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# Prevalence and predictors of peripheral arterial disease determined by ankle brachial index in diabetes population treated within primary care services in a non-urban area of lower northern Thailand

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**Abstract**

In diabetes patients, urban lifestyle has been concerned as one of the risk factors for peripheral arterial disease (PAD). The aims of this study were to find out the prevalence and associated risk factors of PAD in type 2 diabetes patients who live in a non-urban community area. A total of 885 participants with type 2 diabetes mellitus were enrolled from six primary care units in the health network centered at Naresuan University Hospital, Phitsanulok, between May and June 2018. Ankle-brachial index (ABI) was performed in all subjects using a vascular screening device. PAD was defined by an ABI value of 0.9 or lesser at least on one leg. The predictors of PAD were analyzed using multiple logistic regression. The prevalence of PAD was 7.2% among 884 evaluable patients. Diabetic neuropathy and a history of macrovascular complications were significant predictors of PAD.

**Keywords**

Peripheral arterial disease, type 2 diabetes, ankle-brachial index

Dear Editor,

Peripheral arterial disease (PAD) is one of the problematic macrovascular complications which occurs twice as much in diabetes patients, compared to people with non-diabetes.[1] For the screening and diagnosis of PAD, ankle brachial index (ABI) is one of many simple non-invasive tools being used in several countries.[2] Information of PAD in diabetes determined by ABI has been growing, and its prevalence of 23.5% and 17.7% has been reported from Europe and Asia, respectively.[3,4] Several risk factors for PAD in diabetes patients have been studied showing both concordant and conflicting results. Among these, urban lifestyle has been proposed as one of the risk factors.[5] In Thailand, there are three studies that have reported prevalence of PAD in diabetes population living in Bangkok with a result of 12.6%, 33.3%, and 60.3%.[6–8] In the present study, we aim to find out the prevalence of PAD determined by ABI in diabetes patients being treated within primary care services in the non-urban area of Phitsanulok, and to determine the risk factors for PAD.

A cross-sectional prospective study was conducted between May and June 2018 at six primary care units in the health network centered at Naresuan University Hospital, Phitsanulok. The province is located in the lower north of the country with approximately 800,000 population. Type 2 diabetes patients aged at least 15 years old who live in the area that is an outskirt of Phitsanulok

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**Table 1.** Demographic data of diabetes subjects comparing between PAD and non-PAD group.

| | PAD ($n=64$) | Non-PAD ($n=820$) | $p$-value |
|---|---|---|---|
| Age (years) | 66.52 ± 12.54 | 61.46 ± 9.98 | 0.002* |
| Gender | | | |
| Female, number (%) | 48 (75.0) | 568 (69.3) | 0.337 |
| Duration of DM | | | |
| ⩾10 years, number (%) | 30 (46.9) | 243 (30.5) | 0.007* |
| BMI (kg/m$^2$) | 26.82 ± 7.55 | 26. 44 ± 4.83 | 0.696 |
| FPG | 138.39 ± 50.15 | 132.24 ± 47.24 | 0.329 |
| Hb $A_{1C}$ (%) | 7.67 ± 2.01 | 7.45 ± 1.56 | 0.406 |
| Total cholesterol (mg/dL) | 180.88 ± 43.51 | 174.04 ± 37.80 | 0.185 |
| Triglyceride (mg/dL) | 174.37 ± 92.58 | 155.47 ± 85.81 | 0.105 |
| HDL-c (mg/dL) | 50.14 ± 15.44 | 51.35 ± 13.52 | 0.511 |
| LDL-c (mg/dL) | 97.46 ± 40.41 | 91.57 ± 32.37 | 0.279 |
| Smoking, number (%) | 7 (10.9) | 130 (15.9) | 0.295 |
| Hypertension, number (%) | 52 (81.3) | 644 (78.5) | 0.609 |
| Hyperlipidemia, number (%) | 49 (76.6) | 628 (76.6) | 0.997 |
| Diabetic retinopathy, number (%) | 9/59 (15.3) | 63/801 (7.9) | 0.048* |
| Diabetic nephropathy, number (%) | 19/47 (40.4) | 204/617 (33.1) | 0.303 |
| Diabetic neuropathy, number (%) | 12/57 (21.1) | 63/676 (9.3) | 0.005* |
| History of macrovascular complications, number (%) | 10/62 (16.1) | 52/804 (6.5) | 0.004* |

*Significant difference ($p < 0.05$).
Abbreviations: BMI, body mass index; DM, diabetes mellitus; FPG, fasting plasma glucose; Hb $A_{1C}$, hemoglobin A1C; HDL-c, high density lipoprotein cholesterol; LDL-c, low density lipoprotein cholesterol; PAD, peripheral arterial disease.

covered by each primary care unit were recruited. A mobile medical team comprised of endocrinologist, ophthalmologist, vascular technician, and nurse was sent to the sites to conduct the study. All participants were enrolled by an endocrinologist who collected their demographic data and recent investigations within 6-month period via the electronic medical record system. ABI was measured by two experienced vascular technicians using a vascular screening device (Fukuda Denshi VS 1500N, Tokyo, Japan). Normal ABI value was 0.91 to 1.40. PAD was defined with ABI of 0.90 or lesser. Subjects with one or both legs amputation were excluded from the study. Retinopathy was evaluated by an ophthalmologist using indirect ophthalmoscopy. History of diabetic nephropathy, neuropathy, stroke, and ischemic heart disease was retrieved from medical records. The study was approved by the Institutional Ethics Committee of Naresuan University (approval number 563/59).

