International Journal of Pharmacy Practice, 2023, **31**, 512–519
https://doi.org/10.1093/ijpp/riad055
Advance access publication 1 August 2023
Research Paper

IJPP International Journal of Pharmacy Practice

OXFORD

Diabetes risk assessments and HbA1c-measurements in community pharmacies

Aslaug Johanne Risøy[1,2], Reidun Lisbet Skeide Kjome[1,2], Sverre Sandberg[1,3,4] and Una Ørvim Sølvik[1,*]

[1]Department of Global Public Health and Primary Care, Faculty of Medicine, University of Bergen, Bergen, Norway
[2]Department of Clinical Science, Centre for Pharmacy, Faculty of Medicine, University of Bergen, Bergen, Norway
[3]Norwegian Organization for Quality Improvement of Laboratory Examinations (Noklus), Haraldsplass Deaconess Hospital, Bergen, Norway
[4]Department of Medical Biochemistry and Pharmacology, Haukeland University Hospital, Bergen, Norway
[*]Correspondence: Una Ørvim Sølvik, University of Bergen, PO Box 7804, N-5020 Bergen, Norway. Email: una.solvik@uib.no

Abstract

Objectives Due to a lack of clear symptoms, type 2 diabetes (T2D) can remain undetected for many years. The aim of the study was to explore if Norwegian community pharmacies could identify individuals with a high risk of developing T2D by offering a diabetes risk assessment service. This study also investigated if the service recruited individuals that the national guideline recommends for diabetes risk assessment, and the proportion of participants who had visited their GP at least once a year.

Methods During the inclusion period (September 2016 to the middle of April 2017), pharmacy customers 45 years or older wishing to participate contacted the pharmacy staff. Included participants completed a diabetes risk test and participants with a high risk were offered an HbA1c measurement. At two months after intervention, all participants were followed up.

Key findings Of the 245 participants, 27% had a high risk of developing T2D. Of these, 46%, 43% and 9% had HbA1c values corresponding to normal (<39 mmol/mol [5.7%]), prediabetes (39–47 mmol/mol [5.7–6.4%]) or above cut-off for diabetes (≥48 mmol/mol [≥6.5%]), respectively. A total of 86% of the participants were in at least one category that the guideline recommends for a diabetes risk assessment, and 88% had visited their GP at least once a year.

Conclusions Norwegian community pharmacies can identify individuals with a high risk of developing T2D by offering a diabetes risk assessment service. Individuals who sought out the service were within the relevant demographics for testing, and a high proportion visited their GP at least once a year.

Keywords: community pharmacies; diabetes risk assessment; type 2 diabetes; haemoglobin A1c; guidelines

Introduction

Worldwide, an estimated 450 million people have type 2 diabetes (T2D), 50% of whom are undiagnosed.[1] The estimated number of persons with T2D in Norway in 2020 was around 250 000, representing a prevalence between 4 and 5%, and a further estimated 60 000 are undiagnosed.[2] Due to few clear symptoms, the disease may go undetected for a long time, and individuals may have T2D for several years before diagnosis.[3]

While the benefits of screening for T2D are disputed,[4–7] in 2016 international experts recommended a national screening program for groups at risk of developing T2D.[8] Likewise, the Norwegian Directorate of Health recommends that general practitioners (GPs) assess the risk of T2D in people who have close relatives with diabetes, people with high body mass index (BMI), who are physically inactive and in people from Asia or Africa.[9]

Studies have found it feasible to implement diabetes risk assessment services in a community-pharmacy setting by using a risk test alone[10–12] or a risk test followed by a measurement of haemoglobin A1c (HbA1c) or glucose using point-of-care (POC) instruments.[11, 13–15] Community pharmacies, with long opening hours and many locations, can reach groups who otherwise would not have been tested. Previously, we found that it was feasible to implement a diabetes risk assessment followed by a quality-assured HbA1c measurement in a Norwegian community pharmacy setting.[13] In this larger-scale study, an optimized protocol based on the feasibility study was used. Early detection of diabetes and treatment can prevent or delay serious complications such as heart disease, stroke, eye complications, nerve damage and kidney disease. This service may be one of several options for early detection of high-risk individuals and undetected T2D, and the supposed benefit is for the pharmacy customer, the GP and for the society. Early detection might save costs for the society for treatment for serious complications.

Concerns have been raised that screening for T2D might lead to a higher level of anxiety among the individuals who participate in a screening service[16] and two systematic reviews found that screening could increase the short-term anxiety.[17, 18] Thus, this is an important aspect of risk assessment that is seldom included in studies describing this type of pharmacy service.[12, 13]

Received: 25 September 2022 Accepted: 11 July 2023

The aim of this study was to explore if Norwegian community pharmacies could identify individuals with a high risk of developing T2D by offering a diabetes risk assessment service. The objectives were to:

1. Determine the proportion of participants with high-risk of developing diabetes and their HbA1c values.
2. Identify the proportion of participants who should be assessed for T2D according to the Norwegian national guidelines for diabetes.
3. Determine if participants with low and high risk of developing T2D differed regarding how often they visited their GP and whether they had discussed diabetes with their GP prior to the diabetes risk assessment at the pharmacy.
4. Determine if participants with low and high risk of developing T2D differed regarding their concern about developing T2D at baseline and two months after the risk assessment at the pharmacy.

