Pacific participant, female]*
Controls symptoms	Um, well it helps me in the fact that I don't feel the cold and the other sort of symptoms that come around diabetes that I used to. I must say that this morning, for the first time in a long long time, that I can remember, I didn't have to get up in the night to go to the toilet, which is a big change. [Non-Māori non-Pacific participant, male] ...it gives me more energy. *[Māori participant, female]* I know I'll be dizzy if I don't take my medication. *[Pacific participant, female]*
Provides reassurance that there is something that helps to control type 2 diabetes	Definitely it's the thought, it's the reassurance, that I've got this that's helping me inside my body. You know? *[Pacific participant, female]*
Has broader health benefits	I saw something on [TV programme] about metformin being the miracle drug. There's a big study in the States and they wanna know why they don't release metformin as a drug to take to help with your health, maintain your health. *[Māori participant, female]*

some, this had happened very occasionally, whereas for others it had occurred more frequently. Almost all of these participants had been prescribed metformin twice daily and many mentioned they were more likely to miss their evening dose. A change in routine was the most common factor that made it difficult to take metformin as prescribed (Table 5).

Although no participants identified people who intentionally made it difficult for them to take metformin regularly, a few commented that short appointment times made it difficult to establish a relationship with their general practitioners, and another questioned whether doctors really understood what it was like to take the medications they prescribed. A couple of participants also noted that the absence of active support from their partners or other family members made it harder to take metformin than it otherwise might have been.

Sources of help for metformin-related issues

The most commonly cited sources of help for metformin-related issues were the Internet, general practitioners, and nurses. Importantly, many of the people who mentioned the Internet appeared to undertake broad undirected searches, and not all participants had access to a computer or smart phone.

Table 3: Things participants disliked about taking metformin.

Things disliked	Illustrative quotes
Side effects	...the bowel situation was horrendous... For the first couple of months, I very rarely went out because I was too scared to be far away from the toilet. I think it was a case of 'I could have coughed and had an accident'... But after the first couple of months, it started to go away or settle down and I thought I could deal with it. There were still times when it happened, but not as much. And then when I decided to… adjust or, yeah, adjust my medications to suit myself, it worked better... So instead of taking morning and night, I take two tablets first thing in the morning… *[Māori participant, female]* The first time I took it, after about two days, I felt quite nauseated and was dry retching. So I looked up Dr Google. And I saw nausea can be that, so I just halved it. And I took two days on half a tablet and they said the symptoms would settle. And I went back up to the full one and it was fine. *[Non-Māori non-Pacific participant, female]* All of a sudden I just went off food and I just couldn't stand this. Maybe my taste buds, it's just something was happening, you know and I thought 'ok, give that a miss...' *[Māori participant, female]*
More pills to take	Then the metformin came along and then, you know, increase the metformin and then you're taking five. And then next minute, you're taking six. And then that's in the morning and you have to take three or four in the evening. That's a real burden to me. *[Pacific participant, female]*
Taking any sort of medication	I'm not a pill taker 'cause I've never been a pill taker. I fight even to take a Panadol. *[Non-Māori non-Pacific participant, female]*
Being questioned by others about taking metformin	They [participant's children] don't ask questions now. Like before they asked, 'what's that for'? Or, you know, it really upsets my feelings. *[Pacific participant, female]*
Being reliant on medication and anxiety about running out	If I had an alternative, I wouldn't be taking it. That's just how I see it... It's just like I'm controlled by this drug now… I get sort of worried when there could be a natural disaster, as such, and I haven't got enough stock. That will be it. And that sort of plays on my mind a little when I know that I'm running out of stuff. So I'll have to, you know, go and get some more. *[Māori participant, female]*
Impact on family and social life	It did at the start... with... because of the pricking all the time. But now, because it's under control, it is easier. *[Non-Māori non-Pacific participant, female]*

Discussion

Overview

This study has identified factors that help and hinder adherence to metformin in the critical period following initiation from the perspectives of Māori, Pacific, and non-Māori non-Pacific people with type 2 diabetes in New Zealand. Together, the themes identified from the participants' accounts have provided a context for considering the sub-optimal adherence and persistence observed in our national quantitative study.[32]

Findings in relation to previous research

Consistent with qualitative research elsewhere, we found that the development of an understanding of type 2 diabetes, and the important role that medication plays in its management, was a dynamic process that occurred at differing speeds for different individuals,[14,18,26] and that delays in accepting the diagnosis had a negative effect on initial adherence and persistence.[14,15]

Our findings relating to the perceived advantages and disadvantages of taking metformin are broadly in line with the findings of qualitative explorations undertaken in diverse settings (eg, Scotland,[26] Brazil,[12] Canada,[13,19] the United States,[28] Malaysia,[20] among Nepalese living in Australia or Nepal,[21] and Turkish immigrants in Belgium[22]), although only one[28] of those studies focussed solely on metformin.

