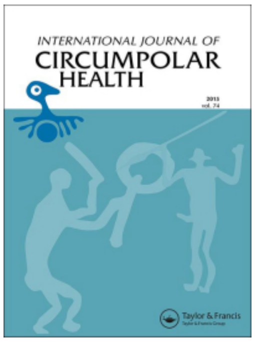

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International Journal of Circumpolar Health

ISSN: 2242-3982 (Online) Journal homepage: www.tandfonline.com/journals/zich20

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To cite this article: Matthildur Birgisdóttir, Hafdís Skúladóttir & Árún K. Sigurðardóttir (2025) “Outcomes of treatment for people with type 2 diabetes within two nurse-led clinics in primary care in Iceland”, International Journal of Circumpolar Health, 84:1, 2517932, DOI: 10.1080/22423982.2025.2517932

To link to this article: https://doi.org/10.1080/22423982.2025.2517932

Published online: 11 Jun 2025.

INTERNATIONAL JOURNAL OF CIRCUMPOLAR HEALTH
2025, VOL. 84, 2517932
https://doi.org/10.1080/22423982.2025.2517932

ORIGINAL RESEARCH ARTICLE

OPEN ACCESS

"Outcomes of treatment for people with type 2 diabetes within two nurse-led clinics in primary care in Iceland"

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ABSTRACT

As the prevalence of type 2 diabetes increases in Iceland, more nurse-led diabetes clinics have been established in primary health. This study aimed to evaluate treatment outcomes in patients with type 2 diabetes at two rural nurse-led diabetes clinics and compare these outcomes with guidelines. A retrospective cohort study was conducted in primary care settings in Northern Iceland using secondary data from medical recording systems. The sample (n = 88) included patients with two glycated haemoglobin (HbA1c) measurements taken at least 6 months apart (Time 1 and 2). Between Time 1 and 2, HbA1c levels (p = 0.049), body mass index (p = 0.013), and systolic blood pressure (p = 0.040) decreased. At time 2, approximately 70% of patients reached clinical goals for HbA1c levels, 33% for body mass index, 56% for systolic blood pressure, and 49% for diastolic blood pressure. This finding is consistent with those of other European studies in diabetes care. Assessing healthcare outcomes is beneficial for small rural clinics, where work is often conducted in isolation. This programme evaluation study conducted in two nurse-led clinics in Iceland demonstrated improved diabetes outcomes with care aligned with clinical guidelines and provided a baseline for measuring future outcomes.

ARTICLE HISTORY
Received 19 December 2024
Revised 4 June 2025
Accepted 5 June 2025

KEYWORDS
Clinical guidelines; nurse-led clinics; rural; type 2 diabetes; primary health care

Introduction

The incidence of diabetes is growing globally, with more than 90% of the diagnosed cases classified as type 2 diabetes (T2D) [1]. Effective disease management requires patients to develop self-management skills, which necessitates learning and active participation. Appropriate self-management includes good metabolic control and addressing risk factors related to T2D co-morbidities, such as cardiovascular complications [2]. Complications are common among individuals with T2D [3] and can be present even at the time of diagnosis [4]. A study by Fang and Selvin [4] examining 30 years (1988–2018) in diabetes complications among newly diagnosed adults in the United States discovered that reductions in cardiovascular complications, retinopathy, and reduced glomerular filtration rates had not occurred, despite improvements in glycaemic control. Over this period, the increase in body mass index (BMI) in the United States had been remarkable, from 31 kg/m^2 to 34.5 kg/m^2 [4] similar increases are noted in European [5] and Icelandic populations [6].

Increased BMI and T2D often co-occur [7]. In Iceland, the number of people living with T2D increased 2.5 times between 2005 and 2018 [6]. In 2018, the prevalence of T2D was 3.5% in women and 4.1% in men, similar to the United States prevalence from 20 years earlier. A comparison of T2D prevalence data with medical prescription records revealed a 29% underestimation of cases [6]. A study from rural Norway, using data from regions with Sami and non-Sami populations, discovered that age-standardised prevalence of diabetes was slightly higher among men: 5.5% for Sami and 4.6% for non-Sami. Among women, the prevalence was 4.8% for Sami and 4.5% for non-Sami [8]. As Iceland lacks an official national diabetes register, no data are available on the age at diagnosis or disease duration. However, a working group appointed by the Minister of Health has recommended establishing such a register [9]. The Global Burden of Diseases, Injuries, and Risk Factors Study [10] assessing global, regional, and national burden of diabetes from 1990 to 2021 demonstrated that diabetes prevalence peaked between ages 75 and 79, with T2D accounting for 96% of all cases. Additionally, the age-standardised disability-adjusted life year rate per 100,000 individuals due to diabetes in Iceland increased by 55.7% between 1990 and 2021, compared with 13.2% in Western Europe.

