The Effects of Distance on Health Outcome and Risk Factors of Estimated Glomerular Filtration Rate Among Type 2 Diabetes Patients

Krekpon Dissara, Thaksin University, Thailand
Tum Boonrod, Thaksin University, Thailand
Witchada Simla, Thaksin University, Thailand
Vallop Ditsuwan, Thaksin University, Thailand
Butsakorn Sangsuwan, Thaksin University, Thailand
Ausana Ko-aien, Thaksin University, Thailand

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Abstract
Diabetic nephropathy (DN) is a health problem that leads to end-stage chronic kidney disease (CKD). Accessibility of healthcare facilities is concerned with commanding appropriate healthcare resources as it could improve health of individual patients. This study aimed to 1) compare the effects of distance to community hospital on health outcomes and 2) determine factors related to chronic kidney disease in patients with type 2 diabetes. The retrospective study was conducted using a database from October 2021 to September 2022 among type 2 diabetes patients with CKD aged 60 years and over. The data was analyzed by the One-Way ANOVA and Kruskal Wallis test, Spearman's rank correlation coefficient. The findings revealed that among 585 type 2 diabetes patients with CKD, their distance from home to the community hospital ranged from 0 to 10 km(n=257), 11-20 km. (n=48) 21-30 km. (n=48) and 31-40 km. (n=57). The effects of distance to community hospital significantly differed in waist circumference (p=0.0086), systolic blood pressure (SBP) (p=0.0045), and diastolic blood pressure (DBP) (p=0.0413). Moreover, the correlation between factors and estimated glomerular filtration rate (eGFR) within the 0-10 km range encompassed age, DBP, HbA1c, and creatinine, whereas within the 11-20 km range, it included age and creatinine. For distances of 21-30 km, the association involved age, SBP, HbA1c, and creatinine, and for distances of 31-40 km, it implicated age and creatinine. The results suggested that the distance from home to the hospital affected health outcomes. Therefore, those patients should access treatment and care from health facilities near their homes.

Keywords: Diabetes Type 2, Chronic Kidney Disease, Distance, Community Hospital

Introduction

Diabetic nephropathy (DN) is a critical health concern contributing to end-stage chronic kidney disease (CKD), a major global burden with a prevalence of approximately 11% to 13% (Rodríguez-Poncelas et al., 2016). Recent findings highlight diabetes as the third primary factor in CKD onset, progression, and the development of end-stage renal disease (An et al., 2023). In Thailand, diabetes prevalence has surged over the past 25 years (NIDDK, 2022). yet accessing specialized medical care presents challenges, particularly for those facing system-level barriers like lower income and geographical isolation (Karly B. Smith et al., 2020). These obstacles hinder optimal clinical outcomes, particularly in remote areas, where the link between remoteness and chronic disease outcomes is a subject of significant research (Marcello Tonelli et al., 2019).

Disparities in accessing primary and specialty care persist, affecting vulnerable populations such as the elderly, women, children, and racial/ethnic minorities, regardless of geographic location (Otieno et al., 2020). National agencies advocate for improved service delivery among these groups, yet existing conceptual frameworks often overlook urban-rural distinctions in specialty care access (Karly B. Smith et al., 2020).

Despite the widespread prevalence of diabetes and its complications in rural areas, there exists a notable gap in comprehensive data comparing the quality of diabetes care between rural and non-rural communities, particularly among high-risk groups concurrently dealing with chronic kidney disease (CKD) (Shaw et al., 2019). While some research has delved into complications such as retinopathy, foot ulcers, and amputations, which are unrelated to kidney issues in diabetes (McLean et al., 2020), it's essential to recognize that diabetes remains the primary global cause of CKD. Therefore, this study specifically targets individuals managing both diabetes and CKD (Newtonraj et al., 2019).

Access to healthcare in rural areas like Phanom district in Surat Thani province of southern Thailand is relatively limited. This situation could create barriers for these patients to receive appropriate healthcare management. Rather it could bring about poor health and increase complications (Cyr et al., 2019).

Objective

The objective of this study was to compare the effects of distance to community hospital on health outcome and to determine factors associated with chronic kidney disease among patients with type 2 diabetes.

Materials and Methods

Study Design and Period

This retrospective study compared the distance of patients' residences to Phanom District Hospital, Surat Thani Province, southern Thailand. We obtained ethics from the Thaksin University Ethics Committee on Human Research (REC No.0527 COE No. TSU 2023_203). In this particular study, researchers utilized a hospital database spanning, from October 2021 to September 2022, at a standard-level hospital in southern Thailand.

Population and Sample
The study focused on patients diagnosed with of CKD, as identified by ICD-10 codes N181-N189. These codes correspond to various forms of Diabetic Nephropathy (DN). In total, 585 type 2 diabetes patients with CKD aged over 60 years were included in this study.

Data Analysis And Management
The data underwent a process of cleaning, coding, entry, and analysis through the utilization of STATA program version 18 statistics. The data was analyzed using One-way ANOVA, Kruskal-Wallis test, and Spearman's rank correlation coefficient.