The responses of our participants raise two important points. First, it is interesting that the long-term complications of type 2 diabetes they cited were retinopathy, lower-limb amputation, and end-stage renal disease, but coronary heart disease and stroke were not mentioned. This suggests either a lack of awareness that atherosclerotic cardiovascular disease is the leading cause of morbidity and mortality among people with type 2 diabetes,[35] or

Table 4: Strategies participants used to help them take metformin regularly.

Strategies	Illustrative quotes
Establishing a routine	…in the morning, I take this, brush my teeth, have my medication. At night, brush my teeth, have my medication, the end. So, I don't forget. *[Māori participant, female]*
Carrying supply of metformin tablets	Yeah, it's [pill container] in my handbag [all the time]. Yeah. And I make sure to fill it up when I'm going away. *[Māori participant, female]*
Using a pill dispenser	I set my meds up for the week and I have them in different coloured containers… yellow canister for the morning ones, purple for the night. *[Māori participant, female]*
Keeping metformin in a place where it will be seen	I just have it over on that bench, so when I get up to make a cup of tea... I see it there. *[Māori participant, female]*
Using pharmacist-prepared blister packs	'Cause I kept, kept forgetting. That's how I ended up in A&E. So they put me on these [blister packs] with days of the week. *[Māori participant, female]*
Keeping a supply of metformin at work	I have... um... my... here at work, I have a bottle here. *[Non-Māori non-Pacific participant, female]*
Keeping an extra supply of metformin at home	'Cause I always have at least another month's supply in my drawer… 'Cause I got caught out once. I will never get caught out again. *[Māori participant, female]*
Adapting prescribed frequency	When I used to take my one in the lunchtime, they would say 'have you taken your medication?' No, forgot. So I changed it, just take it in the evenings and the mornings. *[Pacific participant, female]*
Keeping a notebook	I've got one of those wee notebooks where I write all the blood sugars and just note when I take them, the times. *[Non-non-Pacific participant, male]*
Prioritising self	...I'm at the stage where 'no, it's about me', you know. And I think that's it. 'It's about me now, and this is what I need to do to make me well.' *[Māori participant, female]*

Table 5: Factors that made it difficult to take metformin regularly.

Factors that made it difficult	Illustrative quotes
Being away from home	…or if I'm on holiday, I tend to forget the morning one. *[Non-Māori non-Pacific participant, female]*
Changing time zones	'Cause I was mucking them up and some days I was completely forgetting them for days on end. 'Cause you were travelling for 24 hours and you'd think you had them. Couldn't remember if I had it the day before or the day before that, and... *[Non-Māori non-Pacific participant, male]*
Unexpected events	If, like say, I got to work and all of a sudden we're asked to be somewhere or go somewhere, like that's an example of when I keep missing it because I haven't planned to take it with me *[Pacific participant, female]*
Changes in meal times	Taking medication in the evening is kind of different because I may eat dinner at different times so it is highly likely I may forget, but not too often. *[Pacific participant, male]*
Eating out	Thursday night, usually when I go out for a meal, that's the only night I miss out. *[Non-Māori non-Pacific participant, male]*
Being very busy	…but I will have some days where 'oh [exclamation], I forgot to take it this morning' because I've been rushing around doing something else… *[Non-Māori non-Pacific participant, male]*
Having no time for oneself	I am managing my tablets now, but it's taken me a wee while to get to a… to get to where... um, there's time, there's time for me. *[Māori participant, female]*
Putting others first	I probably follow like most Polynesians or Māori and we just don't… we care, but not... I dunno, we care about others, rather than caring about yourself. And so as long as my kids are ok, husband's ok, the dog's ok, then things are ok. But it's actually… yeah, not really. *[Māori participant, female]*
Tiredness	Sometimes I forget. When I'm tired… Sit down and relax and I go to sleep. *[Māori participant, female]*
Memory issues	…because my memory is like a sieve now. 'Cause, I'll be honest, probably in a couple of hours, I will have forgotten everything we talked about. *[Māori participant, female]*
Having to take metformin with food	It started off metformin just at night... and then a wee while ago, she [doctor] said, 'oh I'd like you to start having one in the morning'. That's my problem one. It's a problem for me because I've spent 50 years being a smoker and my breakfast has been coffee and a fag… So when I find out that these pills I've gotta have with food, it's like oh... and I'm gagging because I, sometimes I can't get up early in the morning and have food, it's just not… I don't know whether it's a mentality thing or whether it's just what it is. But I've really struggled. So sometimes at the beginning, I wasn't taking the pill because I wasn't having food... *[Non-Māori non-Pacific participant, female]*
Other timing issues	It's taken me a while to... you know, [find] the right times to have it. You know, like I started having it at eight o'clock in the morning and eight o'clock at night. Um, but then, I started forgetting. But now because I drop my daughter off at her work bus at the station down here, um at four o'clock in the morning. So I've decided that's the time I'm going to take it. So four in the morning, and, and maybe four in the afternoon… And that's working out quite nicely for me. *[Māori participant, female]*
Cost	I don't see the Dr because I have to pay. *[Pacific participant, female]*
Other health conditions more important than type 2 diabetes	So I've got more metformin pills than I've got my blood pressure. Which shows me that I'm not taking all of my metformin… 'Cause in my head, the heart's more important than the kidney. *[Māori participant, female]*