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Guidelines for diabetes management [11] and hyperglycaemia control in T2D [2] state that diabetes care should be person-centred, emphasising patient participation in treatment. Regular monitoring has a positive effect on biological factors such as the HbA1c level, blood pressure, cholesterol, and blood lipids [2,12]. A study from Greenland demonstrated that restructuring diabetes care resulted in improved monitoring of these factors [13].

Research from low- and middle-income countries has revealed differences in diabetes care between rural and urban areas, with those living in rural areas less likely to achieve treatment goals [14]. Similar findings have been reported in the United States, where people living in rural areas receive fewer outpatient visits and are less likely to meet clinical guidelines [15]. In Europe, most diabetes care is provided in traditional primary care or ambulatory settings [16,17]. As the prevalence of diabetes increases, more nurse-led clinics have been established. These clinics provide complex interventions, usually adhering to structured protocols and guidelines for decision-making [18]. One aspect of the nurse's role is the promotion of self-management [16]. Crowe et al. [16] found evidence from well-designed trials that nurse-led clinics may be more effective than usual care in improving HbA1c levels and other biological outcomes. At some diabetes clinics in the country, clinical nurse specials are appointed. In Iceland, to become licenced as clinical nurse specialist, the nurse must hold a master´s degree and have 2 years of clinical training in a specialist programme [19]. According to Sulosaari et al. [20] the clinical specialist nurse programme in Iceland includes the components that the International Council of Nursing recommend as the four pillars of advanced practice: clinical, education, management/leadership and research.

Recently, the emphasis on establishing diabetes clinics in primary healthcare in Iceland has increased. Generally, diabetes clinics are specialised nurse-led clinics for individuals with T2D, where interdisciplinary teams, including nurses, doctors, dietitians, and other professionals collaborate based on international diabetes guidelines [21]. Usual primary healthcare in Iceland is mostly provided by physicians that are responsible for their patients and often does not include nursing care. According to guidelines from the American Diabetes Association and European Association for Study of Diabetes [2] the main objectives of diabetes care are to promote healthy behaviours through self-management education and encourage active patient participation. Shared decision-making is recommended to determine individualised goals, ultimately improving patient´s quality of life.

We aimed to retrospectively analyse treatment outcomes in nurse-led diabetes clinics in rural Iceland. Participants had at least two glycated haemoglobin (HbA1c) level measurements taken over 2 years. The study also aimed to compare clinical measurements to national [19] and American Diabetes Association guidelines [11]. We hypothesised that the HbA1c levels between Time 1 (T1) and Time 2 (T2) would significantly decrease. Furthermore, high-density lipoprotein (HDL) cholesterol would increase significantly, and cholesterol levels, triglycerides, systolic and diastolic blood pressure, and body mass index (BMI) decrease significantly between T1 and T2.

Materials and methods

Study design

This retrospective cohort study is a programme evaluation that utilises secondary data collected for clinical care.

Participants

The study population consisted of patients with diabetes who attended two diabetes clinic appointments during a 2-year period from January 2019 to December 2020. The inclusion criteria at enrolment involved participants aged ≥18 years, diagnosed with diabetes, who were patients of the two diabetes clinics, and had a minimum of two HbA1c measurements taken with least 6 months interval (T1 and T2).

Setting

The setting was two small diabetes clinics in primary healthcare (PHC) facilities that are part of the Healthcare Institution of North Iceland (HSN). These clinics were chosen because they were recently established as nurse-led diabetes clinics. Additionally, the researchers conducting the research had no formal arrangement with the clinics that were from 50 to 80 kilometres from the research centre, the first author is a diabetes nurse in another diabetes clinic in HSN. The diabetes clinics were formally established in January 2019. HSN is comprised of 18 PHC centres and four small hospitals [22]. The PHCs are mostly located around the northern coast in small villages and one larger town. PHC distribution is based on the historical distribution of settlements and the challenges of winter travel owing to extreme weather conditions and darkness. The distance between the easternmost and westernmost PHC clinics in the HSN service area is 378 kilometres. This very rural area is home to about

35,000 of Iceland's 383,726 total population in 2024 [23]. Iceland is a historically homogenous society with little ethnic or racial diversity, where most people are of Northern European ethnicity. In 2024, the mean age in Iceland was 38.8 years, with 15% of the population aged ≥65 years [23]

The nurse-led diabetes clinics in HSN are generally located in small PHC centres. The two small diabetes facilities in this study are situated in fishing and agricultural villages, where the PHC in each village serves approximately 2,000 patients. In Iceland, PHC is funded by the state; however, non-pensioners pay a small fee for doctor or nurse visits. The nurse-led diabetes clinics incorporate nurses, doctors, dietitians, and physiotherapists. The diabetes nurses are responsible for organising care and appointments, but decisions on medical treatment are made in consultation with doctors.

