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Correlation between Serum Vitamin D Levels and Allergic Rhinitis Severity at Vajira Hospital: A Cross-Sectional Study

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ABSTRACT

OBJECTIVE: Vitamin D affects the immune system and inflammatory process, and its deficiency is significantly associated with an increased prevalence of allergic rhinitis (AR). Therefore, the correlation between the serum 25-hydroxyvitamin D levels and the severity of AR symptoms must be investigated.

METHODS: This research utilized a cross-sectional approach, focusing on patients aged 18 years and above diagnosed with AR at the Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand from August 15, 2023, to January 15, 2024. The relationship between AR severity and serum vitamin D levels was analyzed using Pearson correlation coefficient. AR severity on symptoms and quality of life was assessed using the Thai version of Sinonasal Outcome Test-22 (SNOT-22) and Rhinoconjunctivitis Quality of Life questionnaire-36 (RCQ-36) questionnaires. Serum-specific immunoglobulin E (IgE) and total IgE levels were also measured to examine their relationship with the serum vitamin D level.

RESULTS: Among the 58 participants, 34 (58.60%) had vitamin D deficiency. These individuals with vitamin D deficiency exhibited significantly higher AR severity compared with those without vitamin D deficiency. The mean difference between these groups was 21.90 points for SNOT-22 scores (95%CI: 17.71–26.69, p-value < 0.001) and 19.17 points for RCQ-36 scores (95%CI: 12.08–27.34, p-value < 0.001). Further analysis revealed a significant inverse correlation between serum vitamin D level and AR severity, with Pearson correlation coefficients of −0.72 for RCQ-36 (95%CI: −0.82 to −0.56, p-value < 0.001) and 0.80 for SNOT-22 (95%CI: −0.88 to −0.68, p-value < 0.001). No correlation with serum vitamin D level was found for serum-specific IgE and total IgE levels.

CONCLUSION: A significant inverse relationship existed between serum vitamin D levels and AR severity. No correlation with serum vitamin D level was found for serum-specific IgE and total IgE levels.

KEYWORDS: allergic rhinitis, RCQ-36, serum vitamin D, serum-specific IgE, SNOT-22

INTRODUCTION

Allergic rhinitis (AR) is an immunoglobulin E (IgE)-mediated inflammatory disease that causes allergic reactions to an inhaled allergen. Its symptoms include nasal congestion, nasal discharge, sneezing, and itching nose, all of which affect the quality of life and sleep and performance at school and work[1,2]. The pathophysiology of AR is type 1 hypersensitivity to the specific allergen causing increased IgE production and eosinophil recruitment. The inflammatory processes are driven by type 2 immune response, which is related to the production of many inflammatory cytokines e.g., interleukin (IL)-4, IL-5, IL-9, IL-13,

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and granulocyte–macrophage colony[1]. Genetic disposition, lifestyle, and environmental factors influence AR development[3]. The prevalence of AR in many countries is over 40%–50%, affecting over 500 million people worldwide[4]. In Asia, its prevalence varies widely and is rising up to 45% mostly in low- and middle-income countries[5]. In Thailand, its prevalence is 50.60%[6].

The main function of vitamin D is to maintain bone health and calcium balance. It also has roles in the immune system and anti-inflammation[7,8]. Vitamin D modulates multiple mechanisms of the immune system, both adaptive and innate. It has immunomodulatory effects on allergen-induced inflammatory pathways, suppresses T helper 1 (Th1) and T helper 2 (Th2) immune responses, decreases proinflammatory cytokines, and increases regulatory T cells, which are important in maintaining immune homeostasis[9].

Vitamin D insufficiency and deficiency are defined as a serum 25-hydroxyvitamin D level of 20–30 ng/ml and less than 20 ng/ml, respectively. Vitamin D can be synthesized in the skin following exposure to UVB in the sunlight. Insufficient sun exposure and inadequate vitamin D dietary intake can lead to vitamin D insufficiency and increase the risk of osteoporosis[10].

A meta-analysis suggested that a low serum vitamin D level is associated with a high prevalence of AR[11,12]. In terms of disease severity, a study showed a significant inverse correlation between serum vitamin D level and AR severity[13]. To date, no study has investigated the correlation between serum vitamin D level and AR severity on symptoms and quality of life using disease-specific questionnaires, particularly on Thai populations in Bangkok metropolitan area. These people are expected to have a low serum vitamin D level because of their urban lifestyle of indoor office working, low sunlight exposure, and high pollution, all of which cause inadequate UVB exposure to the skin that reduces its ability to synthesize vitamin D[14,15]. This research aims to examine this correlation and its possible influence on disease knowledge and treatment strategy in the future. The correlation of serum vitamin D level with specific IgE and total IgE levels is also examined as a secondary outcome. The specific IgE level used for calculation is the highest value for the positive allergen of each person measured by ImmunoCAP™ allergy testing.

METHODS

This cross-sectional study was conducted on AR patients selected via consecutive sampling at the Department of Otolaryngology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand between August 15, 2023 and January 15, 2024. The protocol was approved by the ethic committee of the Faculty of Medicine Vajira Hospital, Navamindradhiraj University (certificate of approval 145/2566). All patients gave their signed and informed consent before being recruited to the study.

The participants were 58 patients with AR aged above 18 years with symptoms diagnosed according to Thai clinical practice guidelines for AR 2022[16]. The sample size calculation for the multivariable analysis was conducted using multiple linear regression analysis. The significance level (α) was set at 0.05, and the power of the test was set at 80%. The researcher determined the effect size for the multivariable analysis by using an effect size (f^2) of 0.35 (large effect size), as recommended by Cohen[17]. The number of predictors was 10. The calculated sample size indicated that 57 participants would be required. All the patients were confirmed to exhibit sensitization via serum-specific IgE testing which include *Dermatophagoides pteronyssinus, Dermatophagoides farina*, cockroach, cat, dog, Bermuda grass, Johnson grass, *Aspergillus fumigatus*, *Cladosporium herbarum* and *Alternaria alternata*. The exclusion criteria were as follows: vitamin D supplementation, irrelevant allergen on allergy test, immunotherapy, systemic steroid or immunosuppressive medication, pregnancy, chronic kidney disease, cancer, history of radiotherapy in head and neck area, sinusitis, and sinonasal tumor.

The following demographic data were recorded: sex, age, education level, marital status, underlying diseases, current medication, and smoking status. Furthermore, the patients were asked to complete the Thai version of Rhinoconjunctivitis Quality of Life questionnaire-36 (RCQ-36)[18] and Sinonasal Outcome Test-22 (SNOT-22)[19] which have validated to evaluate their disease severity and impact on quality of life. Serum vitamin D level and total IgE level were evaluated by blood sampling. Descriptive data were presented as frequency or percentage for qualitative data and mean ± standard deviation or median and interquartile range for quantitative data.

The correlation of serum vitamin D level with the disease-specific questionnaire scores, serum-specific IgE level, and serum total IgE level was calculated using Pearson's correlation coefficient. The correlation was presented in a scatter plot. Multivariable analysis was also conducted to calculate the relationship. In particular, the multiple linear regression model was adopted to control the influence of covariates. The factors associated with vitamin D deficiency were also investigated by univariable and multivariable analyses.

RESULTS

Among the 58 patients with AR, 29 were female (50.00%). Their mean age was 37.10 ± 13.64 years. As shown in Table 1, 58.62% completed primary school education level, 48.28% were married, 15.52% had asthma, and 12.07% were current smokers. With regard to serum vitamin D level, 34 patients (58.62%) with mean age of 37.97 ± 14.39 years exhibited vitamin D insufficiency. The mean serum vitamin D level in all patients was 26.80 ng/mL. In particular, the mean serum vitamin D level was 17.15 ng/mL in the group with vitamin D insufficiency and 40.46 ng/mL in the normal group.

Table 1 Demographic and clinical characteristics of patients by serum 25-hydroxyvitamin D level (25[OH]D) level

Characteristics	All patients (n = 58)	25(OH)D level		P-value
		Low (n = 34)	Normal (n = 24)	
	n (%)	n (%)	n (%)	
Age (years)				
20-39	35 (60.34)	20 (58.82)	15 (62.50)	1.000‡
40-59	17 (29.31)	10 (29.41)	7 (29.16)	
≥ 60	6 (10.34)	4 (11.76)	2 (8.33)	
Male	29 (50.00)	12 (35.29)	17 (70.83)	0.008†
Education				
Primary school	34 (58.62)	21 (61.76)	13 (54.17)	0.446‡
Secondary school	16 (27.59)	10 (29.41)	6 (25.00)	
Bachelor's degree	8 (13.79)	3 (8.82)	5 (20.83)	
Marital status				
Single	26 (44.83)	17 (50.00)	9 (37.50)	0.490‡
Married	28 (48.28)	14 (41.18)	14 (58.33)	
Widowed	4 (6.90)	3 (8.82)	1 (4.17)	
Asthma	9 (15.52)	9 (26.47)	0 (0.00)	0.007‡
Smoking	7 (12.07)	6 (17.65)	1 (4.17)	0.221‡
Medication				
Fluticasone furoate	21 (36.21)	19 (55.88)	12 (50.00)	0.658†
Mometasone furoate	4 (6.90)	3 (8.82)	1 (4.17)	0.635‡
Oral antihistamine	12 (20.69)	7 (20.59)	5 (20.83)	1.000‡

Abbreviation: n, number
†Chi-square test, ‡Fisher's exact test

Total IgE level was 254.03 ± 120.29 and 242.58 ± 119.57 IU/mL in the group with vitamin D insufficiency and the normal group, respectively. No significant difference was observed between these groups (p-value = 0.722). The specific IgE level was 35.91 ± 32.23 and 39.92 ± 46.11 kUA/L in the group with vitamin D insufficiency and the normal group, respectively. No significant difference was found between these groups (p-value = 0.698) (table 2).

For the Thai RCQ-36 questionnaire, the mean score was 68.79 ± 19.00 and 49.08 ± 9.61 points in the group with vitamin D insufficiency and the normal group, respectively. The former had significantly higher mean score (19.17) than the latter (95%CI: 12.08–27.34, p-value < 0.001). For the domains of the questionnaire, the group with vitamin D insufficiency had significantly higher scores in Rhinitis Symptoms, Sleep, Emotion, and Quality of Life domains compared with the normal group as shown in Table 3.

For the Thai SNOT-22 questionnaire, the mean score was 47.76 ± 10.68 and 25.86 ± 5.66 points in the group with vitamin D insufficiency and the normal group, respectively. The former had significantly higher mean score (21.90) than the latter (95%CI: 17.71–26.69, p-value < 0.001). For the domains of the questionnaire, the group with vitamin D insufficiency had significantly higher scores in rhinologic symptoms, psychological dysfunction, and sleep domains compared with the normal group as shown in Table 3.

Table 2 Comparison of total IgE and serum-specific IgE levels between the patients with vitamin D insufficiency and normal patients

Variables	25(OH)D level		P-value
	Low (n = 34)	Normal (n = 24)	
	Median (IQR)	Median (IQR)	
Total IgE (IU/mL)	199 (155-322)	225 (141.5-316)	0.764†
Serum specific IgE (kUA/L)	28.0 (12.1-42.0)	32.1 (13.5-41.0)	0.893†

Abbreviations: IgE, immunoglobulin E; IQR, interquartile range; IU/mL, international unit per milliliter; kUA/L, kilo units of allergen per liter; n, number
†Mann-Whitney U test

Table 3 Comparison of RCQ-36 and SNOT-22 score between the patients with vitamin D insufficiency and normal patients

Variables	25(OH)D level		Mean difference (95%CI)†	P-value
	Low (n = 34)	Normal (n = 24)		
	Mean ± SD	Mean ± SD		
RCQ-36				
Rhinitis symptoms	22.53 ± 6.12	7.33 ± 3.69	15.20 (12.69, 17.71)	< 0.001
Eye symptoms	4.35 ± 4.70	2.04 ± 1.68	2.31 (0.61, 4.02)	0.008
Other symptoms	5.26 ± 5.75	1.92 ± 1.56	3.35 (1.33, 5.37)	0.001
Physical functioning	3.79 ± 3.60	2.13 ± 2.15	1.67 (0.20, 3.14)	0.026
Role limitations	3.47 ± 3.50	2.29 ± 2.79	1.18 (-0.43, 2.79)	0.150
Sleep	3.00 ± 2.80	1.38 ± 1.74	1.63 (0.47, 2.78)	0.006
Social functioning	3.35 ± 2.70	1.67 ± 0.48	1.69 (0.77, 2.61)	< 0.001
Emotions	12.03 ± 4.15	2.33 ± 1.93	9.70 (8.12, 11.28)	< 0.001
Quality of Life	3.74 ± 1.05	1.79 ± 0.72	1.94 (1.49, 2.40)	< 0.001
RCQ-36 total score	57.79 ± 19.00	21.08 ± 9.61	36.71 (29.31, 44.11)	< 0.001
SNOT-22				
Rhinologic symptoms	15.32 ± 6.80	5.46 ± 4.85	9.87 (6.89, 12.84)	< 0.001
Extra-nasal rhinologic symptoms	6.26 ± 2.87	1.88 ± 1.54	4.39 (3.25, 5.53)	< 0.001

Table 3 Comparison of RCQ-36 and SNOT-22 score between the patients with vitamin D insufficiency and normal patients (continued)

Variables	25(OH)D level		Mean difference (95%CI)†	P-value
	Low (n = 34)	Normal (n = 24)		
	Mean ± SD	Mean ± SD		
Ear/facial symptoms	4.76 ± 2.35	2.92 ± 1.06	1.85 (0.96, 2.74)	< 0.001
Phychological dysfunction	18.41 ± 5.18	5.38 ± 3.27	13.04 (10.88, 15.20)	< 0.001
Sleep dysfunction	3.00 ± 2.80	1.38 ± 1.74	1.63 (0.47, 2.78)	0.006
SNOT-22 total score	47.76 ± 10.68	17.00 ± 5.66	30.77 (26.55, 34.98)	< 0.001

Abbreviations: CI, confidence interval; SD, standard deviation; RCQ, rhinoconjunctivitis quality of life questionnaire; SNOT, sinonasal outcome test
†Mean difference (2-sided 95%CI) estimated by Generalized linear model with Gaussian family.