Method

The implementation of the community pharmacy service is described in detail in an earlier study.[13] The service consists of a diabetes risk test and a HbA1c measurement for those with a diabetes risk score above the cut-off. In this paper, we present data from a sub-sample of the study registered in ClinicalTrials.gov.

Participating pharmacies

In our previous study, three participating pharmacies recruited 219 participants for 2 months.[13] Based on this, we aimed to recruit at least 10 pharmacies and a minimum of 1000 participants, hoping to identify a minimum of 10 persons with T2D over a period of 6 months. The regional managers from the pharmacy chain Apotek 1 sent an invitation by e-mail to all 350 pharmacies in the chain.

Training of the pharmacy employees

The recruited pharmacies were invited to each send two pharmacists to attend a face-to-face daylong course that included information about the project, procedures for recruitment and diabetes risk assessment and a session on how to convey risk information. The course also included information about internal and external analytical quality control assessment, a demonstration of how to use the HbA1c POC instrument (DCA Vantage Analyzer, Siemens Healthcare Diagnostics, Erlangen, Germany) and practice in using the POC instrument.

The pharmacies were enrolled in Noklus.[19] Noklus is a national non-profit foundation that provides quality improvement services for POC testing for primary care laboratories in Norway. The pharmacies were enrolled in Noklus to receive guidance and to participate in the external quality assessment (EQA) for HbA1c measurements provided by Noklus (for further details see[20]). The diabetes risk assessment service was offered at the pharmacies from the middle of September 2016 to the middle of April 2017.

Recruitment of participants

Community pharmacies recruited participants from September 2016 to April 2017. The participants were followed up two months after they had participated in the service.

The inclusion criteria were age ≥45 years (changed from 18 years in the feasibility study) and being able to read and write Norwegian or English. The exclusion criteria were known diabetes, pregnancy and blood diseases that might affect the measurement of HbA1c.[21] Information leaflets were available in the participating pharmacies as well as in nearby pharmacies from the same chain. The pharmacy staff handed out leaflets and actively told customers about the service. This was done at a convenience level if they in their interaction with the patient assessed that them as fulfilling the criteria. Posters advertising the service were placed inside and outside the pharmacies. The study was mentioned in two regional radio news shows and announced in three regional newspapers. In addition, information about the study was available on the pharmacy chain website, including a short film about the project that was spread through Facebook. Those who wished to participate contacted the pharmacy staff, received oral and written information and signed an informed consent before entering the study.

Outcome measures

The primary outcomes measures were the percentages of high-risk participants and the percentages of high-risk participants with HbA1c <39 mmol/mol (5.7%; normal), 39–47 mmol/mol (5.7–6.4%; prediabetes) and ≥48 mmol/mol (6.5%; cut-off for diabetes).[9] We used 5.7% (39 mmol/mol HbA1c) as the cut-off for prediabetes according to the guidelines at the time of the study. Additional outcome measures were the proportion of participants fulfilling the Norwegian national guideline for diabetes criteria for receiving a diabetes risk assessment,[9] the number of participants who visited their GP for any reason at least once a year and whether they discussed diabetes with their GP.

Contact with the pharmacies

To improve implementation, and keep up motivation throughout the study period, the participating pharmacists were called by phone by the project leader for an update once a week during the first half of the project period. In the remaining project period, there was weekly contact via emails and phone calls when needed. Halfway through the study, the pharmacists were invited to teleconferences to share their experiences and maintain their motivation. It was also a way to keep the project leader updated on how they found the service to work.

Background questionnaire and diabetes risk assessment

Participants were given identification numbers, and names were not disclosed to the researchers. Participation was free of charge for the pharmacy customers. The pharmacies received approximately €10 for each participant they recruited. All participants completed a background questionnaire at the pharmacy (Supplementary material S1). The questionnaire was paper-based, and the pharmacist was available to assist the participant if needed. Participants with a Western background filled in the FINDRISC diabetes risk test,[9, 22] while participants with a non-western background (Asia or Africa) filled in the Leicester Risk Assessment (LRA).[9, 23] The diabetes risk test was used both for assessment of participants fulfilling the Norwegian national guideline for diabetes criteria for receiving a diabetes risk assessment and to find participants with high risk of developing T2D. Participants with a diabetes risk test result above cut-off (≥15 for FINDRISC[22]/≥16 for