Procedure

Data were collected from electronic medical record systems. Iceland has a national electronic medical recording system, especially for diabetes care, where all healthcare professionals are required to document their work. Other medical recording systems, including those used for clinical measurements, are utilised for all patients attending the PHCs. The first author (MB), a diabetes nurse at another PHC at HSN, collected the data. MB analysed the electronic journals of patients with diabetes and inputted study variables into an Excel (Microsoft 365 A5, Microsoft Corporation, Redmond, WA, US) sheet. The other authors, who are nursing researchers and a diabetes nurse, reviewed the data for accuracy.

Study variables and guidelines

Demographic and personal history variables collected at Time 1 included age (years), sex (male/female), diabetes duration (years), and diabetes-related co-morbidities (e.g. macrovascular disorders, nephropathy, neuropathy, and retinopathy). The variable smoking status were divided into; current smoker, ex-smoker (who had once smoked) and never smoked.

The HSN uses both national guidelines [21] and the guidelines published by the American Diabetes Association (ADA) [11] to assess clinical outcomes. Blood levels for cardiometabolic risk factors collected at Time 1 and Time 2 included HbA1c level (mmol/mol) (<53 mmol/mol), measured in every clinical visit [19]. The HDL cholesterol (mmol/L) (>1.3 mmol/L), triglyceride (mmol/L) (<1.7 mmol/L) and glomerular filtration rate (mmol/L) (>60 mmol/L) measured once a year [11,19]. Other clinical risk factor measurements collected in Time 1 and Time 2, BMI (kg/m^2) (<30 kg/m^2), systolic blood pressure (mmHg) (<140 mmHg) and diastolic blood pressure (mmHg) (<80 mmHg). BMI and blood pressure measurements are recommended conducted in every clinical visit [11,19].

Use of glucose-lowering medications was recorded at T1 as: No glucose-lowering medications; Metformin only; glucose lowering medication and Insulin; two types or more of glucose lowering medications; and Glucagon-like peptide-1 receptor agonist (GLP-1 analogues). One patient could be included in more than one medication category as for example, if taking glucose-lowering medications and GLP-1 both were noted. Use of cardiovascular medications and lipid-lowering medications were recorded.

At T1 neurological examination (monofilament test) (at least yearly), referrals to a dietitian (last 2 years), ophthalmologist (last 2 years) or to a physiotherapist (last year) for physical activity counselling were documented. The frequency (once a year) of Problem Areas in Diabetes scale [19] usage was recorded. The national guidelines for diabetes care in primary care recommend that patients attend diabetes clinic at least every 6–12 months. Attendance to appointment was counted in the electronic medical record system as each time the patient attended the diabetes clinic. Telephone consultation was not counted as attendance to clinic even though patients were not allowed attendance due to the COVID-19 pandemic. The education variable included, for example, diabetes management, diet, and smoking cessation (if necessary) and national guidelines recommend that patients receive education on each visit [19]. At each appointment, clinical measurements such as HbA1c levels, blood pressure, weight, and BMI are discussed in relation to patient-specific goals, such as diet, metabolic control or weight management. In addition, patients receive education on diabetes management, symptoms, co-morbidities, treatment, and self-care at every appointment. We compared the study results at T2 to these guidelines.

Statistical analysis

Descriptive and inferential statistics were used. Clinical measurements were compared with clinical guidelines. Pearson correlation was used to assess relationships between clinical measurements, participant characteristics, and medication use (glucose-lowering medications and cardiovascular medications) at T1. A paired *t*-test was used to analyse differences in HbA1c, cholesterol, HDL, triglycerides, blood pressure, glomerular filtration rate, and BMI between T1 and T2. The significance level was set at $p<0.05$, and one-side p-value was used exclusively for the paired *t*-test. For linear regression analysis, the HbA1c level at T2 was the dependent variable. Independent variables included those that showed correlation with HbA1c level at T1; use of GLP-1 analogues, BMI, cardiovascular diseases (CVD), smoking status (never smoked, ex-smoker, current), diabetes diagnosis year, and sex. As age is associated with T2D, it was included in the model. Statistical analyses were conducted using IBM Statistical Package for Social Sciences (SPSS) 26 (IBM, Armonk, NY, USA).

Ethical considerations

The Icelandic Bioethics Committee (VSN-21–091) and HSN Executive Committee approved the study, which was conducted in accordance with the Declaration of Helsinki. Participants were unaware that their medical records were used for research purposes. All data were anonymised and entered into the database using study identification numbers.

