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From inequalities to solutions: an explanatory sequential study on type 2 diabetes health services utilization

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Abstract

Background Health inequities are a significant issue. This study aimed to measure and decompose socioeconomic inequality in the utilization of type 2 diabetes (T2D) services and propose solutions to mitigate these inequalities.

Methods This explanatory sequential mixed-method study was conducted in two phases: quantitative and qualitative. A total of 2000 T2D patients from health centers, hospitals, and diabetes clinics in Isfahan and Khuzestan provinces, Iran, were selected. In the quantitative phase, the existence of inequality in the utilization of T2D services was examined using the Concentration Index (CI) approach. To determine the contribution of each explanatory variable to T2D inequality, we used concentration index decomposition analysis. In the qualitative phase, based on the main contributors identified in the quantitative phase, we conducted semi-structured interviews with purposefully selected key experts to identify solutions for reducing inequality in the utilization of T2D services.

Results The sample consisted of 65.3% men, with 40% of T2D patients being over 60 years old. The CI values were 0.31 ($p < 0.05$) for outpatient services, -0.10 ($p > 0.05$) for inpatient services, and 0.11 ($p < 0.05$) for pharmaceutical services. This indicates an inequality in the utilization of outpatient and pharmaceutical services among T2D patients, while the inequality in inpatient services was not significant. The main variables contributing to inequality in outpatient services were health status (33.54%), basic insurance (27.43%), and socioeconomic status (24.08%). For pharmaceutical services, the contributing variables were health status (22.20%), basic insurance (13.63%), and socioeconomic status (34.35%). Experts' solutions to reduce socioeconomic inequalities in Iran were classified into three main themes: socioeconomic status, health status, and basic insurance, with 29 sub-themes.

Conclusion The results suggest that targeted health interventions for poor T2D patients are recommended. Efforts towards universal coverage in outpatient care and commonly used pharmaceutical items, such as: Antidiabetic Drugs, Triglyceride Control Drugs, Cardiovascular Drugs, Neuropathy Drugs, and Nephropathy Drugs, should be considered.

Keywords Inequality, Socioeconomic status, Utilization, Diabetes mellitus, Concentration index, Decomposition qualitative approach

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Background

Type 2 Diabetes (T2D) Mellitus is a widespread disease, and its prevalence has been steadily increasing, transforming it into a global epidemic [1]. Unfortunately, diabetes remains a significant contributor to mortality rates in most countries [2]. As a crucial non-communicable disease, [3] T2D affects more than one in ten people worldwide; however, its prevalence is not evenly distributed across different socioeconomic groups [4]. The global burden of T2D Mellitus is on the rise, with diagnosed cases projected to increase from 463 million in 2019 to a staggering 700 million by 2045—a 51% surge in just 26 years [5, 6]. Within this context, Iran faces its own challenges, as evidenced by data from the Non-Communicable Diseases Research Center and Steps Information (STEPS) report for 2016. In Isfahan province, the prevalence of diabetes stands at 12.3% among women and 11% among men. Meanwhile, in Khuzestan province, these figures are even higher: 13.9% among women and 14.1% among men. Notably, both provinces exceed the national average prevalence of diabetes, which rests at 10.6% in Iran [7]. Beyond prevalence, socioeconomic disparities play a pivotal role in T2D. Lower socioeconomic status (SES) groups bear a disproportionate burden, [8] affecting not only disease prevalence but also management, chronic complications, [9], and mortality [10]. Access to healthcare services remains unequal, hindering timely interventions and exacerbating health outcomes [11]. T2D patients' preferences for health services are influenced by income, socioeconomic conditions, and overall health status [12]. Observational data reveal stark differences in diabetes outcomes across populations. Those at a socioeconomic disadvantage—often characterized by lower education and income levels—experience reduced access to care, preventive services, and effective disease management [13]. These disparities manifest as lower diagnosis rates, suboptimal health behaviors, [14] worse cardio-metabolic outcomes, [15], and even shorter life expectancy compared to more advantaged populations [16]. Recognizing that diabetes is intricately tied to broader socioeconomic contexts, [17] researchers have investigated socioeconomic inequality in T2D and healthcare service utilization [18–26]. Also, it is evident that T2D is among the health priorities of Iran [27]. In this study, we employ the concentration index approach and decomposition techniques [6] to measure inequality in utilization of health services for T2D patients. Simultaneously, we employ a qualitative approach to propose solutions for mitigating socioeconomic inequalities in T2D health service utilization. By integrating quantitative findings with expert insights from qualitative interviews, we pinpoint policy entry points and priorities to address inequality effectively. In summary, our study

aims to measure socioeconomic inequality in the utilization of T2D health services, and shedding light on critical areas for inequality targeted solutions.

Methods

Study design

This research follows an explanatory sequential mixed-methods approach, conducted in two distinct phases: quantitative and qualitative. The study spanned from May 22, 2022, to May 13, 2024. We collected data from 2000 patients diagnosed with type 2 diabetes who were referred to diabetes management and control centers, health and treatment facilities, and hospitals in Isfahan and Khuzestan provinces, Iran. For the quantitative phase, we employed a socio-economic checklist and a utilization questionnaire. To address potential confounding variables, we used statistical control methods. These confounding factors were included as control variables in our regression model. By doing so, we controlled for the impact of these variables, allowing us to isolate the effect of the independent variable on the dependent variable. In the quantitative phase, initially, and of utmost importance, we assessed the socioeconomic status (SES) of patients with T2D using an asset-based approach. Participants provided information about household assets and housing, including ownership of house, foreign car, domestically made car, motorcycle, smartphone, refrigerator, side-by-side refrigerator, laptop, dishwashing machine, vacuum cleaner, microwave, TV, LCD/LED TV, and internet access. Principal component analysis (PCA) was then employed to derive a SES score for each T2D patient based on the aforementioned assets. Subsequently, we ranked T2D patients according to their SES scores, creating SES quintiles ranging from the poorest to the richest. These quintiles as a proxy of SES were used for statistical modeling. We employed the Concentration Index (CI) approach to assess socioeconomic inequality in the utilization of services related to T2D patients. This method allowed us to quantify and compare the extent of SES inequalities in health-related variables [28, 29]. Additionally, to understand the contribution of each explanatory variable on health inequality, we utilized the Concentration Index Decomposition Analysis method. As the outcome variable in this study is a binary variable, the corrected concentration index suggested by Erreygers [30] was used. In the qualitative phase, building upon the findings from the quantitative analysis, we identified solutions to mitigate inequalities related to service utilization among T2D patients. These solutions emerged from interviews with key health experts and continued until we reached data saturation. The qualitative data were gathered through semi-structured interviews and subsequently analyzed thematically using the six-step

approach proposed by Braun and Clarke [31]. The transcribed interviews was reviewed and categorized into themes and sub-themes using MAXQDA version 2020 software.

Study setting

The Iranian healthcare system is a dynamic blend of public and private components, all aimed at ensuring universal access to healthcare services for the population. While both sectors play a role, the public sector takes predominant [32]. This sector includes Government-funded hospitals, clinics, and health centers form the backbone of the public sector. These facilities cater to a significant portion of the population, emphasizing primary healthcare as a fundamental pillar of the system. Public hospitals and clinics operate within budgetary constraints, and their services are covered by various health insurance schemes available in Iran. This approach ensures that patients receive medical care at the most affordable cost [12]. Iran's health network spans urban and rural areas, striving for optimal healthcare delivery. At the core of this network are "Health Houses" in rural regions and health posts and urban health centers in cities. These serve as the first point of contact between communities and the primary healthcare system. Health Houses, managed by health centers affiliated with provincial medical universities, offer preventive services like nutrition guidance, diabetes control, and medical screenings. Similarly, urban health centers act as hubs for primary care in major cities, often serving as provincial capitals. To ensure equitable access and quality services, Iran employs a well-structured referral care system. Family physicians, responsible for 2000 to 4000 individuals in their catchment areas, provide primary healthcare. When necessary, patients are referred to secondary and tertiary healthcare centers for specialized treatment. Alongside public-governmental facilities, private for-profit hospitals and clinics operate independently but under the supervision of medical universities. Their goal: efficient and effective care [33]. To cover a large segment of the population, Iran operates the Islamic Republic of Iran Health Insurance Organization—a national health insurance system. This system ensures coverage for hospitalization, outpatient care, and prescription medications [34]. In summary, Iran's healthcare landscape combines public commitment, primary care emphasis, and an interplay between public and private providers.