LRA[23]) were given an HbA1c measurement. If participants had HbA1c 39–47 mmol/mol (5.7–6.4%), the pharmacist recommended visiting their GP within the next year for a follow-up (changed from the feasibility study[13]), according to guidelines.[9] All participants that had their HbA1c measured received a printout of the result. Participants with HbA1c ≥48 mmol/mol (6.5%) were recommended to visit their GP for diagnosis as soon as possible. All participants were given a printout of their score from the diabetes risk test together with lifestyle recommendations from the Norwegian national guideline for diabetes.[9]

Follow-up questionnaires

Participants were followed up approximately 2 months after baseline assessment. Participants with diabetes risk score ≥15 for FINDRISC[22]/≥16 for LRA[23] and HbA1c ≥48 mmol/mol (6.5%) were called by their pharmacist and asked if they had seen their GP. In addition, these participants with diabetes risk score ≥15 for FINDRISC[22]/≥16 for LRA[23] and HbA1c ≥48 mmol/mol (6.5%) were asked questions regarding their concerns about developing T2D, and if they would recommend this service to others (Supplementary material S2). If they had not visited their GP yet, they were again advised to do so. The remaining participants received, by mail or email, a follow-up questionnaire with similar questions that participants with HbA1c ≥48 mmol/mol (6.5%) were asked (Supplementary material S3). If they did not respond after a week, a reminder was sent.

Data management and statistical analysis

In the following, participants with a risk score <15 (FINDRISC) or <16 (LRA) are referred to as 'low-risk participants'. Participants with risk score ≥15 (FINDRISC) or ≥16 (LRA) are referred to as 'high-risk participants'. Fisher's exact test was used to assess the association between low/high risk and self-reported concern (yes/no) prior to taking the risk test, and the association between low/high risk and seeing a GP at least once a year. The significance level was set at $P \leq 0.05$. Statistical analysis was performed using IBM SPSS Statistics (version 25 for Windows, Amonk, New York, USA).

Ethical approval

This study was approved by the Regional Committee for Medical and Health Research Ethics, Region West, Norway (approval date 22 June 2016, REK 2016/808-1), and registered retrospectively at ClinicalTrials.gov (registration number NCT03979768). The authors confirm that all ongoing trials for this service are registered.

Results

Nine pharmacies were recruited (2.6% of those who were asked by e-mail), located across Norway in both rural and urban areas (Table 1). Before the study started, one pharmacy withdrew from the study due to sick leave amongst the pharmacy employees. The eight participating pharmacies each sent two pharmacists to the course. The pharmacists recruited a total of 245 participants that were considered eligible for participation (Tables 1 and 2). Each pharmacy included between 10 and 45 participants (Table 1). Due to the small number of participants of non-Western decent, a sub-group analysis on the Western and non-Western participants was not conducted. Pharmacists from six of the eight pharmacies attended the teleconferences.

Risk of developing T2D

Table 2 shows the distribution of sex, age and level of education among the participants with a low and a high risk of developing T2D. Results from the risk assessment tests showed that 27% (67) of the participants were at high-risk of developing T2D (Table 3). In total, 46% (31) of these participants had HbA1c <39 mmol/mol (5.7%; normal), 43% (29) had HbA1c values of 39–47 mmol/mol (5.7–6.4%; prediabetes) and 9% (6) had HbA1c ≥48 mmol/mol (6.5%; cut-off for diabetes) (Table 3). A total of 86% of all participants fulfilled the guideline for diabetes criteria for a diabetes risk assessment at their GP[9] (Table 2).

Contact with the GP

Most participants (88%) reported that they saw their GP at least once a year, and there was no difference between the low- and high-risk group in the frequency of visits ($P = 0.267$) (Table 4). A higher proportion of the participants in the high-risk group (12%) had spoken with their GP about diabetes in the past year compared with the participants in the low-risk group (2%) ($P = 0.007$) (Table 4).

Concern about developing T2D

At baseline, 15% of the low-risk participants and 22% of the high-risk participants were concerned about developing T2D (Table 5). Ninety-nine percent of the participants who replied

Table 1 Characteristics of the participating pharmacies

Pharmacy number	Location of the pharmacy	Area[a]	Number of pharmacists, *n*	Total number of employees[b], *n*	Number of customer prescriptions per day, *n*	Number of included participants, *n* (%)
1	Shopping centre	Medium city	4	6	270	15 (6%)
2	Main street	Town	3	9	106	14 (6%)
3	Main street	Large town	4	13	154	25 (10%)
4	Shopping centre	Large town	3	6	62	18 (7%)
5	Shopping centre	Large town	3	5	41	10 (4%)
6	Main street	Large town	5	13	200	33 (14%)
7	Main street	Town	3	4	48	18 (7%)
8	Shopping centre	Large town	3	6	153	112 (46%)

[a]Medium city = 100 000–300 000 inhabitants, Town = 100–10 000 inhabitants, Large Town = 10 000–100 000 inhabitants.
[b]Includes pharmacists and pharmacy technicians, in some pharmacies also skin care workers and nurses.