Pearson's correlation coefficient was used to investigate the correlation of serum vitamin D level with AR severity as assessed by the Thai version of RCQ-36 and SNOT-22, total IgE level, and serum-specific IgE level. The results were as follows: serum vitamin D level and Thai RCQ-36 score had a significantly strong negative correlation (r = −0.72, 95%CI: −0.82 to −0.56, p-value < 0.001). Serum vitamin D level and Thai SNOT-22 score had a significantly strong negative correlation (r = −0.80, 95%CI: −0.88 to −0.68, p-value < 0.001). Serum vitamin D level and total IgE level had no correlation with each other (r = 0.04, 95%CI: −0.22 to −0.30, p-value = 0.755). Serum vitamin D level and serum-specific IgE level had no correlation with each other (r = 0.11, 95%CI: −0.16 to −0.36, p-value = 0.424). These results are shown in the scatter plot in Figure 1.

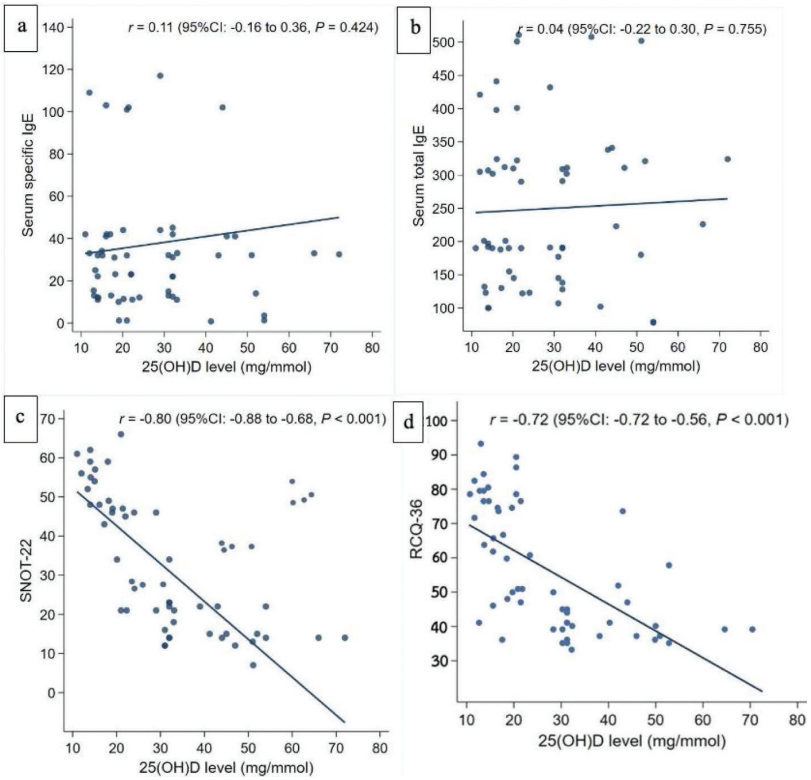

Figure 1 Scatter plot of the relationship between serum vitamin D levels and other variables
Serum vitamin D levels and serum-specific immunoglobulin E (IgE)
Serum vitamin D levels and serum total IgE
Serum vitamin D levels and Sinonasal Outcome Test-22 (SNOT-22) score
Serum vitamin D levels and Rhinoconjunctivitis Quality of Life questionnaire-36 (RCQ-36) score

For the serum-specific IgE results, the allergen that caused the most sensitization was house dust mite (n = 47, 81%), followed by grass pollen. Investigation revealed no significant difference in the number of sensitized allergens between the group with vitamin D insufficiency and the normal group.

For the correlation of serum vitamin D level with AR severity, total IgE level, and serum-specific IgE level, multivariable analysis was conducted using the multiple linear regression method to control the influence of covariates. The results were as follows: Serum vitamin D level and Thai RCQ-36 score had a significant, strong negative linear correlation with a regression coefficient of −0.959 (p-value < 0.001). Serum vitamin D level and Thai SNOT-22 score had a significant, strong negative linear correlation with a regression coefficient of 0.903 (p-value < 0.001). Serum vitamin D level and Total IgE and serum-specific IgE level had no correlation with each other. Details are shown in Table 4.

Univariable and multivariable analyses on the factors associated with vitamin D deficiency showed that only the female sex had a significant association with the high prevalence of vitamin D insufficiency with odds ratio of 4.45 (95%CI: 1.44–13.74, p-value = 0.009) in univariable analysis and 11.97 (95%CI: 2.13–67.22, p-value = 0.005) in multivariable analysis as shown in Table 5.

Table 4 Correlation of serum vitamin D level with allergic rhinitis severity, total IgE level, and serum-specific IgE level

	B	SE(B)	*β*	*t*	P-value†
Total IgE	1.494	1.202	0.184	1.24	0.220
Serum-specific IgE	0.481	0.386	0.184	1.25	0.218
RCQ-36 score	-0.959	0.175	-0.583	-5.49	< 0.001
SNOT-22 score	-0.903	0.108	-0.748	-8.37	< 0.001

Abbreviations: B, regression coefficient; IgE, immunoglobulin E; RCQ, rhinoconjunctivitis quality of life questionnaire; SE(B), standard error of B; SNOT, sinonasal outcome test; β, standardized regression coefficient; *t*, t-value
†Multiple linear regression model adjusted for age, sex, asthma, smoking and medication.

Table 5 Univariable and multivariable analyses of the factors associated with vitamin D deficiency

Factors	Univariable analysis		Multivariable analysis	
	Crude OR (95%CI)†	P-value	Adjusted OR (95%CI)‡	P-value
Age (years)				
20-39	1.00 Reference			
40-59	1.07 (0.33-3.47)	0.908		
≥ 60	1.50 (0.24-9.30)	0.663		
Sex				
Male	1.00 Reference		1.00 Reference	
Female	4.45 (1.44-13.74)	0.009	6.65 (1.83-24.13)	0.004
Education				
Primary school	1.00 Reference		1.00 Reference	
Secondary school	1.03 (0.30-3.52)	0.960	1.76 (0.41-7.46)	0.445
Bachelor's degree	0.37 (0.08-1.82)	0.222	0.43 (0.07-2.59)	0.360
Marital status				
Single	1.00 Reference			
Married	0.53 (0.18-1.58)	0.255		
Widowed	1.59 (0.14-17.56)	0.706		

Table 5 Univariable and multivariable analyses of the factors associated with vitamin D deficiency (continued)

Factors	Univariable analysis		Multivariable analysis	
	Crude OR (95%CI)†	P-value	Adjusted OR (95%CI)‡	P-value
Smoking	4.93 (0.55-43.94)	0.153	10.79 (0.99-117.65)	0.051
Medication				
Fluticasone furoate	1.27 (0.44-3.61)	0.658		
Mometasone furoate	2.23 (0.22-22.8)	0.500		
Oral antihistamine	0.99 (0.27-3.58)	0.982		

Abbreviations: CI, confidence interval; NA, data not applicable; OR, odds ratio
†Crude odds ratio estimated by logistic regression model.
‡Adjusted odds ratio estimated by multiple logistic regression model adjusting for sex, education and marital status.

DISCUSSION

This study showed that Serum vitamin D level and AR severity have a significant, strong negative linear correlation. Vitamin D contributes to the immune response, both adaptive and innate. It has immunomodulatory effects on allergen-induced inflammatory pathways, suppresses Th1 and Th2 immune responses, decreases proinflammatory cytokines, and increases regulatory T cells[9]. Hence, vitamin D should have a role in the immunologic response to AR severity.

In this study, we found that 34 out of 58 patients with AR had vitamin D insufficiency, and most of them are female. Univariable and multivariable analysis revealed that the female sex had a significant association with the high prevalence of vitamin D insufficiency. Similarly, Nimitphong et al.[20] reported that females have threefold higher prevalence of vitamin D insufficiency than males. This phenomenon may be attributed to the social preference in Thailand where females want to have a light skin color so they tend to avoid outdoor activity, have less sunlight exposure time than males, and routinely apply sunscreen, causing inadequate UVB exposure that results in low vitamin D synthesis in the skin.

Although Thailand is located near the equator with equal hours of sunlight throughout the country[10], the prevalence of vitamin D insufficiency is still high among the Thai population. Siwamogsatham et al.[15] addressed that lifestyle and environmental factors have the major influence on the vitamin D status in the Thai population. For people living in urban areas such as Bangkok, pollution decreases UVB exposure, which is crucial for vitamin D synthesis in the skin. Less sunlight exposure time due to their indoor lifestyle also leads to vitamin D insufficiency. Moreover, Thai dairy products are not fortified with vitamin D, so the vitamin D dietary intake of the Thai population is quite low[15].

In our study, we found that serum vitamin D level had significant, strong negative correlations with Thai RCQ-36 and Thai SNOT-22 scores. Awan et al.[21] reported that low serum vitamin D level is associated with the increased severity of AR symptoms. They found that the mean serum vitamin D level was significantly lower in the moderate-to-severe AR symptom group than in the mild symptom group in accordance with ARIA-WHO classification. The patients with vitamin D deficiency were 24 times more likely to have moderate-to-severe AR. Similar results were also reported by Sudiro et al.[13] who found that vitamin D deficiency was significantly correlated with AR severity based on ARIA-WHO classification, with the coefficient of −0.321 ($p = 0.005$) calculated using the Rank–Spearman correlation test.

For the secondary outcome, we found that serum vitamin D level had no correlation with total IgE and serum-specific IgE levels. International consensus statement on allergy and rhinology: AR-2023 and Thai clinical practice guideline for AR 2022 do not support the routine

use of total IgE for AR. The total IgE level can either be elevated or low IgE in allergic diseases[1,16]. It may also be associated with disease severity. Awan et al.[21] found that the mean serum total IgE level in the moderate-to-severe AR group was significantly higher than that in the mild symptom group. By contrast, Alnori et al.[22] found a statistically significant negative correlation between serum total IgE level and serum vitamin D level in patients with AR with coefficient of −0.3643 ($p < 0.05$) calculated with Pearson correlation test. This value is considered as weak negative correlation. Further investigation of this correlation must be conducted.

In our study, the allergen that caused the most sensitization was house dust mite, followed by grass pollens, pet dander, insects, and fungi. This finding was in line with a previous report in Thailand stating that house dust mite was the most sensitized allergen for the Thai population[23].

The strength of this research is that it is the first to investigate the correlation between serum vitamin D levels and AR severity using disease-specific questionnaires, and the results show a significant inverse correlation. The assessment of vitamin D levels in patients with severe AR is especially useful in females to detect and treat vitamin D deficiency. The limitation of this research is that it does not account for all confounding factors, such as participants' dietary habits, sunscreen usage, and sun exposure time, which may affect vitamin D synthesis. Additionally, this research is a cross-sectional study, so it may not show dynamic changes in serum vitamin D levels and AR severity over time. Further research with longitudinal data and larger populations may provide more information about this correlation and the role of vitamin D supplementation in the treatment of AR.

CONCLUSION

Serum vitamin D level and AR severity have a significant, strong negative linear correlation with the Thai version of RCQ-36 and SNOT-22. Most patients with AR and vitamin D insufficiency are female due to their indoor lifestyle. Assessment of vitamin D level in patients with severe AR symptoms is useful especially in female.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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DATA AVAILABILITY STATEMENT

All the data generated and analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

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Original Article

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Prevalence of 2-Year Breastfeeding among Thai Mothers and Associated Factors of Achievement

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ABSTRACT

OBJECTIVE: To assess 2-year breastfeeding (BF) rate and factors for the achievement of 2-year BF.

METHODS: This cross-sectional study was conducted between June 27 and December 11, 2023 by an electronic online questionnaire. Thai mothers with babies aged more than 2 years who registered on Facebook page of one author and could recall their infant's 2-year feeding pattern were included in the study. Participating mothers completed a questionnaire covering personal data, history of BF pattern of previous and current child, and knowledge and attitude toward BF. The rate of 2-year BF and factors for the achievement were analyzed by univariate and multivariate analyses.

RESULTS: The included mothers had a mean age of 36.2 ± 4.7 years, and 94.1% reported BF for at least 2 years. Among favorable features, only four exhibited a significant association with 2-year BF according to the univariate analysis: age > 36 years (odds ratio (OR) 3.07, 95% confidence interval (CI) 1.90-4.95, p-value < 0.001), being self-employed or working from home (OR: 2.60, 95% CI 1.64-4.10, p-value < 0.001), used contraception within 2 years postpartum (OR: 2.07, 95% CI 1.08-3.97, p-value = 0.025), and good history of 2-year BF in their previous child (OR: 4.71, 95% CI 1.96-11.28, p-value < 0.001). Multivariate analysis revealed that only the mothers with a history of 2-year BF in their previous child was the only independent feature associated with their current 2-year BF (adjusted OR: 5.25, 95% CI 1.61-17.07, p-value = 0.006).

CONCLUSION: The results of this study revealed a high rate of 2-year BF among the studied mothers. The only independent factor for a 2-year BF was a mother's history of 2-year BF with their previous child.

KEYWORDS: attitude, breastfeeding, history of breastfeeding, knowledge

INTRODUCTION

In 2019, the World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF), recommended nourishing infants with breast milk alone, that is, without any other food or liquid, during the first 6 months, or "exclusive breastfeeding"[1]. In 2021, the WHO also recommended that breastfeeding (BF) be continued along with complementary food for up to 2 years of age or beyond[2].

BF offers several benefits to children and mothers[3]. An exclusive BF (EBF) and proper nutrition during the first 2 years of life of children can improve their growth and development, boost intelligence, increase the likelihood of attained higher education and income during adulthood, and lower the risk of obesity and diabetes mellitus.

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In addition, breast milk contains immune components that reduce the risk of infection, which makes it an excellent nutrient source. The benefits of long-term BF to mothers have led to a decreased incidence of numerous diseases, e.g., ovarian and breast cancers, type II diabetes, etc.

According to the Global Breastfeeding Collective group, at least 60% of children should be continually breastfed until 2 years of age by 2030[4]. However, a systematic review and meta-analysis of data from 11 studies in 2013 indicated that the prevalence of 2-year BF of age or beyond reached only 33%[5]. A longitudinal study from China revealed the declined rate of 2-year BF in low-middle-income countries from 56.2% in 2010–2018 to 45% in 2023[6].

Thailand has been established a national BF promotion scheme in for several decades through the Baby-Friendly Hospital Initiative program (WHO Baby-Friendly Hospital Initiative 2020). According to UNICEF, 29% of mothers in Thailand exclusively breastfeed their babies in the first 6 months of life; this value is exceedingly below the Global Nutrition Target of 50% exclusive BF by 2025[7]. The low rate of exclusive BF in the country led to a low rate of 2-year BF. This outcome was evidenced in a study in Thailand showcasing that 9.9% of mothers can extend BF between 18–24 months[8].