that losing sight, a limb, or kidney function was of greater importance. Second, some researchers have expressed concerns about beliefs (as were held by some of our participants) that taking oral hypoglycaemic agents as prescribed will prevent the progression of type 2 diabetes and obviate the need for treatment escalation.[13] They argue that, while such beliefs may have a positive impact on adherence, the disadvantage is that adherent patients will experience a sense of failure, or may feel that the medication 'doesn't work', when the natural progression of the disease requires intensification of therapy, and this may have a detrimental impact on adherence to future treatment regimens.

The approaches that participants employed to help them take metformin are all consistent with strategies reported in qualitative studies internationally.[12,13,21,22,26] Comments made by the participants also highlighted the importance of establishing and maintaining good patient–healthcare provider relationships and tailoring communication styles to the preferences of patients. In contrast to some international studies,[13,22] a lack of confidence in doctors' expertise appeared to be very uncommon.

Our findings in relation to barriers to adherence and persistence are congruent with international findings.[12,13,20–22,24,26] Missing a metformin dose was most often unintentional (due to 'forgetfulness') and was more likely to occur when there was a change in routine. As others have noted,[18,22,26,27] forgetfulness is a particular issue for people prescribed oral hypoglycaemic drugs for type 2 diabetes because there are usually no symptoms to remind patients to take their medication and no reduction of symptoms to positively reinforce adherence.

The cost of visiting a doctor and prescription charges were issues for some participants. This is in line with the findings of the 2018/2019 New Zealand Health Survey, where cost was a barrier to visiting a general practitioner for a medical problem in the preceding 12 months for 13.4% of all those interviewed, and where 5.3% reported that they had not filled a prescription because of cost.[2] The corresponding proportions were higher among Māori, Pacific peoples, and those living in the most socioeconomically deprived areas.

Qualitative research in other settings (American Samoa,[23] Malaysia,[20] Ghana[24] and among Nepalese living in Australia or Nepal,[21] Turkish immigrants in Belgium[22] and British Indian and Pakistani patients living in Scotland[17]) has found that cultural and religious beliefs and obligations influence type 2 diabetes medication adherence (sometimes positively and sometimes negatively), and in New Zealand a preference for traditional Māori medicines over 'Western' pharmaceutical therapies emerged as a theme in a qualitative study that explored perceived barriers to glycaemic control among 15 people (Māori, Fijian, New Zealand European) with type 2 diabetes who were attending a diabetes clinic.[36] In our study, some Māori participants said they would have preferred to use traditional Māori medicines rather than metformin, and a few Pacific participants talked about sometimes forgetting to take metformin when they were busy with community and church events. One Pacific participant alluded to religious beliefs leading to sub-optimal medication adherence in his community, although religion did not appear to have influenced adherence among the participants we interviewed.

The main sources of help for metformin-related issues that participants cited were healthcare providers and the Internet, which is consistent with the findings of a New Zealand survey of public knowledge, and desire for knowledge, about medicine safety issues.[37] It is notable that many of the participants who used the Internet for information about metformin undertook general untargeted searches, and only a few appeared to consider the trustworthiness of the sites they visited. In addition, not all participants had Internet access. These findings are consistent with previous reports that have revealed low levels of health literacy in New Zealand[38] and reinforce initiatives introduced to help the New Zealand health system contribute to building health literacy.[39] They also highlight the need to provide patients with resources through a variety of channels, as it cannot be assumed that online resources will suit everyone.