Table 2 The participants' general characteristics and number of participants with selected[a] risk factors for developing type 2 diabetes divided into low (risk score <15 [FINDRISC] or <16 [LRA]) and high risk (diabetes risk score ≥15 [FINDRISC] or ≥16 [LRA]) for developing type 2 diabetes and the total number

		Low risk *n* = 178	High risk *n* = 67	All *N* = 245
Sex, *n*	Women	118 (66%)	45 (67%)	163 (67%)
	Men	46 (26%)	15 (22%)	61 (25%)
	Missing	14 (8%)	7 (10%)	21 (8%)
Age, years, median (10th–90th percentiles)		62 (48–75)	65 (51–80)	62 (49–76)
	Missing, *n*	7 (4%)	2 (3%)	9 (4%)
Level of education, *n*	Primary school	26 (15%)	21 (31%)	47 (19%)
	High School	90 (51%)	25 (37%)	115 (47%)
	Bachelor	39 (22%)	13 (19%)	52 (21%)
	Master or higher	18 (10%)	4 (6%)	22 (9%)
	Other	3 (2%)	3 (5%)	6 (3%)
	Missing	2 (1%)	1 (2%)	3 (1%)
BMI, *n*	<25	65 (37%)	8 (12%)	73 (30%)
	25–30[a]	93 (52%)	29 (43%)	122 (50%)
	>30[a]	19 (11%)	30 (45%)	49 (20%)
	Missing	1 (0.6%)	0	1 (0.4%)
Physically active[b], *n*	Yes, at least 30 min a day	149 (84%)	36 (54%)	185 (76%)
	No[a]	25 (14%)	25 (37%)	50 (20%)
	Missing	4 (2%)	6 (9%)	10 (4%)
Family with diabetes, *n*	No	98 (55%)	9 (13%)	107 (44%)
	Yes, grandparents, aunt/uncle, or cousin[a,b]	35 (20%)	10 (15%)	45 (18%)
	Yes, biological parents, siblings, or children[a]	44 (25%)	48 (72%)	92 (38%)
	Missing	1 (0.5%)	0	1 (0.4%)
Ethnic background, *n*	Western background	175 (98)	61 (91%)	236 (96%)
	Non-Western background[a]	3 (2%)	6 (9%)	9 (4%)
Fulfil criteria for diabetes risk assessment by the GP[c], *n*		148 (83%)	63 (94%)	211 (86%)

[a]Risk factors that the national guideline for diabetes in Norway[9] recommends for a diabetes risk assessment. [b]An option for FINDRISC only. [c]Have one or more of the risk factors that are recommended for GP assessing for type 2 diabetes.[9] BMI = Body Mass Index, FINDRISC = Finnish Diabetes Risk Score, GP = General Practitioner. Descriptive percentages were rounded to the nearest whole number or, if <1, using one significant figure.

Table 3 Results from the diabetes risk tests[a] and HbA1c measurements (*N* = 245).

		Risk of developing type 2 diabetes and HbA1c-values			
Diabetes risk test[a]	**Total score**	**Risk of developing type 2 diabetes within the next 10 years**	***n* (%)**	**HbA1c, mmol/mol (%)**	***n***
FINDRISC (*n* = 236, 96%)	<7	Low: 1 in 100 develops the disease	34 (14%)		
	7—11	Somewhat increased: 1 in 25 develops the disease	85 (35%)		
	12—14	Medium: 1 in 6 develops the disease	56 (23%)		
	15—20	High: 1 in 3 develops the disease	58[b] (24%)	<39 (5.7)	26
				39–47 (5.7–6.4)	27
				≥48 (6.5)	4
	>20	Very high: 1 in 2 develops the disease	3 (1%)	<39 (5.7)	0
				39–47 (5.7–6.4)	1
				≥48 (6.5)	2
Missing			0		1[b]
LRA (*n* = 9, 4%)	0–6	Low: 1 in 20 develops the disease	0		
	7–15	Increased: 1 in 10 develops the disease	3 (33%)		
	16–24	Moderate: 1 in 7 develops the disease	5 (55%)	<39 (5.7)	5
	25–47	High: 1 in 3 develops the disease	1 (11%)	39–47 (5.7–6.4)	1
Missing			0		0

[a]FINDRISC[22] and LRA.[23]
[b]One HbA1c value was missing, but the pharmacy confirmed that this participant had HbA1c <48 mmol/mol (6.5%). FINDRISC = Finnish Diabetes Risk Score. LRA = Leicester Risk Assessment. Percentages were rounded to the nearest whole number.

to the question answered that their level of concern about developing T2D had not changed, or that it was lower, 2 months after the diabetes risk test (Table 5).