Samples

Drawing from Vahedi et al.'s study [35], the sample size for our research was determined with a 95% confidence interval and a test power of 99%. Specifically, we included 2000 patients diagnosed with T2D. These individuals

were referred to diabetes management and control centers, health and treatment facilities, and hospitals in Isfahan and Khuzestan provinces. Within each province, 500 patients were drawn from the inpatient department, and another 500 from the outpatient department across urban and rural areas (totally 1000 in urban and 1000 T2D patients in rural). The allocation of the sample to each center was based on the number of hospital beds and the population served by those centers. The inclusion criteria were patients with a long-term history of type 2 diabetes (more than 5 years), patients confirmed by specialist doctors (endocrinologists and internal medicine physicians) and patients with both outpatient and inpatient records. The exclusion criteria were patients with type 1 diabetes, patients whose diabetes diagnosis was not confirmed by the service centers and patients with insufficient literacy or an inability to understand the study questions or cooperate effectively.

Developing the Utilization Questionnaire

We began by reviewing existing research on health service utilization in Iran. Based on this, we established the primary questionnaire framework. Next, we assembled a panel of five experts, including two PhDs in health and medical services management, a health policy specialist, an internal medicine expert, and a healthcare professional. Their task was twofold: first, to identify any ambiguities or deficiencies in the questionnaire wording, and second, to complete the comprehensive list of services relevant to T2D patients.

Question categories

The resulting utilization questionnaire comprised a total of 70 questions. These questions were categorized as follows:

- 29 questions related to outpatient services needed for T2D patients.
- 12 questions concerning medication requirements for T2D patients.
- 29 questions addressing inpatient service needs specific to T2D care.

Ensuring face validity

To validate the questionnaire, we administered it to 20 type 2 diabetic patients. Their feedback helped us assess face validity—the extent to which the questions appeared relevant and clear to respondents.

Content validity assessment

We calculated both the Content Validity Ratio (CVR) and the Content Validity Index (CVI) based on expert

responses. These metrics ensured that the questionnaire adequately covered essential aspects of service utilization. Additionally, we assessed the reliability of the questionnaire using Cronbach's alpha separately for outpatient, inpatient, and pharmaceutical services.

Quantitative data collection

In collecting data, following a methodology outlined in a prior study [36], questioners engaged directly with respondents in face-to-face interactions. They carefully explained the purpose and objectives of the questions, ensuring clear and authentic answers. Ethical principles guided these interactions, assuring respondents that their information would be treated confidentially. Trust and cooperation were established, fostering a reliable data collection.

Qualitative Data Collection

The aim of the qualitative data collection was to identify solutions, based on the main contributors determined in the quantitative phase, to reduce inequality in the utilization of services for T2D patients in Iran. Data was collected through semi-structured guided interviews, and participants were selected using purposive sampling. This method allowed us to choose individuals with comprehensive and expert knowledge in health. Additionally, the snowball sampling method was employed to identify the network of interviewees. After coordinating and obtaining informed consent, interview times were scheduled. A total of 12 interviews were conducted until data saturation was achieved. Participants included experts from the health department, diabetes control center, health network, health center, and university professors. Interviews were recorded using a voice recorder, and the researcher simultaneously took notes to capture key points.

Results

Quantitative results

Table 1 presents the demographic characteristics of studied T2D patients. The majority of the patients, 1253 (62.6%), who visited health and treatment centers and diabetes clinics, were from urban areas. A significant portion of the sample, 1306 (65.3%), were men. The most affected age group in this study was those over 61 years old, comprising 799 individuals (40%). Additionally, most of the patients were married, accounting for 1828 (91.4%) of the sample.

Table 2 presents the concentration indices for the utilization of health services among T2D patients. The Erreygers normalized CI for outpatient, inpatient, and pharmaceutical services are 0.317 (P -value=0.0001), -0.104 (P -value=0.09), and 0.112 (P -value=0.0001), respectively. This indicates that inequality in the

Table 1 Demographic characteristics of T2D patients ($n = 2000$)

Variables		Frequency	Percentage
Sex	Female	694	34.7
	male	1306	65.3
Age	20–30	60	3
	31–40	383	19.2
	41–50	470	23.5
	51–60	288	14.4
	> 61	799	40
Marital status	Single	172	8.6
	Married	1828	91.4
Place of residence	Urban	1253	62.6
	Suburb	449	22.5
	Rural	298	14.9
Job	Unemployed	21	1.1
	Housewife	464	23.2
	Seasonal Worker	133	6.7
	Manual Worker	399	20
	Employee	283	14.1
	The Employer	33	1.7
	Retired	667	33.4
Education level	Illiterate	70	3.5
	Elementary	415	20.8
	Secondary school	346	17.3
	Diploma	620	31
	Associate Degree	235	11.8
	Bachelor	213	10.7
	Master of Science	91	4.6
	Doctorate	10	0.5
Basic insurance	Health of Iranians	620	31
	Social Security	800	40
	Other	580	29
Supplementary Insurance	Yes	530	26.5
	No	1470	73.5
SES status	The poorest	418	20.9
	Poorer	431	21.55
	Middle	362	18.10
	Richer	394	19.7
	The richest	395	19.75

Table 2 Normalized concentration indices of health services utilization among T2D in Iran

Services	Erreygers concentration index	Standard error	P-value
Outpatient services	0.3171	0.0242	0.0001
Inpatient services	-0.104	0.0251	0.09
Pharmaceutical services	0.1125	0.0249	0.0001

utilization of outpatient and pharmaceutical services is significantly more concentrated among the wealthy. Conversely, the utilization of inpatient services is more concentrated among the poor, although this finding is not statistically significant.

As shown in Fig. 1, the concentration curves for the utilization of outpatient (A) and pharmaceutical (C) services among T2D patients are significantly distant from the equality line and lie below it. This indicates that the utilization of outpatient and pharmaceutical services is more concentrated among wealthier patients. In contrast, the concentration curve for inpatient services (B) lies below the equality line and crosses it, suggesting that the utilization of inpatient services is more prevalent among individuals with relatively lower SES. However, this finding is not statistically significant Fig. 1 (B).

Table 3 presents the CIs for the utilization of outpatient services based on the type of service. The table indicates significant inequity in outpatient services for nutrition visits, weight measurement, BMI determination, meal plan presentation, blood pressure measurement, neuropathy visits, neuropathy electromyography, retinopathy visits, retinopathy treatment, laser retinopathy, nephropathy visits, nephropathy diagnostic tests, cardiovascular visits, echocardiogram/ECG cardiovascular,

diabetic foot visits, liver disease checks, liver enzyme tests, cancer checks, pancreas cancer checks, liver cancer checks, thyroid cancer checks, breast cancer checks, colon cancer checks, other cancer checks, routine tests for diabetic patients, and lipid tests. The positive CIs suggest that wealthier patients utilized these outpatient services more than poorer patients. However, the inequity in some outpatient services, such as retinopathy Laser, visits for retinopathy surgery, and cardiovascular arterial color Doppler ultrasound, was not significant. This indicates that the utilization of these services was similar and proportionate between poor and rich patients.