The authors of a meta-synthesis of qualitative studies that explored self-management of type 2 diabetes have cautioned

against a simplistic emphasis on the role of the individual in managing their disease, as such an emphasis downplays the role of broader influences and determinants of health.[40] Similarly, researchers in New Zealand have highlighted the steps, each with its own complex set of determinants, required for an individual to obtain a prescription medicine.[41] It follows that there is a balance to be achieved between encouraging self-efficacy and self-management of type 2 diabetes and recognising the complex cultural, social, economic, geographic, and political environments in which individuals live. An unintended consequence of focussing entirely on self-management without addressing broader systemic factors is that it might foster counterproductive guilt and shame if self-management appears to have 'failed'. This delicate balance was illustrated in our study with some participants vigorously asserting that they were responsible for managing their type 2 diabetes and feeling empowered to make positive changes in their lives, while others appeared to be grappling with a heavy burden of self-recrimination for having diabetes and/or sub-optimal glycaemic control, feelings that sometimes prevented them from visiting their healthcare providers. Similar feelings of guilt and shame have also emerged in other New Zealand[36,42] and international[16,26] qualitative studies involving people with type 2 diabetes. An added complexity, observed in our study as well as in other qualitative studies of diabetes in New Zealand[36,42] and elsewhere,[26] is the common lack of understanding that type 2 diabetes is a progressive disease and that a need to escalate treatment is not synonymous with personal failure on the part of people with the disease.

Strengths and limitations of the research

This study is the first New Zealand-based qualitative investigation of the views and experiences of people who initiated the recommended first-line therapy, metformin monotherapy, to treat type 2 diabetes.
The study has several strengths. First, we included equal numbers of Māori, Pacific, and non-Māori non-Pacific participants to ensure that the views of Māori and Pacific patients were equally represented alongside those of non-Māori non-Pacific patients.

Second, we took an active recruitment approach and sent personal invitations to potential participants via primary care, as this increased the likelihood of recruiting a broader range of participants than the highly selected group of people who are likely to respond to a generic public advertisement (and who are likely to have better adherence). Recruitment in three cities, through mainstream general practices as well as services for Māori, Pacific, and low-income families, also contributed to ethnic, socioeconomic, and geographical diversity. A further advantage of our recruitment method is that we were able to reassure potential participants that we were not involved in the process of identifying potentially eligible patients and therefore did not have access to their personal healthcare data and, conversely, healthcare providers did not know who had agreed to take part in the study. This may have helped to encourage open discussion.

Third, to further facilitate free discussion, interviews were conducted at a time and place of each participant's choosing; family members or other household members were present if invited by participants; and there was congruence between the ethnicity of participants and interviewers. We used an established theoretical framework to develop the interview guide, but also took a flexible approach that allowed the participants to tell their stories in their own way.

Fourth, several steps were taken to check the accuracy of the interview transcripts. Similarly, the coding dictionary was developed through consensus and several steps were taken to ensure it was used consistently. The provisional results of the analysis were reviewed and confirmed in a research team meeting. We also held group and individual feedback sessions with participants who corroborated our findings.

Finally, our research team included Māori, Pacific, and non-Māori non-Pacific researchers who were involved in the design, recruitment, interview, and analysis phases of the research, as well as in disseminating the results. In addition, we established an advisory group for the project to reflect and represent the interests and perspectives of people with type 2 diabetes, Māori, Pacific peoples, clinicians, and medicine safety specialists, and

we consulted this advisory group at the planning stage of the study regarding the proposed methods for recruiting and interviewing participants.

Our research also has some limitations. People who choose to take part in research are inevitably different from those who do not, so it is possible that there are other barriers to metformin adherence and persistence that were not identified in this study. For instance, despite our efforts to achieve a gender balance at the recruitment stage, about three quarters of those who agreed to take part were women. Future research could focus on exploring the views of men, especially those of Māori men, who were under-represented in this study.

Conclusions

In this qualitative study, participants identified several facilitators and barriers to taking metformin as prescribed. Having an understanding of patients' beliefs and experiences is key to improving medication adherence and persistence because, as the authors of a recent qualitative meta-synthesis concluded, while patients and healthcare providers share similar views about some of the barriers to adherence, there are also some differences.[43] In particular, the authors discussed the tendency of healthcare providers to attribute patients' sub-optimal adherence to a lack of motivation and insufficient understanding of the physiological and biomedical aspects of type 2 diabetes, whereas broader personal, social, and practical challenges are often foremost for people living with type 2 diabetes. Participants' feedback in our study has highlighted several actions (Table 6) that healthcare providers could take in the clinical setting to facilitate adherence.