Results

Over the study period, 101 patients attended consultations at the two diabetes clinics. However, 13 patients did not have two HbA1c measurements and were excluded from the study. Therefore, the final sample included 88 participants, allowing us to analyse 87.1% of the medical records.

Table 1 shows the participants´ characteristics at T1. The mean age was 66.1 years (±12.68), with a range from 32 to 90 years. Diabetes duration ranged from 1 to 21 years, with 57% of the participants having diabetes for less than 9 years. The mean HbA1c level was 50.9 mmol/mol, with a range from 27.9 to 105.5 mmol/mol.

All the participants (*n* = 88) were on medication. Most (93.2%) used blood glucose-lowering medication, with 31.8% taking only metformin. In total, 80.7% of the participants used cardiovascular medicine, and approximately half were on lipid-lowering medication. The most common co-morbidity was CVD (84.1%). Those on glucose-lowering medication and those with higher diastolic blood pressure also had higher HbA1c levels

The results showed that 80.7% of the participants had received diabetes education. Approximately one-third were referred to a dietitian for consultation (30.7%). Regular foot examination was conducted in 62.5% of the cases (Table 1). Owing to coronavirus disease in 2020, some patients only attended the clinic for HbA1c measurements and then received follow-up consultations via telephone, as the PHCs were only open for "necessary" visits.

A paired *t*-test revealed significant reductions in HbA1c levels (*p*=0.049), BMI (*p*=0.013), and systolic

Table 1. Personal and disease-specific characteristics of the participants at T1 (n = 88).

	Mean (±Sd)	Range	Missing data n(%)
Age (years)	66.1 (12.68)	32–90	0
Duration of diabetes (years)	10.3 (6.09)	1–21	0
	***n* (%)**		0
Male	51 (58)		
Female	37 (42)		
	***n* (%)**		
Lifestyle and health behavior			
Smoking status	67(76.1)		21(23.9)
Current smoker	15 (17)		
Ex-smoker	27 (30.7)		
Never smoked	25 (28.4)		
Physical activity	30 (34.1)		17(19.3)
Healthy eating/diet	34 (38.6)		16(18.2)
Foot examination	55 (62.5)		18 (20.5)
Eye examination	49 (55.7)		18 (20.5)
	***n* (%)**		
Treatment medication			0
Glucose-lowering medication			
No glucose lowering medication	6 (6.8)		
Metformin only	28 (31.8)		
Glucose lowering medication and insulin	8 (9.1)		
Two types or more of glucose lowering medications	22 (25)		
GLP-1 analog	39 (44.3)		
Cardiovascular medications	71 (80.7)		
Lipid lowering medication	48 (54.5)		
	***n* (%)**		
Co-morbidities			
Macrovascular	74 (84.1)		4 (4.5)
Nephropathy	7 (8)		8 (9.1)
Neuropathy	25 (28.4)		15 (17)
Retinopathy	8 (9.1)		16 (18.2)

Attendance to appointment was counted in the electronic medical record system.

Table 2. Results of two measurements at T1 and T2 in HbA1c, cholesterol, high-density lipoprotein, triglyceride, BMI, glomerular filtration rate, and systolic- and diastolic-blood pressure.

		T1		T2		
Clinical measurements	N	Mean ±*Sd*	Range	Mean ±*Sd*	Range	*P*-value *
HbA1c (mmol/mol)	88	50.9 (16.5)	27.9–105.5	47.8 (14.8)	23.5–93.4	**0.049***
Cholesterol (mmol/l)	72	4.5 (1.1)	2.3–7.5	4.4(1.0)	2.3–7.6	0.257
High density lipoprotein (mmol/l)	72	1.2 (0.4)	0.7–3.2	1.2 (0.3)	0.6–2.5	0.104
Triglyceride (mmol/l)	72	2.1 (1.3)	0.5–9.3	2.2(1.6)	0.4–10.8	0.111
BMI (kg/m2)	60	33.5(5.9)	21.8–47.6	32.8(6.1)	21.8–49.7	**0.013***
Glomerular filtration rate	72	74.8 (16.3)	18–90	74.0 (18.1)	17–90	0.293
Systolic blood pressure (mmHg)	66	143 (19.4)	105–198	138 (15.5)	112–184	**0.040***
Diastolic blood pressure (mmHg)	66	81 (9.2)	62–105	81 (9.6)	60–103	0.500

**P*-value one-sided paired t-test, values in bold means statistically significant ($p<0.05$).

blood pressure (p=0.040) at T2. Other measurements did not show significant difference (Table 2).