Results

The findings indicated that among 585 type 2 diabetes patients with CKD, the distance from their homes to the community hospital ranged from 0 to 10 km. (n=257), 11-20 km. (n=48) 21-30 km. (n=48) and 31-40 km. (n=57). The effect of distance to the community hospital significantly differed in waist circumference (p=0.0086), systolic blood pressure (SBP) (p=0.0045), and diastolic blood pressure (DBP) (p=0.0413) as shown in Table 1. In addition, the correlation between factors and estimated glomerular filtration rate (eGFR) varied based on distance. Within the 0-10 km range, factors included age (p=<0.001), DBP (p=0.0006), HbA1c (p=0.0145), and creatinine (p=<0.001). For distances of 11-20 km, only age (p=<0.001) and creatinine (p=<0.001) were significant. Within the 21-30 km range, factors comprised age (p=<0.001), SBP (p=0.045), HbA1c (p=0.0006), and creatinine (p=<0.001). Lastly, within the 31-40 km range, age (p=<0.001) and creatinine (p=<0.001) were significant, as illustrated in (Table 2).

Table 1. Comparison of the effect of distance to community hospital for estimated glomerular filtration rate (eGFR)

Factor	0-10 Km (n=257)	11-20 Km (n=48)	21-30 Km (n=223)	31-40 Km (n=57)	P-value
	Median (IQR)	Median (IQR)	Median (IQR)	Median (IQR)	
Age	61 (14)	59 (12)	60 (13)	56.5 (17)	0.1556a
BMI	25.51 (6.36)	26.02 (6.37)	25.34 (5.52)	26.95 (5.77)	0.4717b
waistline	89 (17)	88.5 (14.5)	85 (15)	90 (20)	0.0086a*
HBA1C	7.2 (1.7)	6.9 (1.15)	7.4 (2.2)	6.9 (1.5)	0.186b
LDL	100 (40)	103.5 (43.5)	106 (46)	99.5 (48)	0.4966b
Creatinine	0.75 (0.29)	0.74 (0.3)	0.74 (0.25)	0.78 (0.33)	0.5586b
SBP	136 (14)	131.5 (19)	130 (18)	130.5 (16)	0.0045b*
DBP	80 (12)	76.5 (15.5)	77 (12)	74 (13)	0.0413b*
eGFR	91.31 (26.89)	90.53 (26.73)	93.09 (23.81)	92.61 (48.43)	0.5325b

Body Mass Index (BMI); Hemoglobin A1c (HBA1C); Low-density Lipoprotein (LDL); Systolic blood pressure (SBP); Diastolic blood pressure (DBP); estimated Glomerular Filtration Rate (eGFR); a =one-way Anova b =Ksuskal-Wallis test *= P-value <0.05.

Table 2. The association between factors and estimated glomerular filtration rate (eGFR)

Factor eGFR	**Age**	**BMI**	**SBP**	**DBP**	**HBA1C**	**LDL**	**Creatinine**
0-10 (n=257)	<0.001	0.4135	0.8525	0.0006	0.0145	0.2301	<0.001
11-20 (n=48)	0.0064	0.5085	0.6149	0.3248	0.3248	0.4451	<0.001
21-30 (n=223)	<0.001	0.5693	0.0045	0.2823	0.0006	0.9623	<0.001
31-40 (n=57)	<0.001	0.9786	0.6805	0.0514	0.1074	0.6380	<0.001

* Correlation is significant at the 0.05 level (2-tailed).

Discussion and Conclusion

The study's findings revealed that residents' distance did not influence eGFR, but it did have varying effects on waistline, SBP, and DBP due to proactive access to the health service system. Hence, individuals living closer to nephrologists are more likely to receive recommended quality care and are less prone to adverse health outcomes (Bello et al., 2022). Additionally, government policies emphasize strategies for preventing and promoting CKD, including support for facilities through resource allocation, training, and healthcare officer deployment (The Nephrology Society of Thailand, 2023).

There are associations between remote residence and adverse outcomes in individuals with diabetes and concomitant CKD. Remote dwellers with both conditions are less likely to receive specialist care, undergo recommended assessments, or receive appropriate medications. They are also more likely to experience adverse outcomes such as hospitalization and mortality, although they are less likely to initiate renal replacement therapy during follow-up (Tan et al., 2018).

The implications for clinical practice and policymaking underscore the importance of recognizing the impact of geography on access to services, particularly the potential "distance barrier" in providing timely and effective care for individuals with chronic illnesses like diabetes and CKD (Look et al., 2019). Further studies are necessary to mitigate the impact of remote location on care delivery, focusing on educating care providers as an initial step. Long-term solutions may involve reducing travel burdens through enhanced public transportation, increased clinic availability in remote areas, utilization of alternative care providers, and greater integration of telehealth technology (Rauh et al., 2018).

Additional studies have highlighted that residents' proximity to nephrologists is not necessarily correlated with lower rates of chronic kidney disease (CKD) due to various factors such as illiteracy, limited access to healthcare, and deficiencies in the health system. There's also a lack of awareness among high-risk individuals and primary healthcare providers (Newtonraj et al., 2021). Similarly, barriers preventing individuals with type 2 diabetes and CKD from accessing quality healthcare include a scarcity of nephrologists, inadequate healthcare insurance coverage, restricted healthcare access, and insufficient understanding of CKD and its treatment options (Kelepouris et al., 2023). Hence, it's imperative that these patients have access to appropriate treatment and receive adequate healthcare from the nearest health service system to their residences.

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Contact emails: btum@tsu.ac.th
652997002@tsu.ac. th