Analytical quality assurance

A total of 80 of 81 (99%) internal quality control measurements on the HbA1c POC instrument were within the acceptance criteria. Six of the eight pharmacies reported results in all three EQAs. All results were within acceptable ranges. Two of the pharmacies did not report results in any of the EQAs.

Discussion

This study found that Norwegian community pharmacies could identify individuals with a high risk of developing T2D by offering a diabetes risk assessment service. Even though a low share of the participants were concerned about developing T2D, the population that was picked up by this approach were mainly those guidelines identify as in need of a diabetes risk assessment. Just over a fourth of the participants were found to have a high risk of developing T2D, but only one-tenth of these had HbA1c-values corresponding to cut-off for diabetes. Most of both the high- and low-risk participants had visited their GP at least once in the last year, while a higher proportion of the high-risk participants had spoken with their GP about diabetes compared with the low-risk participants. Participation in this screening service did not increase the level of concern about developing T2D.

Strengths and limitations

A strength of this study is that the HbA1c POC measurements were quality assured as specified in guidelines[24, 25] and recommended in the literature.[26, 27] To our knowledge, this aspect of the pharmacy services has not been described by others. Erroneous test results can lead to misdiagnosis and delayed treatment and accurate and reliable HbA1c results are important for patient care.

The diabetes risk test was free of charge for the customers, which may have recruited a wider range of participants. A common criticism of health screenings is that they may contribute to increase health anxiety. However, our participants did not report an increase in diabetes-related concerns.

The percentage of participants with a non-Western background is representative for Norway in 2016.[28] Also, the level of education was representative for Norway in 2016[29] while there was an overweight of women as often seen in

Table 4 The participants' frequency of visits to their GP and whether they have discussed diabetes with their GP prior to the diabetes risk assessment service, sorted by low[a] and high[b] risk for developing type 2 diabetes.

	Low risk[a] *n* = 178 *n* (%)	High risk[b] *n* = 67 *n* (%)	p-value[c]	Total *N* = 245 *n* (%)
Visit their GP at least once a year			.267	
Yes	154 (87%)	62 (93%)		216 (88%)
No	23 (13%)	5 (7%)		28 (11%)
Missing	1 (0.6%)	0		1 (0.4%)
Had previously discussed diabetes with their GP			.007	
Yes	4 (2%)	8 (12%)		12 (5%)
No	113 (63%)	42 (63%)		155 (63%)
Missing	61 (34%)	17 (25%)		78 (32%)

[a]Risk score <15 FINDRISC[22]) or <16 (LRA[23]).
[b]Risk score ≥15 (FINDRISC[22]) or ≥16 (LRA[23]).
[c]Fishers exact, two-tailed. Percentages were rounded to the nearest whole number or, if <1, using one significant figure. GP = General practitioner. FINDRISC = Finnish Diabetes Risk Score.[22] LRA = Leicester Risk Assessment.[23]

Table 5 The participants' concerns about developing type 2 diabetes, at baseline and two months after the diabetes risk test, sorted by low[a] (*n* = 178) and high risk[b] (*n* = 67) for developing type 2 diabetes (*N* = 245).

	Low risk[a]	High risk[b]	p-value	Total
Concern about developing T2D at baseline, *n* (%)			.179[c]	
Yes	26 (15%)	15 (22%)		41 (17%)
No	151 (85%)	52 (78%)		203 (83%)
Missing	1 (0.6%)	0		1 (0.4%)
Concern about developing T2D two months after diabetes risk test, *n* (%)				
Higher	0	2 (3%)		2 (1%)
Lower	53 (30%)	20 (30%)		73 (30%)
No difference	63 (35%)	23 (34%)		86 (35%)
Missing	62 (35%)	22 (33%)		84 (34%)

[a]Risk score <15 (FINDRISC[22]) or <16 (LRA[23]).
[b]Risk score ≥15 (FINDRISC[22]) or ≥16 (LRA[23]). [c]Fishers' exact. FINDRISC = Finnish Diabetes Risk Score.[22] LRA = Leicester Risk Assessment.[23]

similar studies.[14, 30] The mean age was higher[31] as the inclusion criteria was above 45 years. Thus, our findings are likely generalizable to pharmacy customers ≥45 years fulfilling the inclusion criteria in Norway. All the participating pharmacies belonged to the pharmacy chain Apotek 1. However, the three dominating pharmacy chains in Norway are very similar with respect to customers from all socio-demographic groups and locations in both rural and urban areas (Table 1). Still, as less than 3% of the invited pharmacies took part in the study, the participating pharmacies are not necessarily representative for all Norwegian pharmacies. The fact that follow-up data were collected by phone by the pharmacist for participants with HbA1c ≥48 mmol/mol and the remaining participants filled in the questionnaire themselves, may have introduced a bias in the responses between the two groups, as the latter group did not have the possibility to ask questions if anything was unclear.