Several factors certainly influence BF practice. Such factors include national policies, economic status, cultural norms, lifestyles, and support from family members and healthcare providers. In Thailand, specific characteristics of mothers and their families, e.g., work, financial status, educational background, cultural beliefs, knowledge, attitude, attention, etc., may also influence the accomplishment of such goal[9].

The medical staff's practice in each hospital or area also determines the success of BF program. Our hospital adheres rigorously to the "WHO Ten Steps to Successful Breastfeeding." Notably, mothers having service in the Pediatrics Department have exhibited a high rate of exclusive BF. Although most mothers who brought their babies for a follow-up visit in our hospital were still BF until 2 years, we wanted to expand the assessment of the 2-year BF rate to a broader population. This study aimed to assess the rate of 2-year BF, personal characteristics and features of mothers, and factors determining the success or failure of 2-year BF.

METHODS

This cross-sectional survey project received approval from the Institutional Review Board (COA 002/2022) of the hospital on March 30, 2022. The inclusion criteria were Thai mothers with babies aged more than 2 years and can recall their infant's 2-year feeding pattern. A solicit document regarding the study objectives and inclusion criteria was posted on the Facebook page of the first author (S.U.; https://www.facebook.com/SuthiRaXeuxPhirocnKic). Those who were interested in participating in this work registered and provided their electronic mail addresses and/or phone numbers. The research assistants verified the age of the mothers' current child and sent questionnaires to those who qualified in the inclusion criteria via electronic mail from June 27th to December 11th, 2023. Data retrieval was performed in January 2024. Mothers who did not confirm, had incomplete information regarding the duration of BF, or did not respond to the e-mail were excluded from the study.

The questionnaire comprised four parts: Part 1, personal and obstetrical data; Part 2, BF pattern; Part 3, knowledge comprising 15 statements on BF, breast milk, and formula milk requiring an answer of "correct," "incorrect," or "not sure"; Part 4, attitude toward BF consisting of 10 statements on BF that require the following responses: strongly disagree (score 1), disagree (score 2), neutral (score 3), agree (score 4), and strongly agree (score 5). Prior to the conduct of the study, the Thai version of the questionnaire on knowledge and attitude was deliberated over, discussed, and revised until consensus among the researchers was reached. The final set of

questionnaires was validated by three experts in the fields not involved in the study (one obstetrician and two pediatricians) and tested for reliability using 30 mothers having the same characteristics as the participants. The reliability of Cronbach's alpha coefficient was analyzed. The knowledge and attitude questionnaires had reliability of 0.819 and 0.907, respectively.

The following personal and obstetrical data were collected: age, marital status, parity, education, occupation, workplace, duration of daily work (hours), monthly family income, route of delivery of the current child, gestational age, maternity leave, and BF pattern within 6 months and 2 years after delivery of the previous (if any) and current children, and the time after delivery when they stopped BF their current child. Problems related to BF of the current child were also collated. EBF was defined if the mother had provided only BF, without any other food or liquid, up to 6 months[1]. 2-year BF was defined when the mother had provided breast milk to their children up to 2 years regardless of the frequency[2].

Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 28.0 (IBM Corporation, Armonk, NY, USA). Continuous variables are presented as mean ± standard deviation for normally distributed data, or else with median and interquartile range (IQR), and categorical variables as frequency and percentage. The knowledge and attitude questionnaires had total scores of 15 and 50, respectively.

Comparison involved grouping the data as follows: marital status (married or single/ divorced); parity (primiparous or multiparous); education (lower than bachelor's or bachelor's degree/ higher); occupation (no occupation/ housewife or employee/business); monthly family income as ≥ or < 2,700 USD (average familial monthly income in Thailand)[10]; workplace (work from home or office work); duration (daily work as ≤ 8 hours or longer); BF of current child (EBF for ≥ 6 months or sooner or BF until/ after 2 years or sooner); history of 2-year BF (good if all prior children had continued BF until 2 years; poor if all prior children had not achieved 2-year BF; and mixed if the achievement was not consistent for each child); knowledge and attitude on BF (≥ 80% or lower score) for each aspect based on Bloom's cutoff point[11]. A score ≥ 80% indicates good knowledge or good attitude.

Chi-square or Fisher Exact Test was performed for data comparison as appropriate. Univariate analysis was conducted to determine factors that showed association with the successful achievement or failure of 2-year BF. Factors that presented statistical significance in the univariable analysis were subjected to multivariable analysis. A p-value < 0.05 was considered statistically significant.

RESULTS

Among 3,572 mothers who registered on the Facebook page, 61 mothers with babies younger than 2 years and 1,929 who were unreachable for information verification were excluded. Analyses included data from 1,582 respondents who met the inclusion criteria.

Table 1 provides the basic characteristics of the respondents, whose mean age was 36.2 ± 4.7 years. The majority were married (95.9%), and nearly two-thirds had only 1 child (64%). The median age of a current child was 31 months (IQR 24, 42 months). Almost all participants reported having a bachelor's degree or higher (93.7%), and approximately half were employees or receive a monthly family income < 2,700 USD (56.2%). Approximately half of the participants self-employed or working from home (50.1%), and slightly over two-thirds work for ≤ 8 hours per day (68.9%). A total of 59.7% of the mothers used barrier contraception methods within 2 years postpartum, followed by those who used hormones (22.1%) and those who did not use contraception (18.2%).

Table 1 Characteristic features and details of pregnancy (n = 1,582)

Features	n	%
Age group		
≤ 36 years	642	40.6
> 36 years	636	40.2
NA	304	19.2
Marital status		
Married	1,517	95.9
Divorced/Separated	65	4.1
Parity		
Primipara	1,013	64.0
Multipara	569	36.0
Education		
Bachelor's degree or higher	1,483	93.7
Lower than bachelor's degree	99	6.3
Monthly family income, USD*		
≥ 2,700 USD	693	43.8
< 2,700 USD	889	56.2
Workplace		
Self-employed/ housework	793	50.1
Employee	789	49.9
Daily work hours		
> 8 hours	328	20.7
≤ 8 hours	1,089	68.9
NA	165	10.4
Contraception within 2 years postpartum**		
No contraception	303	18.2
Barrier	991	59.7
Hormonal	366	22.1

Abbreviations: n, number; NA, not available; USD, United States dollar
* Average Thai monthly family income 2023 was 2,700 USD (https://www.timechamp.io/blogs/what-is-the-average-salary-in-thailand-and-trend-analysis/).
** One mother may use one or more contraception.

Table 2 reveals the history and BF patterns of the mothers in relation to their previous and current children and the issues associated with the BF of the current child. Excluding primiparous respondents, among 516 mothers, 59.1% showed a good history of BF of their previous child for at least 2 years, 6.2% reported mixed findings, and 34.7% indicated poor results. For the current child, 94.8% had achieved EBF, whereas 5.2% had no BF at all or had mixed breast milk with other food within 6 months after birth. A total of 94.1% reported BF for at least 2 years, with a median duration equal to 31 months (IQR: 25 and 40 months). On the other hand, 5.9% of those who stopped BF prior to 2 years achieved a median stopping time of 14 months (IQR: 12 and 17 months). In our study, slightly more than half of the respondents reported one or more challenges related to BF of the current child, including maternal factors (61.9%), child's health (27.1%), and other reasons (11%).

Table 2 Pattern of breastfeeding of the mother

Breastfeeding and related problems	n	%
History of 2-year breastfeeding in previous child[a] (n = 516)		
Good	305	59.1
Mixed	32	6.2
Poor	179	34.7
Current breastfeeding pattern (n = 1,582)		
Exclusive breastfeeding to 6 months		
No	82	5.2
Yes	1,500	94.8
Breastfeeding ≥ 2 years		
No	93	5.9
Yes	1,489	94.1
Problem related to breastfeeding		
None	749	47.3
Yes[b]	833	52.7
Maternal factor[c]	741	61.9
Infant/child factor[d]	325	27.1
Others[e]	132	11.0

a. History of 2-year BF in previous child was defined as good if all prior children had continued BF until 2 years; poor if all prior children had not achieved 2-year BF; and mixed if the achievement was not consistent for each child.
b. The 833 mothers who had problems related to BF may have one or more problems.
c. Maternal factors included: breast tenderness/ lump/ mastitis (n = 914), cracked nipple (n = 354), fatigue (n = 263), inadequate breastmilk (n = 151), postpartum depression (n = 7), taking medication for medical problems (n = 10), and pregnancy (n = 106).
d. Infant/ child factor included: poor weight gain (n = 162), health problem (n = 238).
e. Others included: separated from baby (n = 24), no assistance/ support (n = 113).

The mothers were also assessed for their knowledge and attitudes regarding BF. All respondents had a mean knowledge score of 12.9 ± 1.4, with food knowledge observed in 87% of the participants. In regard to attitudes, the respondents had a mean score of 47.3 ± 3.4, with 57.3% exhibited good attitudes.

Investigations were also performed on the association among the characteristics of mothers, history of 2-year BF in previous child, history of EBF in current child, knowledge, and attitudes (table 3). Univariate analysis revealed the significant features associated with 2-year BF achievement compared with those of other groups: age > 36 years (51.6% vs 48.4%: odds ratio (OR) 3.07, p-value < 0.001), self-employed or working from home (51.4% vs 48.6%: OR 2.60, p-value < 0.001), used contraception within 2 years postpartum (75.4% vs 24.6%: OR 2.07, p-value = 0.025), and had good history of 2-year BF of their previous child (61.1% vs 32.4%: OR 4.71, p-value < 0.001). Although certain mothers who were married, primiparous, had bachelor's degree education or higher, earning < 2,930 USD monthly family income, had ≤ 8 hours daily work hours, and had knowledge or attitudes ≥ 80% of total scores had higher rates of 2-year BF than the other comparative groups, the differences showed no statistical significance. One contradictory finding in our study was that the mothers who experienced no problems related to BF attained a lower achievement in 2-year BF. We explored and discovered the favorable features of this group of mothers, including higher education or good knowledge and attitudes (data not shown). Multivariable analysis unveiled that only the mothers with history of 2-year BF of their previous child accounted for the only independent feature associated with 2-year BF (adjusted OR 5.25, p-value = 0.006).

Table 3 Features associated with 2-year breastfeeding patterns

Feature Column	n	Achieved 2-year breastfeeding, n (%)		[c]OR (95% CI)	P-value	[a]OR (95% CI)	P-value
Age, mean (year) (n = 1,278)							
> 36	636	612	(51.6)	3.07 (1.90-4.95)	< 0.001	1.66 (0.60-4.61)	0.328
≤ 36	642	573	(48.4)				
Marital status (n = 1,582)							
Married	1,517	1,428	(95.9)	1.05 (0.37-2.96)	0.790	-	
Divorced/separated	65	61	(4.1)				
Parity (n = 1,582)							
Primipara	1,013	952	(63.9)	1.08 (0.69-1.67)	0.747	-	
Multipara	569	537	(36.1)				
Education (n = 1,582)							
Higher or bachelor	1,483	1,397	(93.8)	1.24 (0.56-2.747)	0.603	-	
< Bachelor's degree	99	92	(6.2)				
Work (n = 1,582)							
Self-employed/ housework	793	766	(51.4)	2.60 (1.64-4.10)	< 0.001	1.99 (0.73-5.45)	0.178
Employee	789	723	(48.6)				
Monthly family income, USD (n = 1,582)							
< 2,700 USD	889	832	(55.9)	1.25 (0.81-1.92)	0.307	-	
≥ 2,700 USD	693	657	(44.1)				
Daily work hours (n = 1,417)							
≤ 8 hours	1,089	1,025	(77.2)	1.38 (0.86-2.21)	0.182	-	
> 8 hours	328	302	(22.8)				
Problem related to breastfeeding (n = 1,582)							
None	749	709	(47.6)	1.20 (0.79-1.84)	0.388	-	
Yes	833	780	(52.4)				
Contraception within 2 years postpartum (n = 1,269)							
Yes	966	896	(75.4)	2.07 (1.08-3.97)	0.025	1.35 (0.27-6.59)	0.715
No	303	292	(24.6)				
History of 2-year breastfeeding in previous child (n = 516)							
Good history	305	298	(61.1)	4.71 (1.96-11.28)	< 0.001	5.25 (1.61-17.07)	0.006
Mixed/ poor history	211	190	(32.4)				
Exclusive breastfeeding to 6 months (n = 1,582)							
Yes	1,500	1,416	(95.1)	2.08 (1.01-4.30)	0.053	-	
No	82	73	(4.9)				
Knowledge score (n = 1,582)							
≥ 80%	1,370	1,295	(87.0)	1.60 (0.93-2.73)	0.082	-	
< 80%	212	194	(13.0)				
Attitude score (n = 1,582)							
≥ 80%	905	853	(57.3)	1.06 (0.69-1.61)	0.795	-	
< 80%	677	636	(42.7)				

Abbreviations: CI, confidence interval; n, number; [a]OR, adjusted odds ratio; [c]OR, crude odds ratio; USD, United States dollar

DISCUSSION

Our study revealed that the prevalence of BF for at least 2 years was 94.1%. This value was considerably higher than 7.5% to 20.9% prevalence reported by four previous studies from Asia, South America, and Australia continents[12-15] and 33% from a recent systematic review[5].

The high rate of 2-year BF in our study can be attributed to a few possible reasons. Such finding can be attributed to the membership of all participants of this study in a fan page called "Breastfeeding Facebook" of the author (S.U.). Mothers should extend additional attention to the health of their children or have received knowledge from this platform, influencing their behavior of BF. In addition, Thai mothers who participated were also found in prior reports showing that mothers in Asian countries were more likely to breastfeed their child up to 24 months[5,15] than those with white skin[13]. Notably, this finding may be attributed to differences in cultural backgrounds.

We also explored and discovered favorable features associated with 2-year BF (table 3). The four features that presented significantly better achievement than the other groups comprised age > 36 years, being self-employed or working from home, contraception use, and a good history of 2-year BF of the previous child, which was the only independent favorable feature.

Old age as a favorable feature agreed with the finding of Santana et al., who observed from their systematic review that old age achieved the highest percentages of associations with BF for 12 months or longer[16]. Other authors proposed the great emotional stability of old-age mothers, which allows them to deal with any peri- and postpartum period, in contrast to younger-age mothers who frequently experienced postpartum depression that resulted in the immediate discontinuation of BF[17]. By contrast, other research indicate that older mothers had discontinued BF before 12 months[18] or after 2 years[14] due to high positions at work, additional work pressure, and great social responsibility[14].

For the positive influence of being self-employed or working from home, previous studies reported that being a full-time mother/freelancer/working from home/1-year leave from work positively influenced the 2-year BF[13-15]. These women should be more available for childcare and BF rather than those who work outside their homes as an employee, which can interrupt BF[14]. Others also discovered that mothers with daytime work can continue BF for at least 12 months[18]. We also observed that short daily working hours (≤ 8 hours) was a favorable factor although not statistically significant.