Table 3 displays the percentage of participants who met guideline target goals at T2. For HbA1c levels, 72.7% reached the goal, an increase of 4.2% from T1. For BMI, 31.6% of the participants met the target, whereas 56% achieved the systolic blood pressure goal. Missing data for the BMI was 32%, for blood pressure measurements it was 25% and for blood lipid measurements it was 17%.

At T1, a correlation was observed between higher HbA1c levels and the use of insulin and blood glucose-lowering medications (p=0.036), and higher HbA1c levels and higher diastolic blood pressure (p=0.010). Furthermore, a correlation was observed between higher HbA1c levels and current smoker (p=0.036). At T2, no correlation was observed between these variables.

Table 4 presents the regression model for predictors variables of HbA1c levels at T2. The model was significant (F=2.87, df=7, p=0.013). The model explained 18% of the variance in HbA1c levels. Predictor variables included GLP-1 analogue, BMI, CVD, smoking, sex, and age. The strongest predictor of higher HbA1c levels was GLP-1 analogue use (B=−17.8), indicating that at the HbA1c level decreased by 17.8 mmol/mol if the patient was using the GLP-1 analogue.

Discussion

This current study examined multiple clinical measurements at two time points (baseline T1 and T2) in two nurse-led diabetes clinics in rural areas in Iceland. The results showed that three clinical measurements, HbA1c level, systolic blood pressure, and BMI were significantly improved at T2. This finding is consistent with those of other studies [24]. At T2, approximately 70% of participants had average HbA1c levels within clinical guideline criteria. The proportion of patients who met the HbA1c criteria has varied across studies, with reported rates of 64% in Norway [25] and 49.6% in Canada [26]. In Greenland, a study

Table 3. Proportion of individuals that reached guidelines goals at T2.

Guideline goals	*n/N* (%)	*Missing data %*
HbA1c < 53 mmol/mol	64/88 (72.7)	0
Cholesterol < 5.0 mmol/l	57/73 (78)	17
HDL > 1.3 mmol/l	22/73 (30.1)	17
Triglyceride < 1.7	33/73 (45.2)	17
Systolic blood pressure < 140 mmHg	37/66 (56)	25
Diastolic blood pressure < 80 mmHg	32/66 (48.6)	25
BMI<30 kg/m^2	19/60 (31.6)	32

National [21] and ADA 2023 guidelines [11].

Table 4. Linear regression at T2, between the HbA1c level and seven explanatory variables.

	B	*t*	95 CI for B		*P*-value**
Constant	102.8	4.4	56.5	149.2	**<0.001****
Sex	−2.3	−0.5	−10.7	6.1	0.589
Age	0.2	1.3	−0.1	0.6	0.198
GLP-1 analog	−17.8	−4.1	−26.5	−9.1	**<0.001****
Macrovascular comorbidities	−7.2	−1.2	−19.1	4.7	0.233
Smoking***	−3.4	−1.3	−8.6	1.8	0.194
Duration of diabetes	−0.4	−1.0	−1.1	0.3	0.301
BMI	−0.6	−1.6	−1.4	0.2	0.121

F = 2.87. df = 7. (p0.013) R^2 = 0.18.
**values in bold means statistically significant ($p < 0.001$).
***Smoking (never, ex, current).

demonstrated that systolic blood pressure decreased significantly among people with diabetes between 2014 and 2017, as those with systolic blood pressure<140 mmHg increased from 55% to 65%. In addition, those with poor metabolic control (HbA1c at or above 75 mmol/mol) decreased significantly from 17% to 20% [13,21]. The analysis from Greenland included all patients diagnosed with diabetes (*N*=1395), whereas our study included only 88 participants, and only those with two HbA1c values 6 months apart to be included in the study. In this current study, approximately 60% of participants had ≥5 years diabetes duration, with an average diabetes duration of more than 10 years. Generally, clinical measurements improve within the first 1–2 years of regular follow-up but may decline in the long term (5 years+) [24].

The results of this study showed that the most common diabetes-related co-morbidity was CVD (84.1%), with 4.5% missing data. The prevalence was higher than those reported in studies conducted in Norway (50%) [25] and Canada (30%) [26]. In the Iceland HSN system, most participants were prescribed cardiovascular medications, but only 55% received lipid-lowering medicine. The strong link between diabetes and CVD is well-established. Hypertension and dyslipidemia, often associated with T2DM, are risk factors for CVD, and diabetes itself is a distinct risk for CVD [27]. Studies have demonstrated the effectiveness of controlling individual CVD risk factors in preventing or slowing CVD in individuals with diabetes [28]. The importance of following clinical guidelines in use of lipid lowering medications and blood pressure medications and measurement is emphasised [25]. However, awareness of diabetes as a major risk factor for CVD must increase in middle- and high-income countries as only one-third out of 48,988 individuals in an online survey in 50 countries recognised diabetes as a major risk factor for CVD [3]. Additionally, the global burden of disease research shows that ischaemic heart disease was the leading cause of disability-adjusted life-years, with diabetes ranking fifth in 2021 [29].