Table 4 shows the CIs of utilization of pharmaceutical services according to the type of services. According to the table, the inequity in pharmaceutical services were significant for Metformin, Gliclazide or Glibenclamide, Pioglitazone, Linagliptin, Combination Drugs including: Metformin/Sitagliptin, Metformin/Linagliptin, Empagliflozin/Linagliptin, Empagliflozin/Linagliptin/Metformin, Novomix30, other drugs Blood Pressure, other Anti-triglyceride Drugs, Cardiovascular Drugs including: Aspirin, Metoral, and LASIX, Vitamins including: B1, B12, D, Pregabalin and other Neuropathy Drugs and spironolactone from the category of Nephropathy Drugs. According to Table 4, some drugs shown a negative concentration

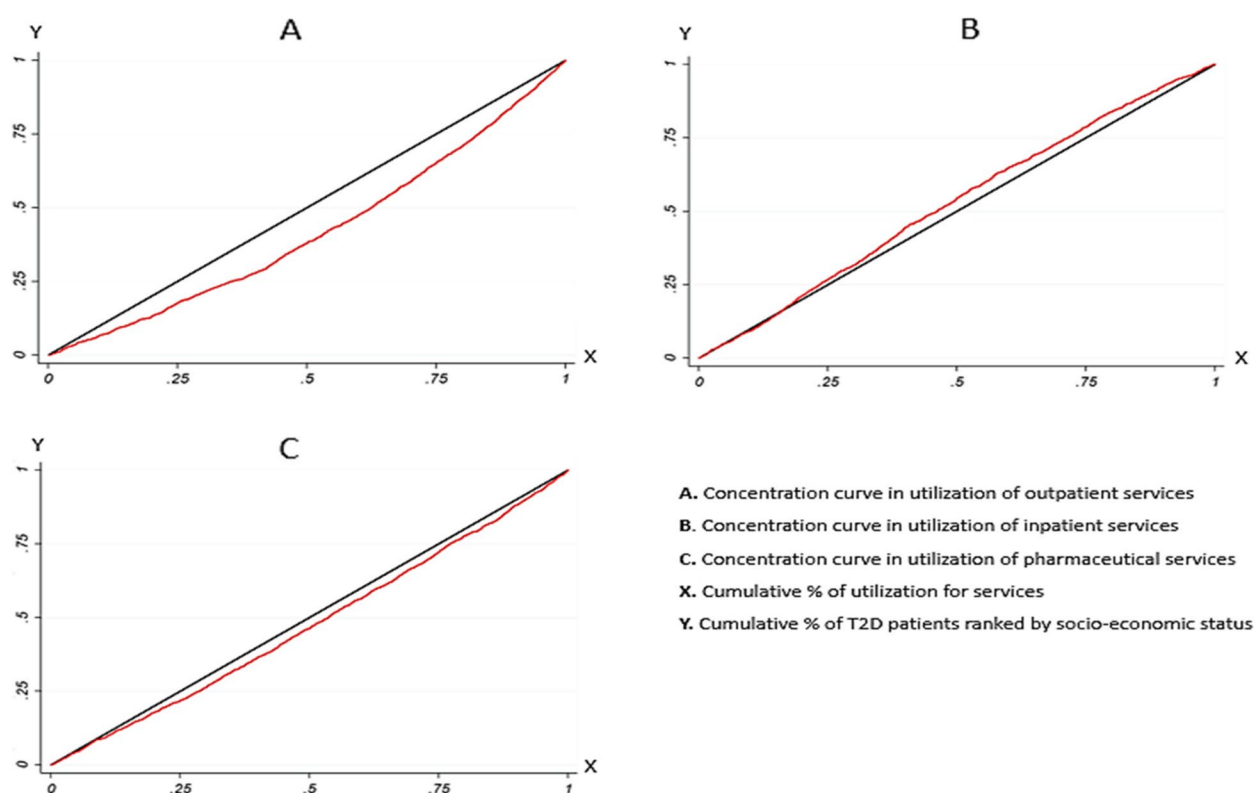


Fig. 1 Concentration curves for utilization of outpatient, inpatient and pharmaceutical services among T2D patient in Iran

Table 3 Concentration indices for the utilization of outpatient services based on the type of service among T2D patient in Iran

Needs	Erreygers concentration index	Standard error	p-value	patients who needed	Patients who utilized
Nutrition visit (checking obesity or increased weight)	0.329	0.024	< 0.001	1001	940
Weight measurement	0.331	0.024	< 0.001	994	916
BMI determination	0.32	0.024	< 0.001	978	926
Providing a meal plan	0.313	0.021	< 0.001	681	583
Blood pressure measurement	0.318	0.024	< 0.001	937	881
Neuropathy visit (examination of tingling and murmur of the lower limb, night pain in the lower limb, pain and numbness of the lower limb, others)	0.06	0.012	< 0.001	164	132
EMG/NCV	0.03	0.008	< 0.001	81	41
Retinopathy visit (checking eye disease, retina involvement, glaucoma (increased eye pressure), cataract (cataract, others)	0.115	0.016	< 0.001	288	227
Treatment for retinopathy (involvement of the retina)	0.027	0.007	< 0.001	67	40
retinopathy Laser	0.012	0.004	< 0.001	26	14
retinopathy Injection	-0.013	0.01	0.18	118	109
Visit for retinopathy surgery	-0.004	0.002	0.09	21	16
Nephropathy visit (excretion of albumin or urine protein, others)	0.071	0.014	< 0.001	228	166
Nephropathy diagnostic tests(urinary micro albumin)	0.09	0.015	< 0.001	255	206
Cardiovascular visit (myocardial infarct, heart failure, cardiovascular or valvular disease, others)	0.06	0.014	< 0.001	218	152
ECO/ECG	0.07	0.012	< 0.001	143	104
Cardiovascular arterial color Doppler sonography	-0.002	0.007	0.73	69	55
Diabetic foot visit (foot wound or history of amputation, others)	0.06	0.012	< 0.001	147	112
Examination of liver disease (examination of non-alcoholic fatty liver)	0.11	0.013	< 0.001	168	129
Liver enzyme tests	0.11	0.013	< 0.001	182	121
Examining the presence of cancer (pancreas, liver, thyroid, breast, colon, etc.)	0.03	0.007	< 0.001	57	34
Examining the existence of pancreatic cancers,	0.03	0.007	< 0.001	54	21
Checking the existence of liver cancers,	0.03	0.006	< 0.001	49	26
checking the presence of thyroid cancers,	0.03	0.006	< 0.001	48	15
Examining the presence of breast cancer	0.03	0.006	< 0.001	49	26
Investigating the presence of colon cancers,	0.03	0.006	< 0.001	50	25
Examining the existence of other cancers...	0.03	0.006	< 0.001	49	16
Routine tests for diabetic patients FBS, A1C, CBC, TSH, BUN/Cr	0.15	0.023	< 0.001	653	606
Lipid tests Cholesterol/TG/HDL/LDL	0.16	0.022	< 0.001	575	512

index such as: Metformin, Gliclazide or Glibenclamide, Aspirin, LASIX and other Blood Pressure Drugs, which indicates that these drugs, were utilized by poor people more than rich people. Also, according to table, some drugs shown a significant inequality and positive concentration index, which indicates that rich people utilization were more than poor people from this type of medicine. While some drugs are showing no significant inequality. So, the utilization of the poor and the rich people is the same including: Sitagliptin, Empagliflozin, Acarbose, Combination Drugs including: Metformin/Empagliflozin, Human Insulin (intermediate acting) including: NPH, Jugular, N/R, Analog Insulin (long acting) including: Lantus,

Levemir, Toujeo, Analog Insulin (rapid-acting) including: Noverpid, Apidra, Lispro, Antihypertensive Drugs including: Losartan, Valsartan, Amlodipine, Diltiazem, Hydrochlorothiazide, Atenolol, Anti-lipid Cholesterol Control Drugs: Atrostatin, Rosuvastatin, others, Triglyceride Control Drugs: Gem Fibrozil, Fenofibrate, Cardiovascular Drugs: Osvox, Nitroglycerin, others, Neuropathy Drugs: Gabapentin, Nephropathy Drugs: Pentoxifylline, etc.