Contraception use within 2 years postpartum was also a significant favorable factor in our study. No prior research examined the effect of contraceptive use and 2-year BF. We proposed that these mothers who temporarily (any means of barrier or hormone) or permanently (by tubal sterilization) refused to have another child intended to provide full care to their child.

The last feature, which had a significant effect on 2-year BF and was the only independent favorable factor in our study, was reported a good history of 2-year BF of the previous child. We can identify one previous study which, although had a shorter period of assessment, also reported that previous experience of BF for at least 12 months was associated with prolonged BF to > 12 months for the current child[18]. This finding can be explained as a pleasurable experience in prolonged BF of previous child that can lead to the same pattern of BF.

Despite the lack of a significant association with 2-year BF and some features demonstrated in our study, they merited a description and were compared with previous reports. Some were consistently reported in other studies: being married[16] or with support from family members[14], exclusive BF of the baby until 4 months or 6 months old[13-14], higher education[14-16,19], and good knowledge and/ or attitude about BF[14,20-21].

The plausible reasons were married mothers receive support in childcare, good experience from exclusive BF leading to more confidence, or having good knowledge/attitudes about breast milk should drive them to achieving a positive performance.

Nevertheless, a few other favorable features in our study had been inconsistently reported in previous research. These features include lower income[13,16], which was in contrast with others who observed better results in mothers with higher income[14]. The actual reasons for the association of high or low income and achievement are unknown. However, possible reasons for these 2 contradictory findings may be due to less work requirements with more available time leading to more dedication to BF in high income mothers whereas mothers with lower family incomes are possibly concerned regarding the cost of formula milk. In contrast to previous studies which found multiparity as a favorable feature by some authors[15-16,19], we found primiparity to be more favorable. Again, the actual reason cannot be explained, and thus, we proposed that the mothers having their first child should show enthusiasm in childcare and raising.

One contradictory finding in our study was to the mothers with problems related to BF tended to present better achievement with the 2-year BF. This may be due to the mothers in this study having high education as was described by some authors that highly knowledgeable mothers may possess management skills vital to improving their BF, especially in the presence of obstacles or problems[22].

We recognized some limitations encountered in our study. First, the high rate of 2-year BF in our study may not represent data of general Thai mothers because the participants were the Fan page members of one of the authors who is a pioneer supporting BF in our country. Second, all data were obtained from the participating mothers themselves and could not be verified except the age of their child which were re-queried for confirmation. Third, the questionnaire did not include detailed features or actual reasons for continuation of BF until or beyond 2 years or stopping prior to that. Fourth, a recall bias especially in remote past (advanced age of the child) might be one factor which affected the actual duration the women had breastfed their children. Finally, some of the features assessed possibly interacted with or influenced each other. These composite factors might have resulted in the variations in the effect of features obtained across studies.

Nevertheless, this study presented some strengths. This work is the first in Thailand to address the rate of 2-year BF among Thai mothers. Several possible influencing factors were also determined. Most findings were consistent with those of previous studies should be data on the BF situation of this group of Thai mothers.

CONCLUSION

Good practice of BF was achieved, and either a good history in BF of the previous child or exclusive BF of the current child had a high chance of success of 2-year BF. Emphasis of the favorable and unfavorable features demonstrated in our study will encourage or support mothers to attain a good practice of 2-year BF. Further study for the exploration and focus on each of these factors in detail will enable its implementation in clinical practice.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

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DATA AVAILABILITY STATEMENT

Please contact the corresponding author for data availability.

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Original Article

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The Prevalence of Postpartum Contraception Use among Teenage Mothers at Vajira Hospital, Thailand

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ABSTRACT

OBJECTIVES: To determine the prevalence of postpartum contraception use among teenage mothers and to identify the factors influencing both postpartum contraception use and loss to postpartum follow-up at the Faculty of Medicine Vajira Hospital in Thailand.

METHODS: Four hundred and seventy-five participants were randomly selected from 1,060 Thai teenage pregnant that gave birth at the Faculty of Medicine Vajira Hospital between 1 January 2017 and 31 December 2020 and were scheduled postpartum visits. The clinical factors associated with postpartum contraception use and loss to postpartum follow-up were studied using multiple logistic regression analysis.

RESULTS: A total of 451 participants remained after excluding criteria. Of these, 212 participants did not follow-up on their postpartum visits, leaving the limitation to summarize the true prevalence of postpartum contraception use of the total population. However, of the 232 participants who visited postpartum follow-ups, the prevalence of contraceptive use was 95.8%. Married status was the only factor associated with higher postpartum contraceptive use (odds ratio (OR) 12.81 [3.38-48.64]). Age 18 years and older (OR_{adj}1.71 [1.16-2.53]), absence of previous contraceptive use (OR_{adj}1.91 [1.29-2.80]), and total antenatal care visits fewer than 8 (OR_{adj} 1.61 [1.07-2.42]) were significantly related with loss to postpartum follow-ups.

CONCLUSION: The prevalence of contraceptive use was high among teenage mothers who had follow-up postpartum visits. However, this population also had a high loss rate of postpartum visits. Interventions and close monitoring should be considered to evaluated further for effective adolescent reproductive services.

KEYWORDS: contraception use, determinants, postpartum, teenage mother, Thailand

INTRODUCTION

Teenage pregnancy has been a public concern globally, which not only affects health systems but is also associated with adverse socioeconomic and psychological consequences, including social stigma, leading to emotional distress, depression, and limited educational and career opportunities[1-4]. Approximately 21 million girls aged 15-19 years in developing regions become pregnant every year, and about 12 million of them give birth[5,6]. Globally, the adolescent birth rate (ABR) has decreased from 64.5 births per 1,000 women (15-19 years) in 2000 to 41.3 births per 1,000 women in 2023[7]. Unfortunately,

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these rates are inconsistent in different regions, with the sharpest decline in Southern Asia and slower declines in the Latin American and Caribbean (LAC) and Sub-Saharan Africa (SSA) regions, and still show the highest incidence at 99.4 and 52.1 births per 1,000 women among SSA and LAC areas, respectively, in 2022[7]. While the estimated global ABR has declined, the actual number of childbirths to adolescents remains high, with the most significant number of estimated births to 15-19-year-olds in 2021 in SSA (6,114,000), while far fewer births occurred in Central Asia (68,000)[7]. In Thailand, the ABR is highest among young mothers aged 15-19 years, especially those aged 18-19, which is in the legal range of marriage. The number of births to adolescents has increased steadily from 2004 and reached the highest peak in 2011, then decreased from 2011 to 2022, from 1.8 births per 1,000 adolescents (15-19 years) in 2012 to 0.8 births per 1,000 women in 2022. Over the period between 2015 and 2022, repeat birth rates among 10 to 19 year-old declined from 12.4 to 7.5%[8].

In Thailand, the antenatal and postpartum care practices are based on the clinical practice guidelines of the Royal Thai College of Obstetricians and Gynecologists [9,10], which generally follow the recommendations of the world expert panels, such as the World Health Organization[9,11] and the American College of Obstetricians and Gynecologists[9,12]. A postpartum visit, which is typically scheduled between 4 and 6 weeks after delivery in Thailand, is therefore essential for these girls to educate them and to promote healthy postpartum behaviors[9]. Despite recognizing its importance, nursing mothers often disregard postpartum visits. Data have suggested that the rates of postpartum visits vary substantially, ranging from 29 to 90%[9].

According to the information above, pregnancy in adolescents leads to various complications for both young mothers and their children. These include preterm birth, low birth weight, developmental and behavioral issues in adolescents, and the requirement for continuous care[13,14].

According to review data from Ghana in 2008, overall contraceptive prevalence among teens was 18.3% and the study found the likelihood of contraceptive use among female adolescents increased significantly with the increase in level of education, working, known ovulation cycle, married or living together, and those that visited a health facility[15]. In the United States, among teens with a recent live birth in 2013, 82.8% reported postpartum contraceptive utilization, with the most effective, moderately effective, and least effective methods reported as 26.9, 40.2, and 15.7%, respectively[16]. In Eastern Uganda, a cross-sectional study in 2020 reported that 61.5% of the respondents were using contraceptives, and more than three-fourths of the respondents opted for short-term methods of contraception[17]. In the adjusted analyses, intention to resume school and the utilization of maternal child health services such as postnatal care services were significantly associated with the utilization of postpartum contraception[17]. In a cross-sectional study from Faridabad in 2023, educational status played a pivotal role in the awareness, acceptance, and usage of contraception[18]. Similarly, socioeconomic status also correlated with postpartum contraceptive acceptance with 42.3% of contraception users belonging to lower socioeconomic status compared to 88.6% in the non-users group[18]. Among the contraception users, 70% had four or more antenatal visits compared to 7.9% of the non-users[18]. According to data from the Faculty of Medicine at Vajira Hospital in Bangkok, Thailand, 86.2% of the follow-up group were using contraceptives. The most commonly chosen contraceptive method was long-acting reversible contraception (LARC) (46.3%) and Depot Medroxyprogesterone Acetate (DMPA) (26.4 %). Only 13.7% did not use any contraceptive method. However, in this study, there was no review of the factors associated with postpartum contraception use[9].

Therefore, knowing the prevalence of contraception use in teenage mothers and the factors influencing both postpartum contraception use and loss to postpartum follow-ups in this

group are important for promoting contraception use in teenage mothers and for reducing the risk of health problems in mothers and children.

METHODS

A cross-sectional study was designed to determine the prevalence of postpartum contraception use among teenage mothers aged 10 to 19 visiting the Faculty of Medicine Vajira Hospital. The secondary outcome was to identify the relevant factors influencing postpartum contraception use among teenage mothers and the factors associated with loss to follow-up on the postpartum family planning appointment at the Faculty of Medicine Vajira Hospital. The study population, based on the formula for estimating an infinite population proportion, adjusted from the prevalence of adolescents using any methods of contraception during the postpartum period, according to Haider et al., 2018[19,20], resulting at 378. Regarding to incomplete data (non-response rate)[21], the study population was adjusted with an additional 20%, giving the final sample number of 473. All Thai teenage pregnancies, aged between 10 years and 19 years, 11 months and 29 days at the time of delivery, who gave viable birth at the Faculty of Medicine Vajira Hospital between 1 January 2017 and 31 December 2020 and had been scheduled for postpartum follow-up were enrolled, with a total number of 1,060 participants. The data were simply randomly selected for a total of 475 cases using the Microsoft Excel program. Six-week postpartum follow-up was the standard care for every woman gave birth at Vajira Hospital. There was no routine offer of LARC prior to discharge from the hospital during our study period due to the limitation of Medicaid insurance. Young mothers with conditions limit contraceptive use during the 6-week postpartum follow-up such as severe postpartum complications, postpartum hemorrhages, admission to the intensive care unit (ICU), medical conditions or contraindications to contraceptives such as blood clot disorders, anaphylaxis, uncontrollable hypertension, undiagnosed abnormal vaginal bleeding, endometrial cancer, or missing medical records were excluded.

The demographic, clinical data, and the outcomes of postpartum contraception use and follow-up postpartum visits were reviewed from the outpatient department's electronic medical records. If the data were incomplete, information was sought from the inpatient department charts. If no data were found from either source, the participant was excluded from the research. The selected study variables included age, education, occupation, underlying disease, sexually transmitted infection, insurance, marital status, previous contraception use, substance use, parity, gestational age (GA) at the first antenatal care (ANC), number of ANC visits, and GA at delivery. All of the data were analyzed using IBM SPSS statistics for Windows, version 28.0 Armonk, NY, USA: IBM Corp., and were statistically significant at the level of 0.05. The prevalence of postpartum contraceptive use in teenage mothers was reported with frequency and percentage. Analysis of the factors associated with postpartum contraceptive services among the teenage mothers and the factors associated with non-attendance at family planning services were Crude analysis, Chi-squared test or Fisher's Exact test based on data suitability and multivariate logistic regression reported with odds ratio and a 95% confidence interval. Ethical approval was obtained from the Vajira Hospital Navamindradhiraj University Research Ethic Committee (COA 029/2565).

RESULTS

Of the 475 Thai pregnant teenage that gave birth during the study period, 24 were excluded due to severe postpartum complications such as postpartum hemorrhages (n = 8), admission to the ICU (n = 1), termination of pregnancy due to fetal abnormalities (n = 7), and incomplete or missing data collection (n = 8), leaving a total of 451 participants (figure 1). The majority of the women were in the age group 18 to 19, had Medicaid insurance, attained junior high school, were unemployed, and married, as shown in Table 1.