Most of the participants in this study (86%) had risk factors that put them in the group which is recommended for a diabetes risk assessment service.[9] In the feasibility study,[13] however, only 37% (79/211, unpublished data) fell into this group. Thus, an increase in the age limit for participation from 18 (feasibility study) to 45 (present study) years clearly gave a higher proportion of participants that were recommended for a diabetes risk assessment. However, with the increasing prevalence of overweight and obesity among the youth globally, coupled with diagnosing T2D at younger ages, it may also be a limitation to have excluded the age group of 18–44 years. Possibly, they could have been included if they had extra risk factors such as being overweight/obese.

It would have been preferable to also recruit participants who did not speak English or Norwegian, as this segment of the population contains groups with an increased risk of diabetes. The language criterium was set to ensure that the pharmacists could offer proper risk counselling, and to ensure proper informed consent. Still, future service providers should strive to find solutions that make the service inclusive and available to all segments of the population.

Findings in relation to other studies

In a similar study of Australian community pharmacies, 77% of the participants had one or more risk factors for diabetes.[30] However, the number of risk factors included in that study was higher than those used in this study. Most of the participants in our study visited their GPs quite frequently and pharmacy service identified high-risk individuals that in principle could have been identified by their GPs. Still, many participants reported that they had not spoken with their GP about diabetes, which is worrying. Data on this have not been reported in the similar studies.

Just over a quarter of the participants in this study were found to have a high risk of developing T2D, comparable to a previous study from Spain with 4222 participants where 24% were found to have a high risk of developing T2D.[14] In a Norwegian population-based study with 47 694 individuals the prevalence of an elevated FINDRISC score (≥15) in the age group 60–69 years was 18.4%.[32] Similarly, the proportion of high-risk participants with HbA1c ≥48 mmol/mol (6.5%) in the population study was 9.8%, which is comparable to 9.0% (6/67) in our study.

This study probably reflects 'a real-world setting' to a higher degree than the feasibility study. In this study, representativity for Norwegian pharmacies was more important. As 46% of the participants in the feasibility study were below 50 years old,[13] the new age limit may have been a reason for the lower recruitment rate in this study. The pharmacies also participated in other projects at the same time, which was not the case in the feasibility study. A qualitative study with participating pharmacists further describes the pharmacists' perceived challenges and revealed that the pharmacists were uncomfortable recruiting participants and lacked motivation.[33] In hindsight, such a service, new to the pharmacy customers, requires a more active recruitment policy. Another reason for the low recruitment rate could be that pharmacy services were limited in Norway at the time of the study, and awareness of the services might have been low among the pharmacy customers. In the qualitative study the pharmacists suggested that if this service had been permanent, pharmacy customers might have requested it more frequently. They commented that an increased number of customers requested the service after the 6-month inclusion period.

In contrast to previous systematic reviews that found that screening could increase short-term anxiety,[17, 18] participation in this screening service did not increase the level of concern about developing T2D.

Implications

Due to our low recruitment rates of pharmacies and customers, our results do not conclusively support a diabetes risk assessment at community pharmacies. Still, we cannot exclude that it could be used as a supplement to GPs to identify individuals with a high risk of developing T2D. This will be facilitated if there is a close collaboration between GPs and pharmacies, for example, if both GPs and community pharmacists could provide information on their independent provision of health care (services) in an electronic patient's journal (EPJ) system on the patient level. Our study revealed that individuals at a high risk of diabetes are not discussing this with their GPs, despite seeing them regularly. Thus, there is clearly a need to find a way to reach this group, be it through pharmacies or closer follow-up from the GP.

Conclusion

This study found that Norwegian community pharmacies can identify individuals with a high risk of developing T2D by offering a diabetes risk assessment service. Individuals who sought out the service were within the relevant demographics for testing and a quarter of the participants were found to have a high risk of developing T2D, almost half of these had prediabetes, and about 10% had a HbA1c-values above cut-off for diabetes. A high proportion visited their GP at least once a year, but few had discussed diabetes with their GP prior to the diabetes risk assessment at the pharmacy. Future research should include a higher number of pharmacies and assess if a more active recruitment of participants and longer recruitment period can increase the uptake. Recruitment strategies especially targeting participants at higher risk, such as non-Western immigrants, could increase the potential value of such a service. Larger studies are needed to assess if such a service is cost-effective.

Supplementary Material

Supplementary data are available at *International Journal of Pharmacy Practice* online.

Acknowledgements

We would like to thank all the participating pharmacists, Apotek 1, Siemens, Noklus and The Norwegian Community Pharmacy Foundation for making this study possible.

Author Contributions

All authors contributed to formulating the research questions and were involved in the study design. A.J.R. was responsible for carrying out the study, analysing the data and writing the first draft of the article. R.L.S.K. and U.Ø.S contributed with analysing the data and writing the article S.S. contributed with writing the article. All authors had complete access to the study data.