Tables 5 and 6 display the results of the decomposition analysis for outpatient and pharmaceutical services, respectively. The Erreygers Concentration Index (EI) analysis was utilized for these services due to the significant inequity observed. These tables analyze the

Table 4 Concentration indices for the utilization of pharmaceutical services based on the type of service among T2D patient in Iran

Needs			Erreygers concentration index	Standard error	p-value	patients who needed	Patients who utilized
Antidiabetic Tablets	Metformin		-0.21	0.025	<0.001	908	818
	Gliclazide/Glibenclamide		-0.04	0.014	<0.001	180	133
	Sitagliptin		0.01	0.013	0.43	157	156
	Empagliflozin		0.02	0.014	0.14	173	171
	Pioglitazone		0.02	0.011	<0.001	115	102
	Acarbose		0.001	0.009	0.8	77	75
	Linagliptin		0.054	0.01	<0.001	97	66
Combination Drugs	Metformin/Empagliflozin		0.003	0.01	0.7	104	98
	Metformin/ Sitagliptin		0.04	0.012	<0.001	154	119
	Metformin/ Linagliptin		0.02	0.012	<0.001	149	132
	Empagliflozin/Linagliptin		0.05	0.014	<0.001	192	119
	Metformin/ Empagliflozin/Linagliptin		0.05	0.016	<0.001	312	219
Human Insulin (Average Effect)	NPH		0.004	0.005	0.4	30	22
	Jugular		-0.002	0.005	0.6	26	25
	N/R		-0.003	0.006	0.6	39	29
Insulin Analog (Length Effect)	LANTUS		-0.01	0.006	0.06	43	35
	Levemir		0.0008	0.005	0.8	33	29
	Toujeo		0.003	0.005	0.5	30	22
Insulin Analog (Fast Acting)	Novorapid		-0.008	0.007	0.2	55	43
	Apidra		-0.003	0.005	0.6	40	38
	lispro		-0.003	0.007	0.6	53	50
Combined Insulin	Novomix30		0.03	0.017	<0.001	294	266
Antihypertensive Drugs	Losartan		-0.02	0.017	0.2	310	290
	Valsartan		0.003	0.014	0.8	196	190
	Amlodipine		0.012	0.012	0.2	128	120
	Diltiazem		0.008	0.01	0.4	90	89
	Hydrochlorothiazide		0.004	0.008	0.6	62	60
	Atenolol		0.003	0.008	0.6	54	51
	Others		-0.03	0.009	<0.001	74	47
Anti-lipid Drugs	Cholesterol control	Atorvastatin	-0.009	0.014	0.5	198	181
		Rosuvastatin	-0.001	0.005	0.8	79	78
		Others	0.003	0.008	0.7	60	58
	Triglyceride control	Gemfibrozil	-0.005	0.008	0.5	58	56
		Fenofibrate	0.01	0.007	0.1	50	45
		Other	0.034	0.008	<0.001	63	33
Cardiovascular Drugs	Aspirin		-0.04	0.01	<0.001	98	68
	OSVIX		-0.004	0.017	0.6	107	102
	Metoral		0.02	0.01	<0.001	84	52
	Nitroglycerin		-0.008	0.007	0.2	49	47
	LASIX		-0.012	0.006	<0.001	33	28
	Others		-0.009	0.005	0.1	28	27

Table 4 (continued)

Needs		Erreygers concentration index	Standard error	p-value	patients who needed	Patients who utilized
Neuropathy	Gabapentin	−0.002	0.007	0.7	49	48
	Pregabalin	0.02	0.007	<0.001	45	40
	Vit B1, B12,D	0.08	0.014	<0.001	196	168
	Others	0.1	0.02	<0.001	432	400
Nephropathy	Pentoxifylline	0.01	0.012	0.1	128	125
	Spironolactone	0.07	0.012	<0.001	136	116
	Others	0.002	0.011	0.8	109	107

contribution of each determinant to the inequality. In terms of absolute contribution, if the contribution value of variable K is k and positive (negative), then the inequality in outpatient and pharmaceutical services would decrease (increase) by k % if the variable were equally distributed across socioeconomic groups.

As shown in Tables 5, the variables included in the analysis account for 87.87% of the inequality in the utilization of outpatient services, leaving 12.13% unexplained. The health status variable had the largest contribution (33.54%) to the utilization of outpatient services for T2D patients. In other words, if health status were equally distributed among T2D patients across different socioeconomic groups, the inequality in outpatient service utilization would be reduced by 33%. The basic insurance variable also had a significant contribution (27.43%) to the utilization of outpatient services for T2D patients. This means that if the basic insurance package were equally distributed among T2D patients of different socioeconomic groups, the inequality in outpatient service utilization would decrease by 27%. Additionally, the socioeconomic status variable contributed 24.8% to the utilization of outpatient services for T2D patients. This implies that if socioeconomic status were equal among T2D patients across different economic groups, the inequality in benefiting from outpatient services would be reduced by 24%.

Table 6 presents the decomposition analysis of the Erreygers concentration index for the utilization of pharmaceutical services among type 2 diabetes (T2D) patients. The variables included in the analysis account for 74.27% of the inequality in the utilization of outpatient services, leaving 25.73% unexplained. The health status variable had the largest contribution (22.20%) to the utilization of pharmaceutical services for T2D patients. This indicates that if health status were equally distributed among T2D patients across different socioeconomic groups, the inequality in pharmaceutical service utilization would decrease by 22%. The basic

insurance variable also had a significant contribution (13.63%) to the utilization of pharmaceutical services for T2D patients. This means that if the basic insurance package were equally distributed among T2D patients from different socioeconomic groups, the inequality in pharmaceutical service utilization would decrease by 13%. Additionally, the socioeconomic status variable contributed 34.35% to the utilization of pharmaceutical services for T2D patients. This implies that if socioeconomic status were equally distributed among T2D patients across different economic groups, the inequality in pharmaceutical service utilization would decrease by 34%.

Qualitative results

In the second phase of the research (qualitative part), the interviewers asked experts for solutions to reduce inequality in the utilization of services for type 2 diabetic patients, focusing on the identified main contributors: socioeconomic status, health status, and basic insurance. As shown in Table 7, solutions for reducing socioeconomic inequalities in utilization of health services for T2D patients are categorized into themes, sub-themes and suggestions.