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Table 6: Clinical implications of the findings.

- Recognise that the process of accepting the diagnosis of type 2 diabetes and the need for medication is a dynamic one that proceeds at different speeds for different patients, and progressively provide individually tailored information and support that is concordant with an individual's current stage of acceptance.
- Recognise and address feelings of personal failure and guilt that may have arisen from a lack of understanding about the progressive nature of type 2 diabetes.
- Reinforce beliefs about the positive aspects of taking metformin and address any misconceptions.
- Actively identify any reluctance to initiate metformin use and explore and address the reasons behind this reluctance.
- Proactively address potential side effects—for example, forewarn patients they may experience gastrointestinal upsets *and* what to do if they occur.
- Help patients to identify potential adherence-facilitating strategies that might work well for their particular circumstances.
- Recognise that most patients will miss a dose of metformin intermittently and pro-actively advise them what to do if that occurs.
- Involve partners and other family members, as appropriate, because they are often influential in facilitating medication adherence.
- Provide patients with visual evidence (eg, blood sugar and HbA1c graphs), especially early on, that metformin is improving glycaemic control.
- Ensure that patients are aware of, and have access to, various types of assistance for which they may be eligible (eg, prescription subsidies).
- Advise patients about trustworthy Internet sites for information about diabetes and its treatment.

Appendix

Appendix Table 1: Interview guide.

Topic areas and questions

Rapport-building initial questions regarding type 2 diabetes and metformin prescriptions
• To begin, would you mind sharing a little bit about yourself and your whānau (family)?
• Could you tell me about your diabetes?
  • When were you first diagnosed with diabetes?
  • How does diabetes affect your day-to-day life/work?
  • What does your whānau understand about your diabetes?
  • What sort of effect does your diabetes have on your whānau?
  • How do you manage your diabetes? *(e.g. medications, lifestyle)*
  • Who helps you to manage your diabetes?
• When were you first prescribed metformin?
• Is your doctor still prescribing metformin for you? ***If no**:* When did you stop taking metformin? What was the reason for stopping?

Questions related to Behavioural Beliefs *(i.e. perceived advantages and disadvantages of medication adherence)* • How did you feel about starting metformin? *If still taking*: How do you feel about taking it now? • What are the benefits of taking metformin? • How does/did taking metformin help you? • Can you tell me what you understand about how metformin works? • What are the things you don't/didn't like about taking metformin? • How does/did taking metformin affect your whānau and social life? Your work? *If relevant:* • How does metformin affect your mental/physical/spiritual/whānau wellbeing?
Questions related to Normative Beliefs: *(i.e. perceived social pressure regarding medication adherence or non-adherence)* • Who would approve of you taking metformin regularly? • Is their opinion important to you? Why? • Who would disapprove of you taking metformin regularly? • Is their opinion important to you? Why? *If relevant:* • How do you think your doctor/nurse/whānau feels about you not taking your metformin? How does this make you feel? • How important is it for you to follow your health professional's instructions about taking your metformin?
Questions related to Control Beliefs: *(i.e. perceived factors that impede or facilitate medication adherence)* • What are the things that help/helped you to take metformin regularly? • What situations make/made it easier for you to take metformin regularly? • Are there people who help/helped you to take metformin regularly? • What strategies have you/did you use to help you take metformin regularly? • What is/was the most challenging part of taking metformin regularly? • What situations make/made it difficult for you to take metformin regularly? • Are/were there people who make/made it difficult for you to take metformin regularly? *If relevant:* • Probe: household dynamics, family connectedness, social connectedness • What might be ways to fix any of the metformin-related problems you face/faced? • Where do/did you go, or who do/did you see, if you need/needed help with metformin issues?

Competing interests:
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Author information:
Lianne Parkin: Associate Professor, Department of Preventive and Social Medicine, University of Otago, Dunedin; Pharmacoepidemiology Research Network.
Karyn Maclennan, Research Fellow, Ngāi Tahu Māori Health Research Unit, Department of Preventive and Social Medicine, University of Otago, Dunedin; Pharmacoepidemiology Research Network.
Lisa Te Morenga, Associate Professor, Research Centre for Hauora and Health, Massey University.
Marie Inder, Research Portfolio Manager, University of Melbourne, Australia.
Losa Moata'ane, Associate Dean (Pacific), Division of Sciences, University of Otago, Dunedin.

Corresponding author:
Associate Professor Lianne Parkin, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, PO Box 56, Dunedin 9054, New Zealand
lianne.parkin@otago.ac.nz

URL:
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