Peripheral neuropathy was demonstrated in almost one-third of participants in this current study. A foot examination, by doing a monofilament test, assessing peripheral skin warmth, colour and integrity as well as feeling pulses in foot and ankle, is an important aspect when assessing peripheral neuropathy and should be conducted once a year, however, it was only performed in two-thirds of our participants. A systematic review and meta-analysis (*n*=20) by Caro-Bautista et al. [30] demonstrated that foot examinations are seldom assessed in studies, appearing in fewer than three out of 20 studies. However, vascular complications are found to be common in patients with T2D, as demonstrated by Kosiborod et al. [31], who assessed vascular complications in patients with T2D in 38 countries. They reported a 7.7% prevalence of peripheral neuropathy, whereas the prevalence of microvascular complications in Europe (excluding Russia) was 16.9%. These findings highlight the need for improved foot examination in diabetes care.

In this current study, approximately 70% of the participants were obese with BMI ≥ 30 kg/m^2. In one study in northern Quebec, 83% of 685 people with T2D were obese, with a mean BMI of 35.7 kg/m^2 [32], which is higher than the BMI observed at T2. In our study, BMI decreased between T1 and T2 measurements; however, it is high (32.8 kg/m^2) at T2 and comparable to results from a European study (*n*=3479), where the mean BMI was 31.9 kg/m^2 [31].

Icelandic guidelines for nursing care in diabetes highlight patient education as a main aspect of the nurse's role [19]. The nurses document in the electronic medical record system whether patients receive education during consultations. According to the medical record system, nearly 81% of the T2D patients received education. This finding aligns with previous literature [30] which emphasises the nurses´ role in promoting self-care, supporting patients in setting self-care goals and providing education on diet and physical activity. However, the results of this study showed that approximately one-third of participants exercised and considered their diet, which are both associated with better BMI, blood pressure, and HbA1c levels [2].

When examining services at the two nurse-led diabetes clinics, the results of this study indicate that these clinics adhere to national [19] and ADA guidelines [11] for diabetes care, including organisation, regular monitoring of clinical measurements, and patient education [2]. A systematic review and meta-analysis by Caro-Bautista et al. [30] revealed that education and follow-up within healthcare have a positive effect on the body's metabolism. Individuals can underestimate the health consequences of diabetes owing to the slow progression of the disease. Therefore, clinical guidelines emphasise regular clinical attendance to prevent or delay complications and improve patients' quality of life [2]. In Iceland, a national strategic policy has been implemented to establish clinics in PHCs that provide care to individuals with chronic illnesses such as diabetes. These clinics are supported by a centre that provides practice guidance [21]. The Organisation for Economic Co-operation and Development (OECD) report states that effective primary diabetes care reduces the need for hospital visits, and Iceland has one of the lowest rates of hospital admission rates due to diabetes [5].

The two nurse-led diabetes clinics are situated in small fishing villages, which also serve the surrounding agricultural areas. For some patients, accessing the diabetes clinics, can be challenging without public transportation. In the wintertime, weather conditions may make access impossible as the roads can be snowy and slippery. Only 3–4 nurses take care of the patients attending the nurse-led diabetes clinics, therefore the service is fragile, as it is impossible to offer specialised diabetes care during the holiday season or due to staff sickness. Information regarding the nurses´ education was not collected. But the authors are aware that some of the nurses have diabetes specialist education.

In the first few months of the study period, the medical recording system was not properly utilised, and data had to be retrieved from other medical recording systems. While documentation improved over the study period, all healthcare staff must continue to improve electronic medical record documentation, especially the Problem Areas in Diabetes scale, which should be completed annually. Missing data for BMI, blood lipid and blood pressure measurements were high. That can partly be explained due to the COVID-19 pandemic as some patients came for HbA1c measurements and then received a telephone call due to limited clinic attendance.

This study had some limitations. It was a retrospective study, the original data were collected for clinical purposes by different providers with different methods and instruments which might give slight variations in individual data points that could slightly impact overall results. That the two clinics selected for evaluation were not selected at random, limit generalisability of the results. Therefore, the results can only be attributed to this clinic sample, this time frame, and not to a broader population region or sector. Also, the fact that the nurse-led diabetes clinics were newly established can be considered a limitation. Another limitation is the small sample size, as small sample sizes and short timelines make it difficult to determine statistical significance when multiple variables are being tested together, as in regression statistics.