Discussion

In the analysis of the CI and concentration curves, we found a socioeconomic inequality in the utilization of outpatient and pharmaceutical services for T2D patients. This indicates that wealthier individuals utilize these services more than poorer individuals. However, the socioeconomic inequality in the utilization of inpatient services was not significant. This can be justified by the necessity and importance of inpatient services and the urgent need for T2D patients to access these services when complications arise. Consequently, all socioeconomic classes, whether rich or poor, are compelled to use inpatient services. Additionally, the implementation of the health system transformation plan, which provides

Table 5 Decomposition of Erreygers concentration index of outpatient healthcare utilization among T2D pharmaceutical patients in Iran

Variables	Mean	GLM coefficients		Elasticity	Erreygers concentration index	Absolute contribution	Percentage of contribution
Structural determinants							
Socio-economic status	^a The poorest	-	-	-	-	-	-
	Poorer	0.215	−0.006	−0.002	−0.316	0.001	0.25
	Middle	0.181	0.08	0.03	0.021	0.001	0.2
	Richer	0.197	0.122	0.049	0.321	0.016	5.01
	The Richest	0.197	0.239	0.097	0.633	0.061	19.35
Total							24.8
Education	^a Illiterate	-	-	-	-	-	-
	Elementary	0.207	0.004	0.002	−0.156	0.0001	−0.09
	Secondary school	0.173	0.019	0.007	0.038	0.0001	0.08
	Diploma	0.31	−0.004	−0.003	0.076	0.0001	−0.06
	University	0.274	0.016	0.009	0.141	0.001	0.39
Total							0.33
Interface Designators							
Age	^a 20–30	-	-	-	-	-	-
	31–40	0.191	−0.026	−0.01	−0.077	0.001	0.25
	41–50	0.235	−0.047	−0.023	−0.021	0.0001	0.15
	51–60	0.144	−0.02	−0.006	−0.011	0.0001	0.02
	Above 61	0.399	−0.03	−0.025	0.12	−0.003	−0.94
Total							0.52
Sex	Male	0.653	0.009	0.012	−0.216	−0.003	−0.82
	^a Female	-	-	-	-	-	-
Health status	^a The weakest	-	-	-	-	-	-
	Weak	0.277	0.227	0.13	−0.48	−0.062	−19.66
	Average	0.378	0.306	0.239	−0.014	−0.003	−1.05
	Good and very good	0.337	0.434	0.301	0.571	0.172	54.26
Total							33.54
Marital Status	^a Single	-	-	-	-	-	-
	married	0.914	0.004/0	0.007	0.008	0.0001	0.02
Place of residence	Urban	0.626	0.023	0.03	−0.064	0.002	−0.6
	Suburb	0.224	−0.014	−0.006	0.055	0.0001	−0.11
	^a Rural	-	-	-	-	-	-
Total							−0.71
Basic insurance	Health of Iranians	0.311	−0.314	−0.201	−0.588	0.118	37.36
	Social security	0.4	−0.31	−0.256	0.123	−0.031	−9.93
	^a Other	-	-	-	-	-	-
Total							27.43
Supplementary Insurance	Have	0.265	0.086	0.047	0.258	0.012	3.8
	^a Doesn't have	-	-	-	-	-	-
Explained Component (percentage)						0.279	87.87
Residual Component (percentage)						0.038	12.13
Total						0.317	100

^a Reference Group

Table 6 Decomposition of Erreygers Concentration Index of pharmaceutical healthcare utilization among T2D pharmaceutical patients in Iran

Variables		Mean	GLM coefficients	Stretch	Erreygers concentration index	Absolute contribution	Percentage of contribution
Structural determinants							
Socio-economic status	^a The poorest	-	-	-	-	-	-
	Poorer	0.215	0.071	0.027	-0.316	-0.009	-7.66
	Middle	0.181	0.152	0.049	0.021	0.001	0.92
	Rich	0.197	0.14	0.049	0.321	0.016	13.99
	The Richest	0.197	0.138	0.048	0.633	0.03	27.10
Total							34.35
Education	^a Illiterate	-	-	-	-	-	-
	Elementary	0.207	0.028	0.01	-0.156	-0.002	-1.41
	Secondary school	0.173	0.017	0.005	0.038	0.0001	0.18
	Diploma	0.31	0.046	0.025	0.076	0.002	1.72
	University	0.274	0.037	0.018	0.141	0.003	2.26
Total							2.57
Interface Designators							
Age	^a 20–30	-	-	-	-	-	-
	31–40	0.191	0.01	0.003	-0.077	0.0001	-0.23
	41–50	0.235	0.019	0.008	-0.021	0.0001	-0.15
	51–60	0.144	0.005	0.001	-0.011	0.0001	-0.01
	Above 61	0.399	0.011	0.008	0.12	0.001	0.87
Total							0.48
Sex	Male	0.653	-0.022	-0.025	-0.216	0.005	4.89
	^a Female	-	-	-	-	-	-
Health status	^a The weakest	-	-	-	-	-	-
	Weak	0.277	-0.408	-0.2	-0.48	0.096	85.63
	Average	0.378	-0.378	-0.253	-0.01	0.004	3.16
	Good and very good	0.337	-0.219	-0.131	0.571	-0.075	-66.59
Total							22.2
Marital Status	^a Single	-	-	-	-	-	-
	married	0.914	0.036	0.058	0.008	0.0001	0.42
Place of residence	Urban	0.626	0.025	0.027	-0.064	0.002	-1.55
	Suburb	0.224	0.02	0.008	0.055	0.0001	0.39
	^a Rural	-	-	-	-	-	-
Total							-1.17
Basic insurance	Health of Iranians	0.311	-0.05	-0.02	-0.588	0.016	14.45
	Social security	0.4	-0.01	-0.007	0.123	-0.001	-0.81
	^a Other	-	-	-	-	-	-
Total							13.64
Supplementary Insurance	Have	0.265	-0.031	-0.014	0.258	-0.004	-3.3
	^a Doesn't have	-	-	-	-	-	-
Explained Component (percentage)						0.083	74.24
Residual Component (percentage)						0.029	25.73
Total						0.112	100

^a Reference Group

Table 7 Solutions for reducing socio-economic inequalities in utilization of health services for T2D patients

Theme	Sub-theme	Suggestion
Socio-economic status	Attention to socio-economic status	<ul style="list-style-type: none"> - Paying attention to the socio-economic situation in planning - Paying attention to the socio-economic situation in providing resources - Paying attention to the socio-economic situation in targeting services
	Improving of socio-economic status	<ul style="list-style-type: none"> - Improving the socioeconomic conditions of households - Strengthening social support and employment structures - Attention to the financial and economic problems of households - Employment generation - Supporting the poor through proper distribution of subsidies
	Planning area	<ul style="list-style-type: none"> - Identifying of vulnerable areas and socio-economic crisis - Focusing on policies related to vulnerable groups and areas - Localization of programs compiled in the ministry for some deprived and less privileged areas - Attention to geography in planning
	Attention to deprived and vulnerable areas	<ul style="list-style-type: none"> - Increasing access to services in marginal and remote areas and vulnerable areas - Deprivation of deprived and vulnerable villages and areas - Distribution of expert personnel to underprivileged areas and villages in the form of passing the commitment period - Providing active services on the outskirts of cities and deprived areas - Paying attention to the rapid growth of marginal and deprived areas and planning to serve them
	Providing a complete information platform	<ul style="list-style-type: none"> - Identifying of households with poor economic status - Data-based programming
	Promote a systemic approach	<ul style="list-style-type: none"> - Mutual recognition of systems and their cooperation to achieve desired results - Improving the systemic, comprehensive and long-term view of the socio-economic variables affecting the state of the health system - Improving the proportional distribution of resources and facilities in the provinces of the country - Focusing on the implementation of designated programs
	Attention to socio-economic factors in providing services	<ul style="list-style-type: none"> - Making healthcare workers aware of the impact of social and economic factors - Formulation of programs to provide special services for specific socio-economic groups - Special attention to specific regions of the country according to its environmental conditions and social context
	Decreasing the costs of health services	<ul style="list-style-type: none"> - Providing cost-effective services for patients - Trying to reduce the indirect costs of providing services - Providing diabetes services based on demand and need in the desired area
	Financial support	<ul style="list-style-type: none"> - Subsidy for the treatment and care of type 2 diabetic patients - Government subsidy for low-income households - Financial protection of type 2 diabetic patients in public hospitals - Designing a financial support package for patients - Increasing insurance coverage
	Cooperation	<ul style="list-style-type: none"> - Sustainable intersectoral cooperation - Holistic approach - Joint efforts
	Equitable distribution of health resources	<ul style="list-style-type: none"> - Paying attention to the free periodic care service packages for diabetic patients - Increasing access to services by developing the network system - Leveling of services - Distribution of specialist doctors, physical health resources (such as hospitals, active beds and pharmacies) in the cities
	Attention to studies in the field of health	<ul style="list-style-type: none"> - Sensitizing of relevant authorities by presenting the results of studies in the field of reducing inequality - Using the results of studies in planning and policies