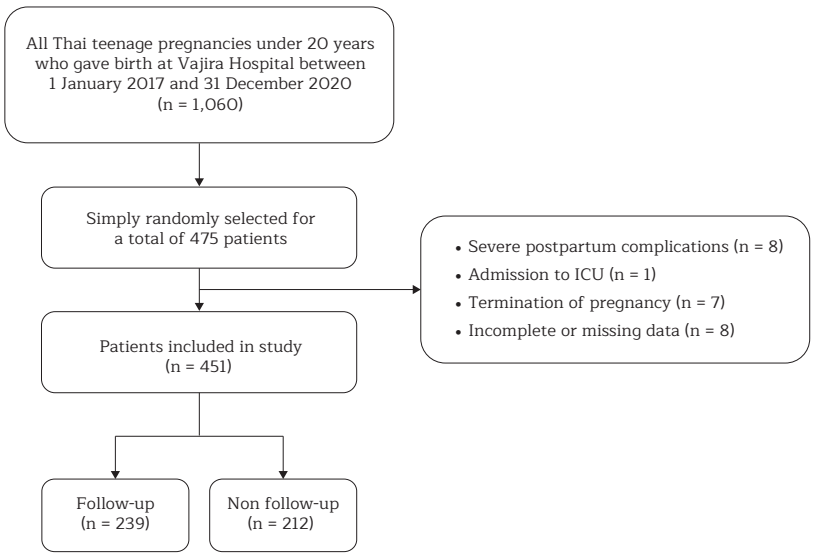

Figure 1 Flow chart of the study population

Table 1 Associated factors of loss to postpartum follow-up at Vajira Hospital (n = 451)

Variable	total n (%)	Follow-up (n = 239) n (%)	Non follow-up (n = 212) n (%)	Univariable analysis		Multivariable analysis		P-value
				OR	95% CI	OR_{adj}	95% CI	
Age (years)								
18-19	248 (55)	120 (50.2)	128 (60.4)	1.51	1.04-2.21	1.71	1.16-2.53	0.03*
10-17	203 (45)	119 (49.8)	84 (39.6)	1.00	Reference	1	Reference	
Education								
Elementary school or less	123 (27.3)	57 (23.8)	66 (31.1)	1.44	0.88-2.37	1.47	0.86-2.52	0.22
Junior high school	200 (44.3)	111 (46.4)	89 (42.0)	1.00	0.64-1.56	1.03	0.64-1.66	
Senior high school or more	128 (28.4)	71 (29.7)	57 (26.9)	1.00	Reference	1.00	Reference	
Occupation								
Employed	135 (29.9)	68 (28.5)	67 (31.6)	1.00	Reference	1.00	Reference	
Unemployed	316 (70.1)	171 (71.5)	145 (68.4)	0.86	0.58-1.29	0.92	0.60-1.41	0.47
Underlying disease								
Yes	230 (51)	122 (51.0)	108 (0.9)	1.00	Reference	1.00	Reference	
No	221 (49)	117 (49.0)	104 (49.1)	1.00	0.69-1.44	1.08	0.73-1.58	0.99
Sexually transmitted infection								
Yes	49 (10.9)	22 (9.2)	28 (12.8)	1.00	Reference	1.00	Reference	
No	402 (89.1)	217 (90.8)	184 (87.2)	0.69	0.38-1.25	0.64	0.35-1.18	0.22
Insurance								
Private	17 (3.8)	5 (2.1)	12 (5.7)	2.81	0.97-8.11	2.57	0.86-7.67	0.056
Medicaid	434 (96.2)	234 (97.9)	200 (94.3)	1.00	Reference	1.00	Reference	
Marital status								
Single/separated	65 (14.4)	30 (12.6)	35 (16.5)	1.38	0.81-2.33	1.19	0.68-2.07	0.23
Married	386 (85.6)	209 (87.4)	177 (83.5)	1.00	Reference	1.00	Reference	
Previous contraception use								
Yes	257 (57)	155 (64.9)	102 (48.1)	1.00	Reference	1.00	Reference	
No	194 (43)	84 (35.1)	110 (51.9)	1.99	1.36-2.91	1.91	1.29-2.80	< 0.001*

Table 1 Associated factors of loss to postpartum follow-up at Vajira Hospital (n = 451) (continued)

Variable	total n (%)	Follow-up (n = 239) n (%)	Non follow-up (n = 212) n (%)	Univariable analysis		Multivariable analysis		P-value
				OR	95% CI	OR_{adj}	95% CI	
Substance use								
Yes	35 (7.8)	20 (8.4)	15 (7.1)	0.83	0.42-1.67	0.83	0.41-1.72	0.61
No	416 (92.2)	219 (91.6)	106 (92.9)	1.00	Reference	1.00	Reference	
Parity								
Multiparity	96 (21.3)	46 (19.2)	50 (23.6)	1.31	0.82-2.03	1.00	0.62-1.62	0.30
Primiparity	355 (78.7)	193 (80.8)	162 (76.4)	1.00	Reference	1.00	Reference	
GA at 1st ANC (week) mean (SD)	19.9 (9.52)							
> 12, including absence of ANC history	347 (76.9)	175 (73.2)	172 (81.1)	1.57	1.01-2.46	0.75	0.46-1.23	0.057
≤ 12	104 (23.1)	64 (26.8)	40 (18.9)	1.00	Reference	1.00	Reference	
Number of ANC visit (time) mean (SD)	7.6 (3.9)							
< 8	220 (48.8)	101 (42.3)	119 (56.1)	1.75	1.20-2.54	1.61	1.07-2.42	0.003*
≥ 8	231 (51.2)	138 (57.7)	93 (43.9)	1.00	Reference	1.00	Reference	
GA at delivery (week) mean (SD)	37.9 (2.5)							
< 37	55 (12.2)	24 (10.0)	31 (14.6)	1.53	0.87-2.71	1.48	0.80-2.74	0.138
≥ 37	396 (87.8)	215 (90.0)	181 (85.4)	1.00	Reference	1.00	Reference	

Abbreviations: ANC, antenatal care; CI, confidence interval; GA, gestational age; n, number; OR, odds ratio; SD, standard deviation
Data are presented as number (%).
P-value corresponds to [t]Independent samples t-test, [m]Mann-Whitney U test, [c]Chi-square test or [f]Fisher's Exact test.
* Significant at p-value < 0.05

According to the study, the prevalence of postpartum contraception accounted for 50.8% of the total participants and accounted for 95.8% among the postpartum follow-up group. There was a total of 239 follow-ups to the postpartum visits (52.9%), while the rest did not follow-up. Of the young mothers who visited postpartum, 229 used some kind of contraceptive method. Of these, 201 (84.1%) and 28 (11.7%) had received contraception within and later than 6 weeks, respectively. The majority of young mothers who followed-up on postpartum visits chose implants as contraceptive methods, followed by DMPA, which covered 80% of participants in this group. Only 10 women did not use any contraceptive method (table 2). Marital status was the only factor associated with higher postpartum contraceptive use as shown in Table 3.

Table 2 Method of postpartum contraception use among teenage mothers (n = 239)

Method of contraception	n (%)
None	10 (4.2)
Implants	137 (57.3)
Intrauterine device	5 (2.1)
Depot Medroxyprogesterone Acetate	65 (27.2)
Oral contraception pills	18 (7.5)
Condom	4 (1.7)

Abbreviation: n, number

Table 3 Associated factors of contraception use at Vajira Hospital (n = 239)

Variable	Contraceptive use (n = 229) n (%)	No contraceptive use (n = 10) n (%)	Univariable analysis		P-value
			OR	95%CI	
Age (years)					
18-19	117 (51.1)	3 (30.0)	2.44	0.62–9.66	0.22
10-17	112 (48.9)	7 (70.0)	1.00	Reference	
Education					
Junior high school or less	107 (46.7)	4 (40.0)	0.97	0.17-5.48	0.78
Senior high school	67 (29.3)	4 (40.0)	0.61	0.11-3.46	
Elementary school or more	55 (24.0)	2 (20.0)	1.00	Reference	
Occupation					
Employed	67 (29.3)	1 (10.0)	3.72	0.46-29.96	0.29
Unemployed	162 (70.7)	9 (90.0)	1.00	Reference	
Underlying disease					
Yes	116 (50.7)	6 (60.0)	0.68	0.19-2.49	0.75
No	113 (49.3)	4 (40.0)	1.00	Reference	
Sexually transmitted infection					
Yes	21 (9.2)	1 (10.0)	1.45	0.80-2.63	> 0.99
No	208 (90.8)	9 (90.0)	1.00	Reference	
Insurance					
Medicaid	224 (97.8%)	10 (100.0%)	-	-	> 0.99
Private	5 (2.2%)	0 (0.0%)	1.00	Reference	
Marital status					
Married	205 (89.5)	4 (40.0)	12.81	3.38-48.64	< 0.001*
Single/separated	24 (10.5)	6 (60.0)	1.00	Reference	
Previous contraception use					
Yes	147 (64.2)	8 (80.0)	0.45	0.09-2.16	0.50
No	82 (35.8)	2 (20.0)	1.00	Reference	
Substance use					
Yes	19 (8.3)	1 (10.0)	1.00	Reference	
No	210 (91.7)	9 (90.0)	1.23	0.15-10.22	0.59
Parity					
Primiparity	183 (79.9)	10 (100.0)	-	-	0.12
Multiparity	46 (20.1)	0 (0.0)	1.00	Reference	
GA at 1st ANC (week)					
≤ 12	63 (27.5)	1 (10.0)	3.42	0.42-27.51	0.22
> 12, including absence of ANC history	166 (72.5)	9 (90.0)	1.00	Reference	
Number of ANC visit (time)					
< 8	94 (41.0)	7 (70.0)	1.00	Reference	
≥ 8	135 (59.0)	3 (30.0)	3.35	0.85-13.29	0.10
GA at delivery (week)					
< 37	22 (9.6)	2 (20.0)	1.00	Reference	
≥ 37	207 (90.4)	8 (80.0)	2.35	0.47-11.78	0.27

Abbreviations: ANC, antenatal care; CI, confidence interval; GA, gestational age; n, number; OR, odds ratio
Data are presented as number (%).
P-value corresponds to [t]Independent samples t-test, [m]Mann-Whitney U test, [c]Chi-square test or [f]Fisher's Exact test.
* Significant at p-value < 0.05

From Table 1, the results revealed that the associated factors with loss to postpartum follow-ups were age of 18 years and older, absence of previous contraceptive use, the first ANC later than 12 weeks or no ANC, and total ANC visits fewer than eight times. After adjusted confounder, age 18 years and older, absence of previous contraceptive use, and total ANC visits fewer than eight times were still significant associated factors.

DISCUSSION

Our study revealed that the prevalence of postpartum contraceptive use among teenage mothers that engaged in follow-up postpartum visits at the Faculty of Medicine Vajira Hospital were 95.8%. Unfortunately, our study showed a high rate of loss to follow-up postpartum visits at 47%, and therefore we could not identify the true contraceptive prevalence among this population, which was the first limitation in this study. Of those who used contraception, most were received within 6 weeks after giving birth, at the postpartum appointment as our obstetric guideline for postpartum visits, choosing implants and injections as the most common methods, retrospectively. However, the most effective techniques such as implants and intrauterine devices were selected by approximately 60%, which could be enhanced if the service provided LARC free of charge before discharge from the hospital.

The only significant associated factor from postpartum contraceptive use in the teenage mothers from the follow-up group was marital status, indicating that married young women had a higher rate of contraception than single mothers, with is similar to the data from Eastern Uganda[17]. Other factors were confined in the analysis of effects due to the small number of non-contraceptive participants, leading to our second limitation in the correlation analysis.

Interestingly, we found that the total number of repeat pregnancies during 2-year intervals was 45 (9.9%). Of these, 33 did not have follow-up postpartum visits. 90.4% (216 of 239) of those that had follow-up postpartum visits did not have a repeat pregnancy. According to the literature review, the significant predictors of rapid repeat pregnancy (RRP) were young age, low socioeconomic status, low education of teenage mothers, marriage, intended or desired first pregnancy, methods of contraception other than implants, depression, and a history of abortion[22,23]. In this study, the prevalence of RRP in teenage mothers was 9.9%, much lower than in previous study, which was over half[24], probably due to the high follow-up rate. However, factors associated with RRP were not revealed in this study.

Loss to postpartum follow-ups often occurs in teenage pregnancy. One possible reason is that these young girls do not have underlying medical conditions or chronic illnesses like their older counterparts, so they feel fine and are less motivated to seek follow-up care[9,25-27]. Another reason that could influence service utilization is the adolescent's hometown, which affects the distance and financial limitations under Medicaid conditions.

In a previous case-control study design in Thailand, the prevalence of loss to postpartum follow-ups at 6 weeks was 24.3%, which was lower than our research findings, probably due to the difference in the study design[9]. An inadequate number of antenatal visits was a predictive factor for loss to postpartum follow-ups, similar to our data[9]. Being single or of separated status and having a lower level of education were predictive factors for loss to postpartum follow-ups, akin to our data but not statistically significant. Similar factors such as private insurance, unemployment, missed prenatal visits, and late initiation of prenatal care were revealed as associated factors with failure to follow-up among teenage mothers in a study from San Francisco. However, these factors were not statistically significant in our study except for inadequate ANC visits[28]. Some significant factors such as age group and previous contraception use were not reported in previous studies. The COVID-19 pandemic in

2020 may also have impacted the delay or the avoidance of seeking medical care due to fear of transmission[29].

From this study, the factors associated with loss to postpartum follow-ups among teenage mothers revealed that the statistically significant factors from the multivariable analysis were older age (18-19 years old), history of non-contraception before pregnancy, and an inadequate number of antenatal visits, where the first two factors have not been reported in previous studies. This would help healthcare providers focus on high-risk adolescents with these characteristic features and closely monitor them with proactive management or provide other interventions to prevent loss of follow-up visits. As their loss to follow-ups reflects their poor self-care behavior, further prospective research is needed to evaluate whether applying intensive intervention programs would be helpful, such as using technology, including text messages and applications to remind them, and home visits or contraceptive counseling during the immediate postpartum period and before discharge from the hospital. Future studies are required to explore all possible reasons for nonattendance to postpartum follow-up visits among teenage mothers.

CONCLUSION

The prevalence of contraceptive use was high among the teenage mothers that had follow-up postpartum visits. However, this population also had a high loss rate of postpartum visits. Teenage mothers of an older age, with an absence of a history of contraception before pregnancy, and an inadequate number of antenatal visits were revealed as having a higher risk for postpartum loss follow-ups, and probably need close monitoring and interventions.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest in this research.

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DATA AVAILABILITY STATEMENT

The present review is based on the references cited. All of the data generated or analyzed during the present study are included in this published article and the citations herein. Further details, opinions, and interpretation are available from the corresponding author on reasonable request.

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Review Article

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Application of AI in Urban Medicine

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ABSTRACT

Globally, the application of artificial intelligence (AI) in urban medicine is changing the way healthcare is delivered in cities. AI is transforming how urban healthcare providers provide patient care, from early disease detection to personalised treatment plans. This review paper examines the various applications of AI in urban medicine, such as telemedicine, diagnostics, predictive analytics, patient monitoring, and drug development. The authors also discuss how AI influences healthcare efficiency, quality, and accessibility in cities.

KEYWORDS: application, artificial intelligence, medicine, urban

INTRODUCTION

Artificial Intelligence (AI) is transforming urban medicine by offering creative answers to problems related to healthcare in cities. Urban areas are seeing a rise in the need for high-quality healthcare resources and services due to population growth. AI tools are being used to enhance patient care, diagnosis, treatment, and overall healthcare efficiency. Examples of these tools include machine learning, natural language processing, and predictive analytics[1].

AI is being applied to urban medicine to scan electronic health records, spot patterns and trends in patient data, and customize treatment regimens. AI systems can improve workflow, lower diagnostic mistake rates, and enable healthcare professionals to make better judgments. Furthermore, AI can help in early disease identification, remote patient monitoring, and outcome prediction based on past data[1].