Funding

This study was financed by The Norwegian Community Pharmacy Foundation and the University of Bergen. The purpose of the Norwegian Community Pharmacy Foundation is to promote the development of Norwegian pharmacy. Siemens lent the DCA Vantage Analyzer instruments to the pharmacies and provided training free of charge. The participating pharmacy chain, Apotek 1, covered some expenses for the training day. The Norwegian Community Pharmacy Foundation had no influence on how the study was conducted, the statistical analysis, or the results. Apotek 1 had no influence on the statistical analysis or the results, but they contributed with valuable input to the protocol and procedures.

Conflict of Interest

The authors declare that there are no conflicts of interest.

Data Availability

The data underlying this article will be shared on reasonable request to the corresponding author.

References

1. Cho NH, Shaw JE, Karuranga S et al. IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. *Diabetes Res Clin Pract* 2018; 138: 271–81. https://doi.org/10.1016/j.diabres.2018.02.023
2. Stene LC, Ruiz PL-D, Asvold BO et al. How many people have diabetes in Norway in 2020? *Tidsskr Nor Laegeforen* 2020; 140. https://doi.org/10.4045/tidsskr.20.0849. https://tidsskriftet.no/2020/11/kronikk/hvor-mange-har-diabetes-i-norge-i-2020
3. Porta M, Curletto G, Cipullo D et al. Estimating the delay between onset and diagnosis of type 2 diabetes from the time course of retinopathy prevalence. *Diabetes Care* 2014; 37: 1668–74. https://doi.org/10.2337/dc13-2101. https://iris.unito.it/retrieve/handle/2318/148075/49542/Porta_Diabetes%20Care.pdf
4. Simmons RK, Griffin SJ, Lauritzen T et al. Effect of screening for type 2 diabetes on risk of cardiovascular disease and mortality: a controlled trial among 139,075 individuals diagnosed with diabetes in Denmark between 2001 and 2009. *Diabetologia* 2017; 60: 2192–9. https://doi.org/10.1007/s00125-017-4299-y
5. Feldman AL, Griffin SJ, Fharm E et al. Screening for type 2 diabetes: do screen-detected cases fare better? *Diabetologia* 2017; 60: 2200–9. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4898846/pdf/mjiri-30-326.pdf
6. Najafi B, Farzadfar F, Ghaderi H et al; eCollection. Cost effectiveness of type 2 diabetes screening: A systematic review. *Med J Islam Repub Iran* 2016; 30: 326. eCollection
7. Simmons RK, Echouffo-Tcheugui JB, Sharp SJ et al. Screening for type 2 diabetes and population mortality over 10 years (ADDITION-Cambridge): a cluster-randomised controlled trial. *Lancet* 2012; 380: 1741–8. https://doi.org/10.1016/S0140-6736(12)61422-6
8. Khunti K, Gavin JR, Boulton AJM et al. Berlin Declaration Steering Group. The Berlin Declaration: A call to improve early actions related to type 2 diabetes. Why is primary care important? *Prim Care Diabetes* 2018; 12: 383–92. https://doi.org/10.1016/j.pcd.2018.04.003
9. Nasjonal faglig retningslinje for diabetes [National professional guideline for diabetes] [Internet]. Oslo: Helsedirektoratet; 2016 (updated 2021 March 16)https://www.helsedirektoratet.no/retningslinjer/diabetes (25 August 2022, date last accessed)
10. Twigg MJ, Wright DJ, Thornley T et al. Community pharmacy type 2 diabetes risk assessment: demographics and risk results. *Int J Pharm Pract* 2015; 23: 80–2. https://doi.org/10.1111/ijpp.12139
11. Kilkenny MF, Johnson R, Andrew NE et al. Comparison of two methods for assessing diabetes risk in a pharmacy setting in Australia. *BMC Public Health* 2014; 14: 1227. https://doi.org/10.1186/1471-2458-14-1227. http://www.biomedcentral.com/1471-2458/14/122
12. Thoopputra T, Pongmesa T, Newby DA et al. Opportunistic risk screening for type 2 diabetes: exploring of application of diabetes risk assessment tool in community pharmacy in Australia and Thailand. *Value Health Reg Issues* 2016; 9: 1–7. https://doi.org/10.1016/j.vhri.2015.03.022
13. Risoy AJ, Kjome RLS, Sandberg S et al. Risk assessment and HbA1c measurement in Norwegian community pharmacies to identify people with undiagnosed type 2 diabetes—a feasibility study. *PLoS One* 2018; 13: e0191316. https://doi.org/10.1371/journal.pone.0191316
14. Fornos-Pérez JA, Andrés-Rodríguez NF, Andrés-Iglesias JC et al. Detection of people at risk of diabetes in community pharmacies of Pontevedra (Spain) (DEDIPO). *Endocrinol Nutr (English Ed)* 2016; 63: 387–96. https://doi.org/10.1016/j.endoen.2016.10.002
15. Wright D, Little R, Turner D et al. Diabetes screening through community pharmacies in England: a cost-effectiveness study. *Pharmacy* 2019; 7: 30. https://doi.org/10.3390/pharmacy7010030
16. Park P, Simmons RK, Prevost AT et al. Screening for type 2 diabetes is feasible, acceptable, but associated with increased short-term anxiety: a randomised controlled trial in British general practice. *BMC Public Health* 2008; 8: 350. https://doi.org/10.1186/1471-2458-8-350
17. Collins RE, Lopez LM, Marteau TM. Emotional impact of screening: a systematic review and meta-analysis. *BMC Public Health* 2011; 11: 603. https://doi.org/10.1186/1471-2458-11-603
18. Sherifali D, Fitzpatrick-Lewis D, Peirson L et al. Screening for type 2 diabetes in adults: an updated systematic review. *Open Diabetes J* 2013; 6: 1–13.
19. The Norwegian Organization for Quality Improvement of Laboratory Examinations [Internet]. Bergen: Noklus; https://www.noklus.no/en/the-norwegian-organization-for-quality-improvement-of-laboratory-examinations/ (15 March 2023, date last accessed)
20. Sølvik UO, Risøy AJ, Kjome RLS Sandberg S. Quality control of Norwegian pharmacy HbA1c testing: a modest beginning. *J Diabetes Sci Technol* 2018; 12: 753–61. https://doi.org/10.1177/1932296818766378
21. Zercher A, Schulman L, Boone J. Quantitative measurement of hemoglobin A1c on the DCA vantage point-of-care analyzer as a diagnostic test for diabetes: an internal validation study. [White paper] Siemens Healthcare Diagnostics: Elkhart, US. https://www.procarebv.nl/wp-content/uploads/2019/03/Precision-study.pdf
22. Lindstrom J, Tuomilehto J. The diabetes risk score: a practical tool to predict type 2 diabetes risk. *Diabetes Care* 2003; 26: 725–31. https://doi.org/10.2337/diacare.26.3.725