Table 7 (continued)

Theme	Sub-theme	Suggestion
Health status	Improving the status of statistics and information	<ul style="list-style-type: none"> - Accurate determination of the level of households in the country and even the level of the city - Implementation of programs to accurately determine the socio-economic quotient of households
	Free service coverage	<ul style="list-style-type: none"> - Utilizing from outpatient and pharmaceutical services by all type 2 diabetic patients in the country - Implementation of free care programs for type 2 diabetic patients - Providing services to type 2 diabetic patients (both rich and poor) regardless of their financial status or place of residence
	Empowerment of society	<ul style="list-style-type: none"> - Identifying of households with poor health status - Institutionalizing a healthy lifestyle in type 2 diabetic patients - Informing patients about diagnostic and treatment measures - Planning and optimal use of social media for health promotion - Strengthening mass media in raising the level of information and awareness of patients - Media support - Health education to informants and patients
	Health policy	<ul style="list-style-type: none"> - Creating policies that support health - Creation of healthy and protected environments - Making it possible to express complaints and grievances
	Monitoring the implementation of self-care programs	<ul style="list-style-type: none"> - Monitoring the implementation of individual self-care programs - Monitoring the implementation of organizational self-care programs - Monitoring the implementation of social self-care programs
	Improving the quality of diabetes services	<ul style="list-style-type: none"> - Standardization of care for type 2 diabetic patients - Improving evaluation systems for quality care at different levels - Improvement of continuous monitoring systems
	Providing care services for diabetic patients	<ul style="list-style-type: none"> - Implementation of community-based screening programs - Outcome-based treatment goals for type 2 diabetic patients - Providing information about the ratio and distribution of undiagnosed diabetics among social and economic strata - Using popular mass media to inform about how to provide services - Risk-based positive health care action - Health care management and control for type 2 diabetic patients - Long-term follow-up of diabetes complications - Providing rehabilitation services for vulnerable and injured diabetic patients
	Structure	<ul style="list-style-type: none"> - Creating a scientific and practical structure in the country's health sector - Paying attention to and improving the status of the referral system - Improve old equipment and facilities
	Service providers	<ul style="list-style-type: none"> - Improve diabetes management skills for providers and physicians through training - Financial and non-financial incentives for service providers - Trying to motivate employees to provide better services - Efforts to improve skills through in-service training for employees
	Promote of interdepartmental cooperation	<ul style="list-style-type: none"> - Identifying of partners and stakeholders - Attracting interdepartmental cooperation - Facilitating interdepartmental cooperation and coordination - Designing and implementing interdepartmental projects - Formation of interdepartmental project teams
	Financing	<ul style="list-style-type: none"> - Proper collection of resources - Creating a suitable tariff system - Strengthening the financing system for collection, aggregation and purchase of services - Creating appropriate financial partnership - Solving problems related to per capita and tariff in the country - Better implementation of the subsidy targeting program - Making the financing system fair - Creating a suitable system for identifying poor people

Table 7 (continued)

Theme	Sub-theme	Suggestion
Basic insurance	Coordination	<ul style="list-style-type: none"> - Strengthening coordination between organizations - Strengthening the coordination of the insurance package with primary care levels and supplementary levels - Strengthen coordination between cost, population and depth of service
	Management factors	<ul style="list-style-type: none"> - Management stability - Non-dependence of programs and policies on individuals - Improvement of supervision and control - Monitoring the correct implementation of the electronic file
	Implementation factors	<ul style="list-style-type: none"> - Commitment to law enforcement - Creating a single database - Accurate estimation of people without insurance coverage - Establishing a monitoring and evaluation system
	Political factors	<ul style="list-style-type: none"> - Emphasizing the discussion of insurance in the constitution - Balance of power and strengthening coordination between the ministers of health and welfare - The need for political pressure to merge insurance funds - Strategic policies
	Structural factors	<ul style="list-style-type: none"> - Creating a single insurance structure - Creating a proper closed review process - Designing a suitable service package for diabetic patients
	Cultural factors	<ul style="list-style-type: none"> - Trying to correct closed behavior - Efforts to increase people's awareness - Trying to increase people's participation - Trying to increase people's satisfaction

subsidized inpatient care services, has increased the utilization of inpatient services among disadvantaged groups, thereby reducing inequality in their utilization.

The findings of our study are consistent with those of Vahedi et al. [35]. Similarly, Sözmen et al. [35] found that in Turkey's HTP plan in 2016, the main users of inpatient services were patients from lower socioeconomic groups and green card holders. The Green Card is an insurance plan that provides subsidized healthcare services for disadvantaged groups [37]. Therefore, public sector participation in providing subsidized inpatient services can facilitate access to these services and reduce socioeconomic inequalities in their utilization. However, policy makers must ensure the sustainability of these interventions. Our study results highlight the tendency of managers to prioritize the coverage of care services and the control and prevention of diabetes complications that lead to hospitalization and long-term bed occupancy. T2D patients require specialized care to manage their condition and prevent irreversible complications that necessitate hospitalization, such as diabetic ulcers, cardiovascular issues, kidney problems, and vision impairments. Specialized care for T2D patients is long-term, and occupying a hospital bed is essential in the health system. It is impossible to encourage and motivate patients to receive free services, establish a suitable referral system, and continuously follow up with identified patients without a comprehensive service package. T2D

patients need primary care services with an emphasis on education and empowerment to control the disease and evaluate the occurrence of complications to prevent further issues. The results of our study align with many other studies that have confirmed the existence of inequality in outpatient and pharmaceutical services for T2D patients. For example, Xu et al. found inequality in the utilization of outpatient services in rural China [38]. Tapager et al. concluded that even in a health system with comprehensive universal coverage, healthcare inequity can arise at the stage of offering access to preventive treatment [39]. Vahedi et al., showed that inequality in the utilization of outpatient services increased, while inequality in the utilization of inpatient services decreased in Iran [35]. Barnard et al. found socioeconomic inequality in access to healthcare in England [40]. Forozan et al. [39] stated that due to positive inequality indicators, the utilization of health services is more concentrated among privileged groups in Tehran, confirming the existence of socioeconomic inequality in outpatient health services [41].