With multiple examples, AI has demonstrated potential in a number of healthcare domains, including disease detection and remote patient monitoring. AI supports both remote patient monitoring and early disease detection. AI systems have been created to evaluate medical imaging data, including magnetic resonance imaging and mammograms, in order to find early indicators of cancer. For example, DeepMind at Google has created AI algorithms that can accurately identify breast cancer from mammograms[2]. Retinal pictures can be analyzed by AI-powered systems to spot symptoms of diabetic retinopathy, the main cause of blindness in people with diabetes. The food and drug administration has approved IDx Technologies and other companies' AI system to identify this illness[3]. With regard to remote patient monitoring, AI may track and analyze patient data gathered from wearables (such as smartwatches[4]) in order to identify any irregularities or changes that can point to deteriorating conditions. This is especially helpful for long-term conditions like diabetes and heart disease. Additionally, elderly people who live alone can have their daily activities and health indicators monitored by AI-driven monitoring systems[5]. Early warning indications for possible health problems like falls or erratic vital signs may come from this[4-5].

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AI in urban medicine has promise for improving patient outcomes, cutting expenses, and changing the way healthcare is provided in metropolitan areas. The good examples are reports on using AI for management of diabetes in urban health clinics[5-6]. The potential for enhancing healthcare in cities is limitless as AI technologies develop. In order to handle the complicated healthcare issues in urban settings, it is critical that politicians and healthcare professionals accept and use AI. It can conclude that there are several advantages of AI in urban medicine (table 1).

TELEMEDICINE: IMPROVING ACCESS TO HEALTHCARE IN URBAN AREAS

The rapidly expanding field of telemedicine, commonly referred to as telehealth, is transforming the healthcare sector by facilitating patients' access to medical treatments in urban areas. Through phone conversations, text messages, or video conferences, patients can now consult with medical professionals from a distance thanks to technology. Telemedicine's capacity to get over time and distance obstacles, which sometimes make it difficult for urban patients to get healthcare services, is one of its main advantages. Due to their hectic schedules or lengthy commutes, scheduling and attending a doctor's appointment can be difficult for many metropolitan dwellers. Patients no longer need to leave their homes or offices to obtain medical advice and treatment thanks to telemedicine, which provides a practical substitute[7-8].

Additionally, by allowing doctors to visit more patients in less time, telemedicine can assist address the shortage of healthcare professionals in urban areas. This can guarantee that patients receive timely care for their medical requirements and help shorten appointment wait times[4-5]. Further flexibility is provided by telemedicine for both patients and medical professionals. Patients can avoid the inconvenience of lengthy waits in busy waiting rooms by scheduling virtual appointments whenever it is most convenient for them[6]. Urban people will find it easier to get the care they require if healthcare professionals are able to offer more flexible hours and treat patients outside of regular business hours[9].

Furthermore, the delivery of healthcare is being completely transformed by the use of AI in telemedicine. AI algorithms have the potential to expedite and enhance the diagnostic process, resulting in faster and more precise diagnoses[10]. Chatbots driven by AI can also help patients with follow-up treatment, medical information access, and appointment booking[10-11]. AI can also assist medical professionals in remotely monitoring patients, enabling more proactive and individualized care. AI can find trends and patterns in vast volumes of data that can improve patient outcomes and treatment strategies[10-11]. All things considered, telemedicine's ability to incorporate AI has the potential to significantly improve the effectiveness and caliber of healthcare delivery, making it an even more useful tool for expanding access to healthcare in metropolitan areas.

Table 1 Applications of artificial intelligence in urban medicine

Application	Description
Telemedicine	Facilitates remote access to healthcare services through technology, improving healthcare accessibility in cities
Diagnostics	Utilizes AI algorithms to analyze medical data for early disease detection and personalized treatment plans
Predictive analytics	Uses data to anticipate health outcomes and provide individualized interventions for patients in urban settings
Patient monitoring	Utilizes wearable technology and sensors to remotely monitor patient health, with AI analyzing and providing insights
Drug discovery	Accelerates medical breakthroughs through the use of AI in drug development and research in urban areas

AI IN DIAGNOSTICS: EARLY DISEASE DETECTION AND PRECISION MEDICINE

Precision medicine in urban medicine and early disease detection could be transformed by the application of AI in diagnostics. Large volumes of medical data, including genetic data, imaging results, and patient symptoms, can be analyzed by AI algorithms to find trends and risk factors linked to certain diseases. Healthcare providers may be able to discover ailments earlier on, when they are more treatable, by utilizing AI to examine this data. Better patient outcomes and a decrease in healthcare costs overall may result from this. The good example is the application of AI in colon cancer screening program[12].

AI can assist in early disease identification as well as patient-specific treatment plan personalization based on each patient's unique genetic composition and medical background. Precision medicine is a strategy that enables medical professionals to customize therapies to meet the unique needs of each patient, increasing treatment efficacy and lowering the possibility of side effects[13-15]. All things considered, the use of AI to diagnostics has the potential to revolutionize urban care by enhancing early disease identification and offering patients individualized treatment options. We may anticipate even bigger advantages in the healthcare industry as AI technology develops[13-15].

PREDICTIVE ANALYTICS: ENHANCING TREATMENT PLANS IN URBAN SETTINGS

Utilizing data to anticipate possible health outcomes and provide individualized interventions for patients, predictive analytics can be extremely helpful in improving treatment approaches in urban environments. Predictive analytics can assist healthcare clinicians make better educated judgments regarding treatment plans by identifying patterns and trends in past patient data, demographic data, environmental factors, and social determinants of health[16-18]. Predictive analytics, for instance, can assist in identifying high-risk patients based on their medical history and social determinants of health, who are more likely to encounter difficulties or have poor health outcomes[16-18]. In order to address these risks and enhance patient outcomes, healthcare providers can then take preemptive measures and create individualized treatment programs.

Furthermore, by anticipating patient demand, streamlining scheduling, and identifying patterns in healthcare consumption, predictive analytics can aid in the optimal allocation of resources and enhance operational effectiveness in urban healthcare settings[19-21]. In addition to ensuring that patients receive timely and appropriate care, this can assist healthcare practitioners in better managing their resources. All things considered, predictive analytics can offer insightful information that can improve and influence treatment regimens in urban environments, improving patient outcomes and community health outcomes[19-21]. Healthcare practitioners can more effectively and individually tailor their care to the complex and varied demands of urban populations by utilizing data and predictive analytics[22].

PATIENT MONITORING: REMOTE HEALTH MANAGEMENT IN URBAN ENVIRONMENTS

Utilizing remote health management and patient monitoring systems can significantly raise the standard of treatment provided to city dwellers[23]. These systems gather patient data and send it in real time to healthcare providers using wearable technology and sensors[23-24]. This makes it possible to check vital signs, medication compliance, and general health condition more frequently, which can help identify any health problems early and implement remedies in a timely manner. When it comes to evaluating and deciphering the enormous volumes of data gathered by patient monitoring devices, AI is essential. AI systems are able to recognize patterns and trends in data, forecast possible health hazards, and offer individualized treatment and lifestyle suggestions. AI, for instance, can assist in identifying individuals who are at

a high risk of contracting chronic illnesses like diabetes or heart disease and recommend risk-reducing preventative measures.

Additionally, AI-driven chatbots and virtual assistants can offer patients instant help and direction by responding to inquiries, reminding them to take their medications, and giving them lifestyle recommendations[23-24]. Additionally, by facilitating communication between patients and healthcare professionals, these virtual assistants can guarantee that patients receive prompt support and feedback[25-26]. All things considered, the use of AI in urban patient monitoring and remote health management has the potential to completely transform the provision of healthcare, enhance patient outcomes, and save expenses. Healthcare practitioners may deliver more proactive and individualized care to urban populations by leveraging technology, which will ultimately result in healthier and more cohesive communities. Finally, there is an important issue for further improvement, an ethical concern on using AI communication[27]. There must be a control of data and privacy which is an issue that requires improved technology for management[27].

AI IN DRUG DISCOVERY: ACCELERATING MEDICAL BREAKTHROUGHS

In urban environments, the use of patient monitoring and remote health management systems can greatly improve the quality of care for individuals living in cities. These systems utilize sensors and wearable devices to collect patient data and transmit it to healthcare providers in real-time[28-30]. This allows for more frequent monitoring of vital signs, medication adherence, and overall health status, leading to earlier detection of potential health issues and timely interventions[28-30].

When it comes to evaluating and deciphering the enormous volumes of data gathered by patient monitoring devices, AI is essential. AI systems are able to recognize patterns and trends in data, forecast possible health hazards, and offer individualized treatment and lifestyle suggestions[28-30]. AI, for instance, can assist in identifying individuals who are at a high risk of contracting chronic illnesses like diabetes or heart disease and recommend risk-reducing preventative measures. Additionally, AI-driven chatbots and virtual assistants can offer patients instant help and direction by responding to inquiries, reminding them to take their medications, and giving them lifestyle recommendations[31]. Additionally, by facilitating communication between patients and healthcare professionals, these virtual assistants can guarantee that patients receive prompt support and feedback[28-30].

All things considered, the use of AI in urban patient monitoring and remote health management has the potential to completely transform the provision of healthcare, enhance patient outcomes, and save expenses[28]. Healthcare practitioners may deliver more proactive and individualized care to urban populations by leveraging technology, which will ultimately result in healthier and more cohesive communities.

CHALLENGES AND OPPORTUNITIES FOR AI IN URBAN MEDICINE

There are several challenges and opportunities for AI in urban medicine (table 2). Concerns about data privacy and security, the possibility of bias in algorithms leading to incorrect diagnoses, the absence of legislation to guarantee patient safety, and the requirement to integrate AI with current systems—which may involve considerable changes—are some of the obstacles to integrating AI technology into urban medical settings[32-33]. AI has a lot of potential to enhance patient outcomes, boost productivity, personalize medicine, and facilitate telehealth and remote monitoring in cities, even in spite of these challenges. Urban healthcare providers have the ability to transform healthcare delivery and eventually help both patients and providers by overcoming these obstacles and seizing the opportunities given by AI[32-33].

Table 2 Challenges and opportunities for AI in urban medicine

Challenges	Opportunities
Data privacy and security concerns	Enhancing patient outcomes, boosting productivity, and facilitating telehealth and remote monitoring in urban settings
Potential bias in algorithms	Customizing treatment, improving patient outcomes, and transforming healthcare delivery in cities
Lack of regulatory framework	Leveraging AI capabilities to benefit both patients and healthcare providers in urban environments
Integration with existing systems	Overcoming obstacles to improve healthcare efficiency and accessibility in urban areas

A lack of regulatory framework to ensure patient safety, data privacy and security concerns, potential bias in algorithms leading to inaccurate diagnoses, and the need to integrate AI with existing systems, which may require significant changes, are some of the challenges associated with integrating AI technology into urban medical settings. Notwithstanding these challenges, AI offers a wealth of chances to enhance patient outcomes, boost productivity, customize treatment, and facilitate telehealth and remote monitoring in cities[29-30]. Urban healthcare providers have the opportunity to transform healthcare delivery and eventually benefit both patients and providers by leveraging AI's capabilities and surmounting these obstacles.

CONCLUSION

In conclusion, AI is revolutionizing urban medicine by providing creative answers to a range of issues pertaining to urban healthcare. AI has the ability to completely transform the way healthcare is delivered in metropolitan areas, from diagnosing and treating patients to strengthening treatment regimens and remote monitoring. Even while incorporating AI technology in urban medical settings is not without its difficulties, there are many prospects for better patient outcomes and increased efficiency. Urban healthcare providers may genuinely transform healthcare delivery and benefit patients and providers equally by overcoming these challenges and utilizing AI. AI-powered urban medicine has a bright future ahead of it, with countless opportunities to improve urban healthcare.

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Review Article

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The Urban Health Themes and Urban Factors Associated with Health: A Brief Review

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ABSTRACT

The current situation is of a population shift from rural to urban areas and is the acceleration of urban growth. In this perspective, comprehending how urbanization has affected human health is critical. Hence, the aim of a synthesized review is the current understanding of urban health themes and urban factors associated with health. The most common topics of concern that emerge from the urban health literature can be summarized in three principal themes: social environment, physical environment, and provision of health and social services. Additionally, the results from our review aim to serve as a springboard for a thorough investigation of urban factors associated with health and their causes to improve predictions of the global health burden, influence health system planning and policy, and direct urban design.

KEYWORDS: physical environment, social environment, social services, urban health, urbanicity

INTRODUCTION

Over half of the world's population lives in cities, and by the middle of the century, that number is projected to increase to 70%[1]. Urban areas would experience the majority of the population increase between 2000 and 2030, making up 60.4% of the world's population (4.9 billion versus 8.1 billion people), increasing from 48.3% currently (2.8 billion versus 6.0 billion in 2000)[2,3]. These "cities", which contain a mix of residential, commercial, and employment environments, are a distinctive aspect of contemporary civilization. The number of people in cities is increasing, and this urbanization trend is expected to last for the rest of the twenty-first century. In this situation, it is critical to comprehend how urbanization has affected human health.

Cities are dynamic in both space and time in Bangkok, Thailand. Nowadays, the population of Bangkok has grown rapidly. There are dense communities, transportation cuts through the communities, more tall buildings, and traffic are congested (figure 1).

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Figure 1 Urban areas and the acceleration of urban growth in Bangkok, Thailand

Urbanization is associated with the population shift from rural to urban areas and the acceleration of urban growth. Cities were dangerous places to live because of violence, crime, and epidemics. Many developing cities today, nevertheless, suffer the same issues as poor neighborhoods in developed countries. Housing regulations, water protection, air quality safety, handwashing practices, indoor plumbing, and smokeless heating have lessened old urban ills in developed countries. Urban regions typically offer better employment, income, and access to health care than non-urban areas can provide, providing city dwellers in industrialized countries an "urban health advantage". For instance, rural residents have a lower life expectancy, greater incidence of disease, injury, suicidal issues, and less convenient access to healthcare services[4,5].

New infections increase unknowingly in urban areas, most often starting from vulnerable populations. They spread swiftly to impact the whole country and the world, because of continuous and significant immigration into and around urban areas. The rapidly rising traveler population makes it tricky to regulate the current public health system, such as during the Corona Virus Disease 2019 (COVID-19). Starting from Wuhan, China, it quickly spread over the planet, causing serious economic damages and loss of health.

In urban society, humans live more isolated lifestyles than they are used to. It is associated with increases in the prevalence of non-communicable diseases (NCDs), such as obesity, high blood pressure, heart disease, cancer, etc. In urban areas with high population densities, accident-related injuries were identified, which is the primary reason for the years of health loss. Pollution issues, environmental diseases, including respiratory diseases, etc., and disaster management, require a more comprehensive level of management to be solved and actively promote advances in disease control, prevention, and protection.

Several significant synthesis studies looking at urban variable factors affect health, such as bullying[6-8], sleep quality[9-11], infection hazards[12-15], violence[16], stressors[17,18], sex workers[19-21], air pollution[22-25], noise pollution[26-28], flood issues[29,30], food waste[31], emergency system[32], quality care[33], safe and healthy housing[34-37], cultural milieu[38], and socioeconomic status[39-42] were reported.