The strengths of the study could be considered that this was the first programme evaluation for these clinics and produced a firm baseline upon which future evaluations can base their results. Programme evaluation conducted early in the life of a clinic signals administration and staff interest in improving care. Detection of strengths and weaknesses in care can lead to important changes in how and what services need to be enhanced or changed to improve patient outcomes. Improved outcomes will ultimately improve trust in providers and serve to encourage patients to attend routine appointments and participate in their care when improved outcomes are demonstrated.

The two small nurse-led rural clinics generally follow clinical guidelines for diabetes care. In clinical practice, evaluating clinical outcomes and evaluating whether the practices adhere to guidelines is essential. Several clinical factors contribute to the progression of T2D and its comorbidities, even though a variable is not statistically significant, it can be clinically significant, highlighting the importance of good documentation. Continuous monitoring of whether treatment objectives are achieved, observing changes that occur between years and examining areas of improvement is important. This programme evaluation study conducted in two nurse-led clinics in Iceland demonstrated improved diabetes outcomes with care aligned with national and American Diabetes Association guidelines and provided a baseline for measuring future outcomes.

Acknowledgments

We would like to thank the Healthcare Institution of North Iceland for the contribution and support through the research

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

Funding was received from the Icelandic nursing association researchers fund – B division.

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References

[1] International Diabetes Federation. Facts & figures. 2024. Available from: https://idf.org/about-diabetes/diabetes-facts-figures
[2] Davies MJ, Aroda VR, Collins BS, et al. Management of hyperglycemia in type 2 diabetes, 2022. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). Diabetes Care. 2022;45(11):2753–2786. doi: 10.2337/dci22-0034
[3] Chaudhary RS, Turner MB, Mehta LS, et al. Low awareness of diabetes as a major risk factor for cardiovascular disease in middle- and high-income countries. Diabetes Care. 2023;47(3):379–383. doi: 10.2337/dc23-1731
[4] Fang M, Selvin E. Thirty-year trends in complications in U.S. Adults with newly diagnosed type 2 diabetes. Diabetes Care. 2021;44(3):699–706. doi: 10.2337/dc20-2304
[5] OECD Overweight or obese population. 2023. Available from: https://www.oecd.org/en/data/indicators/overweight-or-obese-population.html