Mulyanto et al. found socioeconomic inequality in the utilization of pharmaceutical and outpatient services in Indonesia [42]. Gesuita et al. showed that outpatient services are not equally distributed in an Italian region, which may increase disease severity and the risk of diabetes complications, affecting the appropriateness of diabetes care [43]. I. Sorts et al. [42] found different utilization patterns of outpatient services, rehabilitation,

and specialists in primary care according to socioeconomic status [44]. Wang et al. [43] found that a disproportionate concentration of Antidiabetic medication use was observed among the wealthy in both urban and rural areas of China. Socioeconomic factors significantly affected the likelihood of receiving medication and were major contributors to inequality [45]. The National Program for the Prevention and Control of Type 2 Diabetes emphasizes periodic care at the first level of the health system every one to six months, including nutrition visits, weight measurement, BMI determination, meal plan presentation, blood pressure measurement, diabetic foot visits, liver disease checks, liver enzyme tests, cancer checks, pancreatic cancer checks, liver cancer checks, thyroid cancer checks, breast cancer checks, colon cancer checks, other cancer checks, routine tests for diabetic patients, and lipid tests [46]. Amini-Rarani et al. [33] conducted a descriptive phenomenology study to investigate the reasons for the low uptake of free health service packages among T2D patients. The study identified three main themes, encompassing which contributed to the reduction in service package utilization. The themes included individual, accessibility, and structural factors [47]. Schouten et al. found that cultural beliefs are one of the barriers to diabetic healthcare [48]. Babaei Hyderabad's study showed that local traditions and customs are reasons for diabetic patients missing scheduled appointments [49]. Bidarpoor emphasized that low trust was a significant reason for not receiving outpatient services from comprehensive medical service centers [50]. Additionally, Khan's study identified lack of access to transportation as the main reason for patients being unable to visit doctors [51]. Sharifi and Bidarpoor found that physical inaccessibility and long distances were important reasons for diabetic patients not utilizing services [50, 52]. Another reason for the low uptake in our study was time barriers, which included long waiting times and inappropriate working hours of the healthcare center, as mentioned in other studies [49, 50, 52]. Waiting time is defined as the duration a patient waits in the clinic before being seen by medical staff [53]. Various studies have shown that long waiting times adversely affect patients' willingness to return to health and treatment centers, significantly reducing the utilization of these services [54]. Additionally, various studies have emphasized that vulnerable patient groups, such as those with low income or lack of health insurance, are at increased risk of not receiving care and services provided by health centers [55, 56]. The healthcare workforce comprises a wide range of workers who provide healthcare services. The lack of healthcare providers, doctors, specialists, part-time doctors, and the unavailability of free medical tests were among the reasons for T2D patients not receiving

care in other developing countries [57]. Furthermore, Hyderabad et al. found that the absence of employees at work, lack of follow-up with patients, improper communication between patients and doctors, lack of equipment, and lack of motivation among employees were other reasons for non-attendance and non-receipt of services by patients [49]. Poorly motivated health workers can negatively impact the health system. Some studies believe that low wages and poor working conditions of healthcare workers are factors that demotivate employees in the health system [58].

Another aspect of outpatient services that reported a significant inequality index is provided by the second level (public and private hospitals, internal clinics, diabetes clinics, and polyclinics) and the third level (super-specialized centers). These services include: neuropathy visits, neuropathy electromyography, retinopathy visits, retinopathy treatment, laser retinopathy, nephropathy visits, nephropathy diagnostic tests, cardiovascular visits, and echocardiography/cardiovascular ECG.

We also found that the Concentration Index for inexpensive drugs was negative, indicating that these drugs were consumed more by the poor than the rich. These inexpensive drugs include Anti-diabetic pills such as: Metformin, Gliclazide, or Glibenclamide, some Blood Pressure Medications, and aspirin. Conversely, expensive and specialized combination drugs for controlling T2D were more utilized by wealthy patients than poor patients. These drugs include: Antidiabetic pills like Pioglitazone and Linagliptin, Combination Drugs such as: Metformin/Sitagliptin, Metformin/Linagliptin, Empagliflozin/Linagliptin, Empagliflozin/Linagliptin/Metformin, Novomix, other Anti-Triglyceride Drugs, Cardiovascular Drugs like Metoral and Pregabalin, vitamins including: B1, B12, and D, other Neuropathy Drugs, and Spironolactone, which is a positive Nephropathy Drug. On the other hand, some medicinal items showed no significant disparity in utilization between poor and rich patients. These include: Antidiabetic Pills such as Sitagliptin, Empagliflozin, and Acarbose, Combination Drugs like Metformin/Empagliflozin, Human Insulin (medium-acting) including: NPH, Jugular, N/R, Analog Insulin (long-acting) including: Lantus, Levemir, Toujeo, and Analog Insulin (rapid-acting) including: Noverpid, Apidra, and Lispro. Antihypertensive Drugs include: Losartan, Valsartan, Amlodipine, Diltiazem, hydrochlorothiazide, and Atenolol. Lipid-Lowering Drugs for Cholesterol Control include: Atorvastatin and Rosuvastatin, while Triglyceride Control Drugs include: Gemfibrozil and Fenofibrate. Cardiovascular Drugs include: Osvox, and nitroglycerin. Neuropathy Drugs include: gabapentin, and Nephropathy Drugs include: Pentoxifylline these results were justified by the Iran Ministry of Health's announcement in

January 2022, which stated that all types of insulin used by T2D patients, as well as Anti-diabetic Tablets such as: Sitagliptin, Empagliflozin, Acarbose, and some Combination Drugs, were included in the incurable disease package for all diabetes patients. Consequently, utilization of this package was available to eligible patients [59]. Therefore, it is crucial to survey health providers and specialists and assess the needs of T2D patients before designing a package of pharmaceutical services and determining the coverage of pharmaceutical items by policymakers, managers, and health planners. The results of the Concentration Index analysis indicated that the socio-economic status variable had the largest contribution (24.8%) to the utilization of outpatient services and a 34.35% contribution to the utilization of pharmaceutical services for T2D patients. This means that if socio-economic status were equally distributed among T2D patients from different socio-economic groups, the inequality in the utilization of outpatient and pharmaceutical services would be reduced by 24% and 34%, respectively. Additionally, the results of the analysis were consistent with many studies worldwide. Numerous studies have shown that household economic status had the greatest impact on or contribution to socio-economic inequality in the utilization of services by T2D patients, which aligns with the results of this study [4, 6, 45, 60–63]. In this regard, we interviewed 12 policymakers, health managers, and experts to gather solutions for improving the socio-economic status in Iran. The proposed solutions to enhance socio-economic status and reduce inequality in the utilization of services for T2D patients included:

Attention to socio-economic status in planning

Providing resources and targeting services were identified as the main solutions to reduce inequality in the utilization of outpatient and pharmaceutical services for T2D patients. A study by Godlawalti et al. emphasized planning based on the socio-economic factors of diabetic patients [62]. Sikio et al. found that considering socio-economic factors in planning, resource provision, and targeting local health services could increase patient utilization of health services [64].

Improvement of household socio-economic conditions

Several studies mentioned improving household socio-economic conditions as a proposed solution to increase the utilization of health services for T2D patients [63, 64].

Attention to deprived and vulnerable Areas

A study by Leo et al. found that the prevalence of type 2 diabetes was significantly associated with low education levels, low birth weight, unemployment, and low-income rates. Therefore, policymakers need to identify and target

deprived areas [65]. Increasing access to health services in vulnerable areas was emphasized by interviewees as a solution to reduce inequality in the utilization of health services for T2D patients and improve socio-economic status. This solution was also supported by several global studies [39, 42, 63, 66, 67].