23. Gray LJ, Taub NA, Khunti K et al. The Leicester Risk Assessment score for detecting undiagnosed Type 2 diabetes and impaired glucose regulation for use in a multiethnic UK setting. *Diabet Med* 2010; 27: 887–95. https://doi.org/10.1111/j.1464-5491.2010.03037.x
24. International Organization for Standardization. *ISO 22870:2005 Standard. Point-of-Care Testing (POCT)—Requirements for Quality and Competence*. Geneva: ISO;2006. 2
25. Clinical and Laboratory Standards Institute. *Quality Management: Approaches to Reducing Errors at the Point of Care; Approved Guideline. Report POCT07-A*. Waynes, PA: Clinical and Laboratory Standards Institute; 2010.
26. Lippi G, Plebani M, Favaloro EJ et al. Laboratory testing in pharmacies. *Clin Chem Lab Med* 2010; 48: 943–53. https://doi.org/10.1515/CCLM.2010.184
27. Gronowski, AM, Adams, A, Ball, C et al. Pharmacists in the laboratory space: friends or foes? *Clin Chem* 2016; 62: 679–83. https://doi.org/10.1373/clinchem.2015.247445
28. Statistics Norway. Population count. [Internet]. https://www.ssb.no/en/befolkning/folketall (15 March 2023, date last accessed).
29. Statistics Norway. Educational attainment of the population. 2022 [Internet].: https://www.ssb.no/en/utdanning/utdanningsniva/statistikk/befolkningens-utdanningsniva (15 March 2023, date last accessed)
30. Krass I, Mitchell B, Clarke P et al. Pharmacy diabetes care program: analysis of two screening methods for undiagnosed type 2 diabetes in Australian community pharmacy. *Diabetes Res Clin Pract* 2007; 75: 339–47. https://doi.org/10.1016/j.diabres.2006.06.022
31. Statistics Norway. Population. Mean and median age in municipalities, counties and the entire populace (M) 2000–2022 2016 [Internet]. https://www.ssb.no/statbank/table/13536 (15 March 2023, date last accessed)
32. Jolle A, Midthjell K, Holmen J et al. Impact of sex and age on the performance of FINDRISC: the HUNT Study in Norway. *BMJ Open Diabetes Res Care* 2016; 4: e000217. https://doi.org/10.1136/bmjdrc-2016-000217
33. Risoy AJ, Kjome RLS, Svensberg K et al. Pharmacists' experience of a diabetes risk-assessment service and analytical quality control in community pharmacies—a focus-group study. *Res Social Adm Pharm* 2021; 17: 1259–66. https://doi.org/10.1016/j.sapharm.2020.09.011