Hence, the aim of a synthesized review is the current understanding of urban health themes and urban factors associated with health. The ultimate goal of this review is to serve as a springboard for a thorough investigation of urban factors associated with health and their causes to improve predictions of the global health burden, influence health system planning and policy, and direct urban design.

REVIEW METHODOLOGY

We designed a new review methodology in three steps and the details are as follows:

Step 1: We outlined the conceptual approach for our review by using frameworks addressing key search terms, the terms include [("urbanization") AND ("urbanicity") AND ("urban health")].

Step 2: We used the main keywords [("Urban") AND ("Public Health)" AND ("Urban Health")]. The search was refined by varying terms and combinations, using predefined specific keywords. Each of the used keywords covered a range of issues in the main topics of urban health, and the principal themes included [("social environment") OR ("physical environment") OR ("provision of health and social services")].

Step 3: We screened the literature review with a snowball approach in the electronic databases including Scopus, PubMed, ScienceDirect, Springer Link, and Google Scholar with full-text. As a restriction, the language filter was set to English.

Additionally, our approach differs from systematic reviews and offers a strong contribution to the status quo and a comprehensive view of field studies on urban health issues and urban determinants related to health[43]. Consequently, an independent assessment of the identified review literature is unnecessary in our review methodology.

Nevertheless, this approach has some limitations: I) the selection of keywords, (II) the missing double-check of excluded articles, and (III) opting for English-language articles only. However, overall, this approach allowed us to address the prevailing research strands and broad lines of urban public health explicitly to identify existing research gaps at a more fundamental level.

RESULTS

The literature search identified a brief review of current understanding of urban health themes and urban factors associated with health. The ultimate goal of this review is to serve as a springboard for a thorough investigation of urban factors associated with health and their causes to improve predictions of the global health burden, influence health system planning and policy, and direct urban design.

I) Urbanization

Urbanization refers to a change in the size, density, and heterogeneity of cities[44]. Urbanization is frequently accompanied by elements such as population mobility, segregation, and industrialization[45,46]. For example, urbanization may involve the creation (or destruction) of building developments or neighborhoods, the creation (or elimination) of transportation routes, and the inflow and outflow of population, which alters racial and ethnic diversity[44].

Urbanization creates distinctive characteristics in urban settings that require specialized research. Examples of how the characteristics of urbanization influence health can be considered. Poor people may burden the city's infrastructure, which also includes transportation, housing, food, water, sewage, jobs, and healthcare; if they migrate in large numbers in search of jobs and services (e.g., as an outcome of immigration brought on by food or employment shortages in non-urban or other urban areas)[44].

II) Urbanicity

Urbanicity refers to the impact of living in urban areas at a given time[44]. In the US, Andrulis coined the concept "urban health penalty" to represent the higher prevalence of health issues and risk factors in urban areas when comparing urban and suburban[47].

For example, significant industrial pollution and the consequent increased prevalence of respiratory illnesses in some cities characterize urbanicity[44].

Although these processes determine the observed prevalence, it is important to understand the specific risk factors and diseases in urban areas. In the long term, the study of urban health needs to understand the dynamic process of urban transformation and the way urbanization changes the parameters of urbanicity.

III) Urban health

The definition of "**urban**" also varies widely among countries. Compounding these difficulties, definitions of urban have changed over time in different ways in different countries. Thus, what we may call urban in different settings may have included city centers, peri-urban fringe cities, and densely populated isolated regions[44]. Thus, according to urban health, the following topics were among the most commonly examined in the literature on public health and medicine: population growth, population density, race and ethnicity, vulnerable populations, socioeconomic status/poverty, disaster threats, crime, substance abuse, access to healthcare, the environment, patterns of health and social, service networks, high levels and proximity of income inequality, and international differences. For example, providing access to clean drinking water and disposing of household waste are currently one of the largest issues in rapidly developing urban areas in developing countries[48].

Thus, "**urban health**" research can be considered differently. Urban health thinking can be organized around characteristics unique to urban living. The most common topics of concern emerging from the urban health literature can be summarized in three principal themes: social environment, physical environment, and provision of health and social services[44] (figure 2).

Figure 2 A summary infographic on urban factors associated with health

IV) Urban health themes and urban factors associated with health

A Memorandum of Understanding (MOU) between the World Health Organization (WHO) and the United Nations Human Settlements Program (UN-HABITAT) was signed on October 8, 2021, to enhance their mutual aims and objectives and promote urban health[49]. The MOU highlights collaboration on specific technical issues as they correspond to urban contexts including: urban planning and health, NCD and injury prevention, environmental health, emergency preparedness and response, health and migration, environmental management of vector-borne diseases, safe and healthy housing, and safer and healthier diets

It aims for integrated programming in fields, including advocacy, data collection, policy development, and research. The MOU seeks a stronger emphasis on urban health in WHO and UN-HABITAT in recent years. These are in recognition of the potential gains to be made through cooperation on global items on the agenda such as the "triple billion" targets of WHO's Thirteenth General Program of Work 2019–2023, implementation of the New Urban Agenda and the realization of Sustainable Development Goals (SDG). Particularly, SDG 3 refers to ensuring healthy lives and promoting well-being for all at all ages, and SDG 11 also means making cities and human settlements inclusive, safe, resilient, and sustainable[30,49].

Thus, implementation of the New Urban Agenda and the realization of SDG, in particular SDG 3 ("Good health and well-being") and SDG 11 ("Make cities inclusive, safe, resilient and sustainable").

Within each of these themes, concerns regarding urbanization (e.g., aging or diversification of the population) and urbanicity (i.e., socioeconomic status, crime as conditions of urban living) remain important distinctions. Thus, this synthesized investigation of urban health's principal themes: social environment, physical environment, and provision of health and social services, also covers WHO and UN-HABITAT contexts. Hence, a summary infographic of urban factors associated with health (figure 2 and table 1).

a) Social environment

The social environment refers to the properties of the "**urban community**" that affect individual behavior and urban variable factors in Table 1. Additionally, it covers urban planning and health, NCD and injury prevention, health and migration, and environmental management of vector-borne diseases.

Over the past century, many factors of the social environment have changed, and these possibly have differently impacted the well-being of urban populations. Other factors of the urban social environment might benefit health development[50]. In fact, it has been indicated that social support is related to cardiovascular disease mortality. Thus, according to future investigations, urban social networks lend a helping hand and may positively impact residents' health[51,52].

b) Physical environment

Relevant features of the physical environment important to "**urban areas**," and urban variable factors are in Table 1. Additionally, they cover NCDs and injury prevention, environmental health, environmental management of vector-borne diseases, safe and healthy housing, and safer and healthier diets.

More subsequently, a significant amount of interest has arisen in how the built environment affects physical and mental health as well as how public space is designed. Investigating how much physical space affects both physical and mental wellness is important.

c) Provision of health and social services

The study of the urban context includes the provision of health and social services as a core issue. The impact of these services on well-being differs from (though commonly related to) the social or physical environment and urban variable factors in Table 1.

Table 1 Urban health themes and factors associated with health

Urban health themes	Urban variable factors	Diseases	Citations
Social environment	Elderly	CVD	[53, 54]
		NCDs	[10, 11, 55]
		Sleep quality	[9, 56, 57]
		Mental disorders	[56, 58]
	Infection hazards	COVID-19	[12]
		HIV	[14, 59, 60]
		TB	[61–63]
	Sex worker	HIV	[19-21, 64, 65]
	Stressor	Mental health	[17, 18, 66]
	Violence	Mental health	[16, 67-69]
	Bullying	Mental health	[6-8, 70-73]
	Culture milieu	-	[38, 74, 75]
	Social norms	-	[76-79]
	Networks (migration)	Infection diseases	[80-82]
	Socioeconomic status		[39-42]
	Slum health	Mental health	[83-86]
Physical environment	Built environment	Asthma	[87, 88]
	Air pollution	Cancer	[23, 89]
		CVD	[24, 90, 91]
		Mental health	[92-94]
		Respiratory tract infection	[24, 25, 91, 95, 96]
		Mortality from nervous diseases	[96-99]
		Diabetes type II	[22, 100-102]
	Noise pollution	CVD	[26-28, 103, 104]
		Mental health	[105-107]
	Light pollution	Sleep quality	[108, 109]
		Loss of naked-eye	[109]
		Mental health	[109]
	Tobacco	Cancer	[110-113]
		Respiratory tract infection	[114-116]
	Chemical issues	Cancer	[117-119]
		Respiratory tract infection	[117-119]
	Hazardous waste	Respiratory tract infection	[120, 121]
	Landfill sites	-	[122-124]
	Transportation	Accident /Injuries	[125, 126]
	Water issues	Infectious hepatitis, cholera, bacillary dysentery, typhoid, paratyphoid, salmonellosis, colibacillosis, giardiasis, cryptosporidiosis, and amoebiasis	[127, 128]
	Food waste	Diarrheal	[31]
	Flood issues	Water-borne disease	[29, 30]
	Safe and healthy housing	-	[34-37, 129]
Provision of health and social services	Health insurance		[13, 15]
	Quality care		[30, 33]
	Emergency system		[32]
	Public service clinic		[44]
	Well-being		[30, 44]
	Public transportation routes		[30, 44]

NCDs include obesity, high blood pressure, heart disease, and cancer.

Abbreviations: CVD, cardiovascular disease; HIV, human immunodeficiency virus; NCDs, non-communicable diseases; TB, tuberculosis

CONCLUSION

Urban health intellectual can be organized around characteristics unique to urban living. The most common topics of concern that emerge from the urban health literature can be summarized in three principal themes: social environment, physical environment, and provision of health and social services, including covering SDG 3 and SDG 11 for sustainable urban development.

Additionally, cross-sectional or longitudinal study research may provide insights into the key features of cities and the influence of urbanization on population health. Moreover, our review provides the key research gaps, including I) The lack of NCDs and injury prevention. The findings of a thorough literature assessment of disease monitoring systems include the following as major areas for research and implementation: increased cross-sector collaboration between public health and urban services, more use of cost-effective monitoring technologies such as mobile phones that can accelerate disease detection and control measures, and inventive research for new disease control instruments. II) Lack of environmental health prevention. A longitudinal study is needed to identify trends and variation factors. III) Lack of environmental management of vector-borne diseases. The authors suggest implementing policies and practices concentrating on the most vulnerable groups by enhancing disease surveillance and utilizing early warning systems. Significant knowledge gaps exist regarding the role of healthy persons, the impact of co-infections, and other environmental and social factors. IV) Lack of safe healthy housing. The integration of ecological and sustainable vector control methods, waste management and sanitation, and investigation are also highlighted by the authors as new fields of research.

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Case Report

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Unusual Pattern of Spread of High-Grade Serous Fallopian Tubal Carcinoma in a Woman with *BRCA1* Gene Mutation

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ABSTRACT

A 40-year-old woman presented with chronic watery vaginal discharge for one-month and right pelvic pain radiating to the right flank for 2 weeks. Physical and pelvic examination revealed a right pelvic mass. Computerized tomography and magnetic resonance of whole abdomen revealed a 6-cm of heterogeneous mass at the right adnexa and a larger mass of 8-cm with internal cystic portions compressing on the inferior vena cava. Her serum cancer antigen (CA) 125 elevated to 540 U/ml. Surgical intervention revealed a right fallopian tube mass with an intact serosal surface, several enlarged pelvic and para-aortic nodes, and a bulky precaval node. No gross peritoneal nor other organ invasion was found. Complete surgical staging was performed by gynecologic oncologists and a surgeon, resulting in optimal surgery. Pathology revealed high-grade serous carcinoma of the right fallopian tube with metastasis to all resected nodes and a positive peritoneal cytology. Subsequent blood testing showed *BReast CAncer* (*BRCA*) 1 gene mutation. Adjuvant therapy with paclitaxel/carboplatin/bevacizumab was given for six cycles. Maintenance therapy with bevacizumab/olaparib, and periodic surveillance for other cancers, including breast magnetic resonance imaging were planned. This case presented an unusual pattern fallopian tubal cancer spread to a large precaval lymph node which was bulkier than the primary tumor. A thorough pre-operative evaluation and a surgical team specialized in cancer surgery are crucial for successful surgical management. Appropriate adjuvant treatment and follow-up for a woman with *BRCA* mutation were also to be emphasized.

KEYWORDS: BRCA gene mutation, fallopian tubal carcinoma, nodal metastasis

INTRODUCTION

Fallopian tubal carcinoma (FTCA) represents a rare gynecologic cancer frequently presented by a peritoneal spread that involves the ipsilateral ovary and other pelvic tissues, including the peritoneum. Small or early-stage FTCA may be asymptomatic until it ruptures through the serosa and spreads to the peritoneum and other viscera[1,2]. Most FTCA are diagnosed at an advanced stage, which causes difficulty in tracking its primary site and its misdiagnosis as the more common ovarian cancer[1,3].

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A FTCA limited to the primary location without gross invasion of the pelvic viscera and peritoneum but with distant nodal metastasis is rarely observed[4].

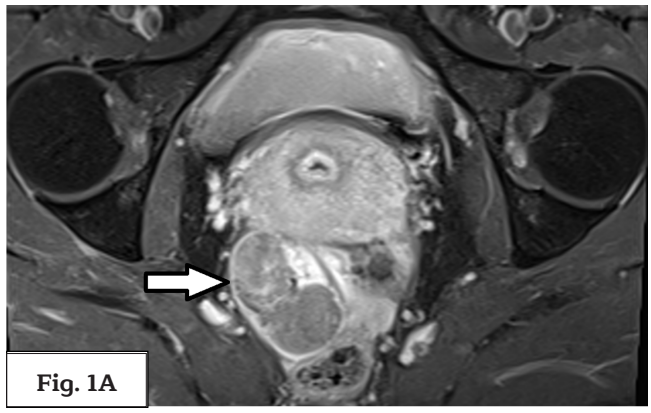
BReast CAncer (*BRCA*) gene is a tumor suppressor gene which produces proteins crucial for repair of damaged DNA. The *BRCA* gene is inherited from the parent, so-called germ line mutation. Its mutation can lead to uncontrolled cell growth contributing to the development of various cancers, especially breast and ovarian cancers[5-8]. In addition, these individuals may develop cancer at young ages[9].