Identifying households with poor economic status

Some studies confirmed the strategy of identifying households with poor economic status, as expressed by the interviewees [68]. Additionally, many studies have proposed providing special services for socio-economic groups [63, 69, 70]. This study proposed solutions to reduce health service costs and improve the socio-economic status of T2D patients. Shrivastava et al. emphasized the need to strengthen the healthcare delivery system for awareness, prevention, early detection, cost-effective management, and rehabilitation of diabetes patients, focusing on lower SES groups and women [71]. Barwah et al. suggested that addressing regional inequalities and providing treatment subsidies to T2D patients with poor socio-economic status would reduce inequality [72]. The study highlighted the need for sustainable intersectoral cooperation, joint efforts, and a holistic approach to improve the socio-economic status of T2D patients. Other studies also supported intersectoral cooperation as a solution to reduce inequality [73]. Fair distribution of health resources was discussed as a means to reduce social and economic inequality in health service utilization for T2D patients, confirmed by many studies [74, 75]. The study showed that health status had the largest contribution (23.43%) to outpatient service utilization and (28.72%) to pharmaceutical service utilization for T2D patients. Equal distribution of health status among T2D patients from different socio-economic groups would reduce inequality in outpatient and pharmaceutical service utilization by 23% and 28%, respectively. These findings were consistent with Barnard et al., who found that health status contributed most to inequality among diabetic patients [40]. The study proposed institutionalizing and educating healthy lifestyles, creating health-supporting policies and environments, and allowing for complaints and grievances to improve the health status of T2D patients, consistent with other studies [76, 77]. Interviewees also suggested improving self-care programs for T2D patients [78]. Strategies to promote and improve service quality for T2D patients were mentioned. Esadi et al. recommended public health strategies to improve health literacy and increase diabetes awareness [79]. Interviewees proposed various solutions for providing care services to T2D patients. A study on income-related inequalities in visual impairment and eye screening services for T2D patients suggested

developing health and healthcare policies to minimize observed inequalities [80]. Improving diabetes management skills for providers through training, financial and non-financial incentives, and motivating employees to provide better services were suggested. Shekelle et al. stated that financial incentives, such as those in the new general practitioner contract, would help reduce disparities [81]. Experts also emphasized improving basic insurance status for T2D patients, confirmed by other studies. Mutyambizi et al. suggested targeting health financing interventions at poor diabetic patients, particularly poor women [82]. Experts recommended improving management factors such as managerial stability, non-dependence on individuals, better monitoring and control, and proper implementation of electronic files to enhance basic insurance status and health service utilization for T2D patients. Many studies pointed to management factors in addressing T2D patient inequality [79, 83, 84]. Interviewees also suggested correcting cultural factors like behavior modification, increasing awareness, participation, and satisfaction to improve insurance company performance. Some studies highlighted behavior modification and awareness to reduce inequality and increase health service utilization [4, 42, 60]. In developing countries, studies indicate that most inequalities stem from a lack of education and health literacy. Therefore, many studies have emphasized promoting public education, improving health literacy, and increasing access to health facilities [35, 49, 54, 85–87]. Conversely, in developed countries, studies have focused on enhancing comprehensive strategies, addressing racial differences, and developing digital infrastructures [35, 63, 66, 83, 88, 89]. We found that the basic insurance variable had the largest contribution (12.66%) to the utilization of outpatient services and (9.24%) to pharmaceutical services for T2D patients. Equal distribution of the basic insurance package among T2D patients from different socio-economic groups would reduce inequality in outpatient and pharmaceutical service utilization by 12% and 9%, respectively. Despite increased coverage of basic insurance plans, especially Iran's health insurance, these plans seem insufficient for cost-effective medical service utilization. Therefore, facilitating access to necessary health services through basic insurance packages is recommended to address inequality in Iran's outpatient sector. Many studies support our findings regarding the contribution of basic insurance to socio-economic inequality in T2D patient service utilization [70, 90–92]. Key expert interviews also highlighted the importance of improving basic insurance status for T2D patients, confirmed by other studies [82]. Experts suggested enhancing management factors such as managerial stability, independence of programs and policies from individuals, better

monitoring and control, and proper implementation of electronic records to improve basic insurance status and health service utilization for T2D patients. Many studies have pointed to management factors in addressing T2D patient inequality [84, 88, 93]. Additionally, improving the implementation of laws and plans, such as commitment to law enforcement, creating a single database, accurately estimating uninsured individuals, and establishing a monitoring and evaluation system, were suggested solutions. Orsin et al. stated that public policies, planning, legislation, and commitment to laws in community-based insurance plans could significantly impact diabetes inequality [63]. Interviewees also mentioned modifying cultural factors such as behavior, increasing awareness, participation, and satisfaction to improve insurance company performance. Studies in developing countries show that most inequalities are due to a lack of education and health literacy, emphasizing the promotion of public education, improving health literacy, and increasing access to health facilities [45, 69, 94]. In more developed countries, studies emphasized improving comprehensive strategies, addressing racial differences, and developing digital infrastructures [82, 95, 96].

Conclusion

This study revealed inequality in the utilization of outpatient services and pharmaceutical items for T2D patients. Rich patients with good socioeconomic status had greater access to these services compared to poor patients. Therefore, targeted health interventions for poor T2D patients are recommended. Efforts towards universal coverage in outpatient care and commonly used pharmaceutical items, such as: Antidiabetic Drugs, Triglyceride Control Drugs, Cardiovascular Drugs, Neuropathy Drugs, and Nephropathy Drugs, should be considered. Equality approaches in the design, implementation, monitoring, and evaluation of health programs should address societal inequalities. The disparity in the utilization of inpatient services between poor and rich patients was not significant. Both groups utilized inpatient services in similar proportions due to the urgent need for these services among diabetic patients. The provision of subsidized inpatient services in the health system transformation plan increased utilization among disadvantaged groups. Specialized care is essential to prevent irreversible complications that lead to long-term hospitalizations. A comprehensive service package emphasizing education and empowerment is necessary to control the disease. Encouraging patients to receive free services, establishing a suitable referral system, and continuous follow-up of identified patients are crucial. Improving variables affecting socio-economic inequality in T2D patients can enhance the country's health system indicators. Despite

increased coverage of basic insurance plans, especially Iran's health insurance, these plans are not cost-effective for medical service utilization. Targeted insurance coverage for poor T2D patients, enriching basic insurance benefit packages, and facilitating access to necessary health services are effective plans to address inequality. Policymakers should strengthen the basic health insurance benefits package to tackle health inequality. Determining the basic medical insurance package in Iran requires a systematic approach to designing a long-term program. Ignoring inequality in the utilization of outpatient services and pharmaceutical items for T2D patients can lead to severe complications such as retinopathy, nephropathy, neuropathy, heart diseases, vascular disease, foot ulcers, diabetes, amputation, and even death. Qualitative research solutions can bridge the gap between epidemiological research on health inequity and health policy by focusing on policy processes for inequalities, prioritizing interventions, and implementing them effectively. Identifying health policy entry points based on contributing factors in inequality and empirical research is crucial for reducing inequality in T2D patient service utilization. Appropriate interventions are needed to reduce social and economic inequalities in T2D. Effective collaboration between researchers, policymakers, managers, doctors, health experts, other institutions, and related communities is essential to improve the social and economic status of patients.

Limitations

- Due to the limitation in data collection, the context of the social system including: structural, cultural and functional aspects was omitted.
- Some factors related to the use of healthcare services such as: issues related to family culture were not considered, which are suggested to be considered in other studies.
- Non-cooperation of some patients to complete the questionnaire.
- The inability of some patients to complete the questionnaire due to old age or illiteracy.
- Limitation of sampling in all cities of Khuzestan and Isfahan provinces in terms of distance and accessibility.
- In the qualitative section: attracting the cooperation and participation of key experts and experts in the field of health is a problem due to the type of job and their time limit, which was tried to be solved by relying on academic correspondence and continuous follow-up and justifying the importance of the study.

Authors' contributions

L.G. contributed in concept, data gathering and wrote the manuscript draft; M.A.R. conceptualized, designed, conducted the analyses and critically revised the manuscript; A.T. conceived of the study, participated in study design and contributed in analyzing data. S.K. developed the original idea and analyzed data. All authors read and approved the final article.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This study obtained the necessary ethics approval from the Research Ethics Committee of Isfahan University of Medical Sciences, Isfahan, Iran, under the ethics code: IR.MUI.NUREMA.REC.1401.033. Informed consent was obtained from all participants, ensuring their confidentiality and data anonymity.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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