[6] Thorsson B, Aspelund T, Harris TB, et al. Þróun Holdafars og sykursýki í 40 ár á Íslandi (trends in body weight and diabetes in forty years in Iceland. Icel Med J. 2009;95:259–266.
[7] Golay A, Ybarra J. Link between obesity and type 2 diabetes. Best Pract & Res Clin Endocrinol & Metab. 2005;19:649–663. doi: 10.1016/j.beem.2005.07.010
[8] Naseribafrouei A, Eliassen B, Melhus M, et al. Ethnic difference in the prevalence of pre-diabetes and diabetes mellitus in regions with Sami and non-Sami populations in Norway – the SAMINOR1 study. Int J Circumpolar Health. 2016;75(1):31697–. doi: 10.3402/ijch.v75.31697
[9] Stjórnarráð Ísland. Government of Iceland. https://www.stjornarradid.is/efst-a-baugi/frettir/stok-frett/2018/04/20/Tillogur-um-vidbrogd-vid-vaxandi-nygengi-sykursyki/.2025
[10] Ong KL, Stafford LK, Mclaughlin SA, et al. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the global burden of disease study 2021. Lancet. 2023;402(10397):203–234. doi: 10.1016/S0140-6736(23)01301-6
[11] ElSayed NA, Aleppo G, Aroda VR, et al. 10. Cardiovascular disease and risk management: standards of care in diabetes—2023. Diabetes Care. 2023;46, Supplement_1 (Supplement_1):S158–S190. doi: 10.2337/dc23-S010
[12] Van Vugt HA, Heijmans MJWM, De Koning EJP, et al. Factors that influence the intended intensity of diabetes care in a person-centred setting. Diabet Med. 2019;37 (7):1167–1175. doi: 10.1111/dme.14072
[13] Pedersen ML. Diabetes care in the dispersed population of Greenland. A new model based on continued monitoring, analysis and adjustment of initiatives taken. Int J Circumpolar Health. 2019;78(sup1):1709257. doi: 10.1080/22423982.2019.1709257
[14] Flood D, Geldsetzer P, Agoudavi K, et al. Rural-urban differences in diabetes care and control in 42 low- and middle-income countries: a cross-sectional study of nationally Representative Individual-Level Data. Diabetes Care. 2022;45(9):1961–1970. doi: 10.2337/dc21-2342
[15] Foss R, Fischer K, Lampman MA, et al. Disparities in diabetes care: differences between rural and urban patients within a large Health system. Ann Fam Med. 2023;21(3):234–239. doi: 10.1370/afm.2962
[16] Crowe M, Jones V, Stone M, et al. The clinical effectiveness of nursing models of diabetes care: a synthesis of the evidence. Intl J Nurs Stud. 2019;93:119–128. doi: 10.1016/j.ijnurstu.2019.03.004
[17] Fuentes-Merlos Á, Quesada-Rico JA, Reina R, et al. Healthcare use among people with diabetes mellitus in Europe: a population-based cross-sectional study. Fam Med Com Health. 2022;10(4):e001700. doi: 10.1136/fmch-2022-001700
[18] Chan RJ, Marx W, Bradford N, et al. Clinical and economic outcomes of nurse-led services in the ambulatory care setting: a systematic review. Int J Nurs Stud. 2018;81:61–80. doi: 10.1016/j.ijnurstu.2018.02.002
[19] Heilbrigðisráðuneytið. 512/2013 regulations on the education, rights and obligations of nurses and the conditions for obtaining a professional license and specialist license ministry of Health. 2013. Available from: https://island.is/reglugerdir/nr/0512-2013
[20] Sulosaari V, Blaževičienė A, Bragadóttir H, et al. A comparative review of advanced practice nurse programmes in the Nordic and Baltic countries. Nurse Educ Today. 2023;127:105847. doi: 10.1016/j.nedt.2023.105847
[21] Þróunarmiðstöð Íslenskrar heilsugæslu (development centre for primary healthcare in Iceland). 2024. Available from: https://throunarmidstod.is
[22] The Healthcare Insititution of North Iceland. 2024. Available from: https://island.is/en/o/hsn
[23] Demographics I. Population of Iceland Statistics Iceland 2024 https://www.worldometers.info/demographics/iceland-demographics/
[24] Dambha-Miller H, Cooper AJM, Simmons RK, et al. Patient-centred care, health behaviours and cardiovascular risk factor levels in people with recently diagnosed type 2 diabetes: 5-year follow-up of the ADDITION-Plus trial cohort. BMJ Open. 2016;6(1):e008931. doi: 10.1136/bmjopen-2015-008931
[25] Bakke Å, Dalen I, Thue G, et al. Variation in the achievement of HbA1c, blood pressure and LDL cholesterol targets in type 2 diabetes in general practice and characteristics associated with risk factor control. Diabet Med. 2019;37(9):1471–1481. doi: 10.1111/dme.14159
[26] Leiter LA, Berard L, Bowering CK, et al. Type 2 diabetes mellitus management in Canada: is it improving? Can J Diabetes. 2013;37(2):82–89. doi: 10.1016/j.jcjd.2013.02.055
[27] Elsayed NA, Aleppo G, Aroda VR, et al. 10. Cardiovascular disease and risk management: standards of care in diabetes—2023. Diabetes Care. 2024;46(Supplement_1):S158. doi: 10.2337/dc23-S010
[28] Rawshani A, Rawshani A, Franzén S, et al. Risk factors, mortality, and cardiovascular outcomes in patients with type 2 diabetes. N Engl J Med. 2018;379(7):633. doi: 10.1056/NEJMoa1800256
[29] Ferrari AJ, Santomauro DF, Aali A, et al. Global incidence, prevalence, years lived with disability (YLDs), disability-adjusted life-years (DALYs), and healthy life expectancy (HALE) for 371 diseases and injuries in 204 countries and territories and 811 subnational locations, 1990–2021: a systematic analysis for the global burden of disease study 2021. The Lancet. 2024;403:(10440:2133–2161.
[30] Caro-Bautista J, Kaknani-Uttumchandani S, García-Mayor S, et al. Impact of self-care programmes in type 2 diabetes mellitus population in primary health care: systematic review and meta-analysis. J Clin Nurs. 2020;29(9–10):1457–1476. doi: 10.1111/jocn.15186
[31] Kosiborod M, Gomes MB, Nicolucci A, et al. Vascular complications in patients with type 2 diabetes: prevalence and associated factors in 38 countries (the DISCOVER study program). Cardiovasc Diabetol. 2014;17 (1):1–13. doi: 10.1186/s12933-018-0787-8
[32] Hayward M, Kuzmina E, Dannenbaum D, et al. Room for improvement in diabetes care among first nations in northern Quebec (Eeyou Istchee): reasonable management of glucose but poor management of complications. Int J Circumpolar Health. 2012;71(1):18418–. doi: 10.3402/ijch.v71i0.18418