CASE REPORT

A 40-year-old married Thai woman with parity 0, presented at the initial hospital for a right pelvic pain radiating to the right flank in the past 2 weeks. Pelvic examination discovered a right adnexal mass without other abnormal findings. Computerized tomography scan of the whole-abdomen revealed a heterogeneous enhancing mass at the right adnexa and a large well-defined heterogenous enhancing mass was detected compressing on the inferior vena cava without a fat plane, along with several para-aortic and pelvic nodes. Pertinent laboratory finding was an elevated CA125 to 540 U/ml. The patient self-referred to our hospital for treatment.

Additional history taking revealed the patient had stopped oral contraceptive pills for 5 years after her 10-year use. A recent breast surveillance involving mammogram and ultrasound was Breast Imaging-Reporting and Data System 3. Family history revealed several cancers in many family members: lung cancer in her father (also pancreatic and prostatic cancers) and brother; ovarian cancer in her sister whose daughter and son had breast and lung cancers, respectively; brain tumor in her auntie (maternal side) whose her daughter had breast cancer.

Magnetic resonance imaging (MRI) of abdomen was additionally performed to have detailed imaging for surgical planning. The right adnexal mass measuring 6.1x3.0x4.2 cm^3 was seen (figure 1A) discrete from the normal right ovary, right pelvic nodes sized up to 1.1 cm, a 3.2 cm, left ovarian cyst with septation and turbid content, and absence of ascites or peritoneal nodule. A 3.2x4.5x7.8 cm^3 well-defined heterogenous enhancing mass at precaval compressing on the inferior vena cava without a fat plane (figure 1B) and other para-aortic nodes with sizes ranging between 2-3 cm. Differential diagnoses of the right adnexal mass and bulky precaval node included pelvic soft tissue tumor and lymphadenopathy or primary retroperitoneal tumors.



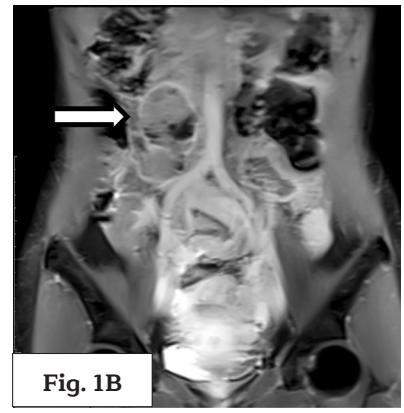


Figure 1 MRI images of lower abdomen revealed a 6.1×3.0×4.2 cm heterogenous enhancing mass at right adnexa abutting to right uterus, urinary bladder, and upper rectum without definite invasion (figure 1A). The image of upper abdomen showed a 4.5×4.0×8.4 cm lobulated mass with internal cystic portions compressing on inferior vena cava without fat plane (figure 1B).

Exploratory laparotomy revealed a right tubal mass measuring approximately 5 cm with a smooth serosal surface (figure 2A), a yellowish tan solid with foci of the hemorrhage cut surface (figure 2B), several enlarged right external iliac and para-aortic nodes with sizes up to 2.5 cm, and a large 8-cm precaval node with intact capsule (figure 2C). The cut surface of the large precaval node unveiled a homogeneous pinkish tan with foci of necrosis (figure 2D).

The right tubal mass and ovary were resected, followed by peritoneal washing, total hysterectomy, and left salpingo-oophorectomy. Resection of the large precaval nodes and other grossly enlarged para-aortic and pelvic nodes were also performed without bleaching of the nodal capsules. The tubal mass and precaval node were submitted for frozen section study which revealed the same features of high-grade carcinoma. Optimal surgery was achieved with an uneventful postoperative clinical outcomes.

The final pathology indicated a high-grade serous carcinoma of the right fallopian tube, with lymphatic invasion, metastasis to pelvic and para-aortic lymph nodes (4/18 nodes), and positive peritoneal washing. No evidence of cancer was found in both ovaries.

Blood germline test revealed *BRCA*1 gene mutation. Comprehensive genetic molecular profiling (CARIS Life Sciences' Molecular Intelligence platform) of the formalin-fixed paraffin-embedded tumor specimens was performed for analysis, and the results revealed the *BRCA*1 exon16 p.T1691K (likely pathogenic variant), TP53 exon4 (pathogenic variant), stable microsatellite instability, low tumor mutational burden (5 Mb), and high Homologous Recombinant Deficiency Genomic Scare (score of 60).

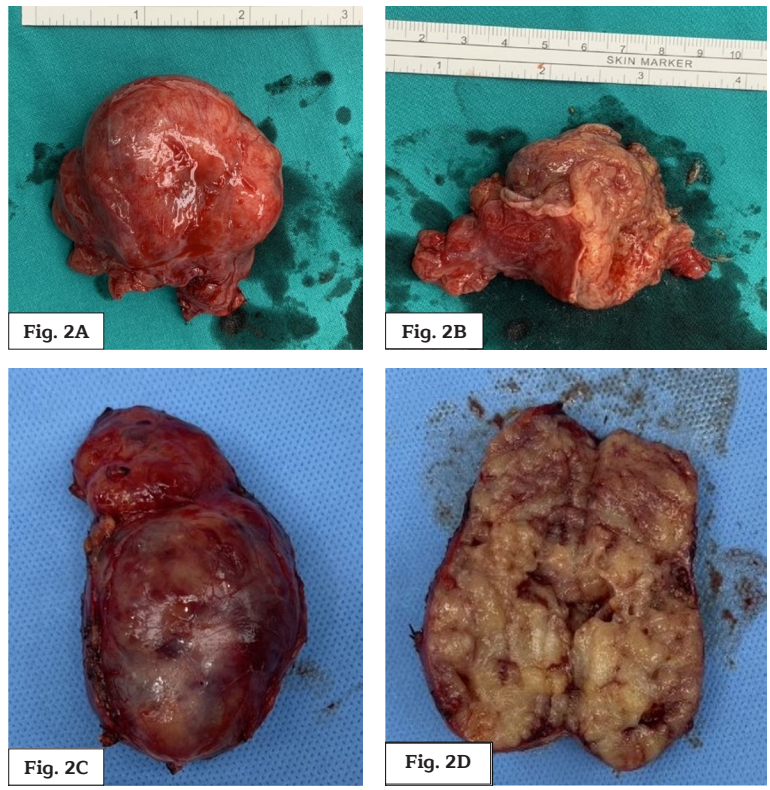


Figure 2 Gross finding of right tubal mass showed with intact serosa (figure 2A). Cut surface showed yellowish tan solid with foci of hemorrhage (figure 2B). Gross pathology of the large oval shape pre-caval lymph node measured 8.0×4.2×3.3 cm with smooth intact capsular surface (figure 2C). Cut surface revealed homogeneous pinkish tan with foci of necrosis (figure 2D).

The final diagnosis was high-grade serous carcinoma of right FTCA, stage IIIA1(ii) according to the 2021 International Federation of Gynecology and Obstetrics (FIGO 2021) in the young woman with *BRCA1* gene mutation.

Post-operative additional history taken revealed a 1-month watery vaginal discharge experienced by the patient. Her primary gynecologist deemed the discharge as normal, which prompted the patient to omit such information during our initial history-taking session.

The patient and her family were counseled about clinical and surgico-pathological findings, diagnoses, and treatment planning which included adjuvant therapy with paclitaxel/carboplatin/bevacizumab for six cycles followed by maintenance therapy with bevacizumab/olaparib. Periodic surveillance through interval breast MRI was also planned with consideration for prophylactic bilateral mastectomy.

She was currently doing well with no evidence of disease after 6 cycles of adjuvant therapy. Subsequent maintenance therapy was to be initiated. Taking into consideration her psychological state of adjustment for medical problems, a prophylactic mastectomy as a risk-reducing surgery will be delayed after a remission from fallopian tubal cancer.

DISCUSSION

FTCA occurs rarely, especially when compared with the more common ovarian cancer. Given its low prevalence and the presence of subtle nonspecific symptoms, a correct preoperative diagnosis presents a challenge, with only 4% (0.3%–15%) of cases being accurately diagnosed prior to surgery[1,10]. For the same reasons, FTCA often remains undetected until it ruptures through the serosa and spreads throughout the abdomen and pelvic cavity. At our best, we could not find any previous report of fallopian tube carcinoma which had bulkier metastatic node to upper abdomen than the primary tumor which was limiting within the tube.

Upon a retrospective review, our patient had all three clinical presentations meeting Latzko's triad of a FTCA, namely, watery vaginal discharge, colicky lower abdominal pain, and a pelvic mass, which can be observed in less than 15% of cases[11-13]. However, the patient's primary gynecologist regarded the reported watery discharge as not clinically meaningful. Thus, the patient skipped reporting such information during our initial history taking. We additionally performed MRI of whole abdomen in our hospital to evaluate the nature of the pelvic and precaval masses and their anatomical relationship with adjacent organs, which was crucial for accurate preoperative planning. The right ovary, which had not been visible on the CT scan, was identified from the MRI images. Additionally, the MRI provided a clear delineation of the precaval masses, even in the absence of a fat plane, thereby increasing our confidence in performing a successful surgical removal.

The resected right fallopian tube mass and pre-caval node were sent for an intraoperative frozen section to confirm its malignancy status, type, and their similar or distinctive features. This step was taken due to the unusual presence of a bulky metastatic node in the upper abdomen, despite limiting cancer spread in the pelvis.

The most frequent route of FTCA spread was through the serosal surface into the peritoneal viscera, especially the adjacent ipsilateral ovary and to other pelvic organs[2]. The clinical and surgico-pathological findings in our patient were unusual. This finding was observed possibly because the tumor (seemingly in early stage) had not yet breached the serosal surface. The positive peritoneal cytology was probably due to the spillage of tumor cells through the tubal fimbriae. The aggressive-behavior–high-grade serous carcinoma and lymphatic invasion around the primary tumor site may explain the unusual nodal spread to the para-aortic and precaval nodes in the upper abdomen.

Advanced ovarian cancer or FTCA necessitates a multidisciplinary approach that aims for a maximal tumor debulking and its favorable prognosis[4]. Our surgical team comprised two gynecologic oncologists and a surgeon. A meticulous approach was implemented to prevent/minimize the risk of tumor spillage, particularly in case of localized tumors, and ensure the safe resection of all enlarged nodes, including the bulky precaval node. As a result, the primary fallopian tubal tumor and lymph nodes, which had no gross invasion to the serosal or capsular surfaces, were removed intact.

Regarding the *BRCA* gene mutation, individuals with mutation show a high risk for several cancers compared with the general population. Compared with the lifetime risks of general women for developing breast or ovarian/fallopian tubal/peritoneal cancers (13% and 1.2%, respectively)[14], those who inherited the *BRCA1* gene mutation have 55%–72% and 39%–44% chances of developing these cancers by 70–80 years old[14-17].

The prevalence of *BRCA* gene mutation varies among various ethnic groups, characteristics, and personal/family history of the population studied. Among Asian population, data of *BRCA* gene mutation were more available for breast cancer. The prevalence of *BRCA* gene mutation ranged from 21.4 to 24.7%[18-20] or 14.6% for *BRCA1* and 23% for *BRCA*2 mutations[21,22]. The prevalence was found higher among the women with risk factors, such as, women with family history of breast/ovarian cancers, aged < 35 years, bilateral breast cancer, women with breast and ovarian cancer, and those with multiple risk factors[23-25].

Data on Asian population, especially ovarian cancer patients, are limited. Two studies in Thailand reported the prevalence of *BRCA* gene mutation in ovarian/FTCA and peritoneal cancers[26,27]. One research used either blood formalin-fixed paraffin-embedded tissue or a fresh tumor specimen and reported a 21.8% prevalence of germline *BRCA* mutation in cancer patients with high-grade histological tumors: 16.1% of *BRCA1* and 5.7% of *BRCA2* gene mutation[26]. A higher mutation rate was observed among patients with positive family history of breast/ovarian cancer and personal history of breast cancer. Patients with FTCA (60%) presented a higher frequency of *BRCA* mutation, followed by those with peritoneal cancer (50%) and epithelial ovarian cancer (18.2%). Notably, all cases with *BRCA* mutation had high-grade serous histopathology. Another study that used 139 tissue paraffin blocks reported a less than 10% of *BRCA* gene mutation in Thai ovarian cancer patients, being somatic mutation in 6.5% and germline mutation in 8.7% (from additional blood testing)[27]. The *BRCA* gene mutation was exclusively found in serous (30.0%) or clear-cell (5.8%) carcinoma.

Tests for inherited *BRCA1* and *BRCA2* variants may be completed using a blood, saliva, or tumor tissue sample. However, the *BRCA* gene mutation identified from tumoral tissue may be of somatic or germline origin, and thus, further blood testing is still required[28]. We performed genetic blood testing of *BRCA1* gene mutation according to the recommendation of the American Society of Clinical Oncology, which specifically states that all women diagnosed with epithelial ovarian cancer should undergo genetic testing for inherited *BRCA1*, *BRCA2*, and other ovarian cancer susceptibility genes, regardless of the clinical features of their disease or family history[29]. Furthermore, the need for genetic testing of the patient was underscored by the reporting of several types of cancer experienced by the patient's family members, in accordance with the criteria for genetic testing of the National Comprehensive Cancer Network, individuals who have a blood relative with a known or possibly has these genes, who certain personal and/or family histories of cancer, cancer diagnosed at a younger age, suffering from certain types of cancer, two or more cancer diagnoses, or families with multiple cases of cancer[30].

CONCLUSION

Our young patient, who carried *BRCA1* gene mutation, was diagnosed with high-grade serous carcinoma of the fallopian tube. The cancer spread to para-aortic lymph nodes as bulky masses, despite the localized primary tumor, was unusual. This case highlights the need for gynecologists or gynecologic oncologists to be aware of this possible event in ovarian/fallopian tubal cancer, especially high-grade serous carcinoma. Optimal surgical debulking of all gross tumors by experienced gynecologic oncologists and an expert surgeon was achieved without bleaching serosa of the primary tumor and metastatic nodal capsules. Emphasis should be placed on meticulous preoperative planning and intraoperative surgical management to ensure successful outcomes. Guidelines for management of an individual who had *BRCA* gene mutations should be followed, including maintenance targeted therapy after adjuvant chemotherapy and periodic history assessments and surveillance for other cancers.

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Reviewer Acknowledgement, 2024

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Editor-in-Chief,
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In order to maintain the high standards of the Vajira Medical Journal: Journal of Urban Medicine, our editorial team relies on the expertise of numerous professionals. They play a pivotal role in determining the topics to explore, deciding which manuscripts to publish, and making necessary adjustments to ensure the scientific integrity and reliability of the information provided. This fosters the growth and advancement of medical and health science research. I deeply appreciative of the dedication and proficiency exhibited by the individuals who reviewed manuscripts for the journal from September 1st, 2023, through August 31st, 2024.

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