There were 885 diabetes subjects recruited. One participant with leg amputation was excluded, leaving 884 subjects for evaluation. Of these, 723 (81.8%) and 62 (7.0%) patients used oral hypoglycemic agents and insulin for their medication, respectively. For microvascular complications, 223 (25.2%), 72 (8.1%), and 75 (8.5%) participants had diabetic nephropathy, retinopathy, and neuropathy, respectively. History of stroke and/or ischemic heart disease was presented in 62 (7.0%) patients.

The prevalence of PAD in our study was 7.2% (64 out of 884 subjects). Thirty-nine (60.9%) patients had PAD on one leg (right or left) while 25 (39.1%) subjects had it on both sides. Of these 64 patients, most of them had an ABI value between 0.4 and 0.9, whereas only one had severe PAD (ABI value = 0.34). Demographic data of diabetes subjects comparing between PAD and non-PAD group were shown in Table 1. For multivariate analysis, diabetic neuropathy and history of macrovascular complications were associated with an increased likelihood of PAD occurrence [odds ratio 2.57 ($p = 0.016$) and 3.06 ($p = 0.006$), respectively].

Prevalence of PAD determined by ABI in the present study is lower than previous reports, especially three studies from Thailand conducted in Bangkok. Urban lifestyle is of great concern being the cause of this rate discrepancy. However, one of major differences between the three mentioned studies and ours is the severity of diabetes in the population. Diabetes patients from the studies conducted in Bangkok compared to ours had more diabetic complications (diabetic nephropathy, 57.1% vs 25.2%; retinopathy, 24.8%–32.0% vs 8.1%; neuropathy, 26.0%–48.9% vs 8.5%; history of macrovascular complication, 5.0%–29.7% vs 7.0%) and more numbers of subject who needed insulin administration (34.0%–45.2% vs 7.0%). Of note, these three previous studies were conducted in tertiary-care-hospital setting. Therefore, risk factor of urban lifestyle may be compromised by the difference in diabetes severity of the population and may not be comparable between the two study areas. Instead, obvious distinction of diabetes severity may explain the lower prevalence of

PAD in the current study. Of note, since median age, duration of diabetes, and average $HbA_{1c}$ levels from the three studies and ours were comparable, these factors may not contribute to the low prevalence of PAD in the present study.

Proportions of patients having retinopathy (8.1%) and neuropathy (8.5%) in our study are quite low compare to another microvascular (nephropathy (25.2%)) and especially macrovascular complications (7.0%). However, since retinopathy was completely evaluated by ophthalmologists, we cannot explain the low rate in nature of retinopathy in our primary care population. Regarding the risk factors for PAD, we found history of stroke/ischemic heart disease and presence of peripheral neuropathy as the only two risk factors for PAD. Although factors of age, duration of diabetes and retinopathy were demonstrated as potential factors in univariate analysis, they were not significant in multiple logistic regression analysis. The explanation may be our PAD prevalence is low causing PAD cases with these potential factors lessen in numbers, while the two significant factors identified in this low-prevalence study are really strong risk determinants for PAD. High missing data was due to a limitation of our study protocol for retrieving the information from medical records in nephropathy (24.9%) and neuropathy group (17.0%), and could be a potential compromising factor for multivariate analysis.

Our study is the first in Thailand to demonstrate the lowest prevalence of PAD in diabetes patients treated within primary care services who lived in a non-urban community area. Despite an uncomplicated diabetes, there remains silent PAD hidden among these patients thus requires a screening test for early detection. In the primary care setting where ABI may not be widely available, a mobile medical team for on-site PAD screening may help improving early disease detection which may finally contribute to a lower amputation rate. However, this strategy of screening requires further evaluation by prospective studies.

## Authors' contributions

PS and SS designed and developed project. PS, SS, WT, PS, NS and PB took part of data collection and analyzed patients data. PS and PW were major contributors for preparing manuscript. All authors read and approved the final manuscript.

## Availability of data and materials

Data and materials are available upon request to the corresponding author.

## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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## Ethics approval and consent to participate

Ethical clearance and approval were obtained from the Institutional Ethics Committee of Naresuan University (approval number 563/59). All study participants were informed about the purpose of the study and additional information was given as they need. Written informed consent was obtained from all the respondents.

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