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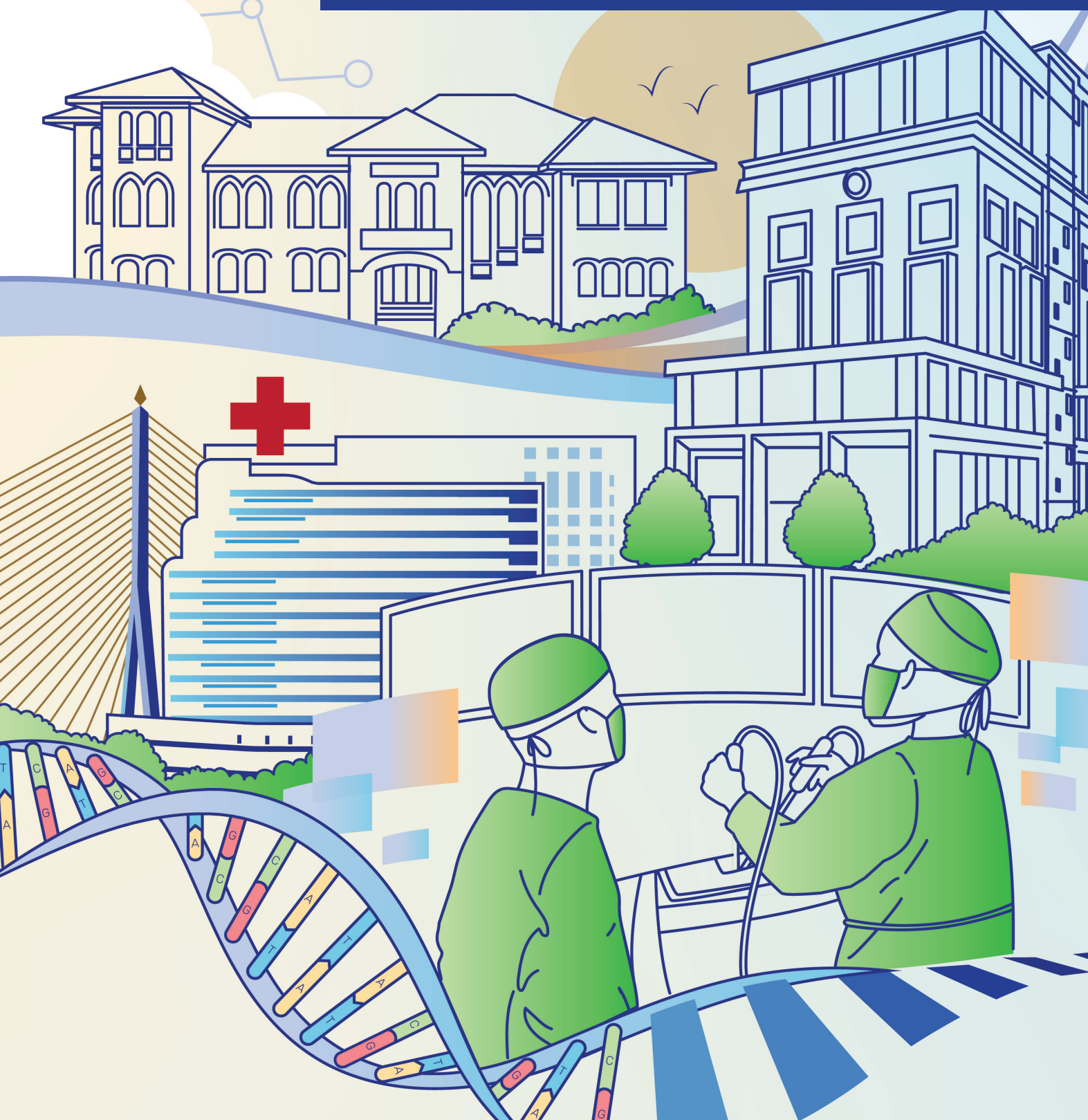

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Original Article

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Behavioral Problems of Girls with Central Precocious Puberty

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ABSTRACT

OBJECTIVE: To compare behavioral problems between girls with central precocious puberty and normal girls in the Faculty of Medicine, Vajira Hospital.

METHODS: A case-control study was conducted on 76 girls aged 6-11 years, 38 of whom were diagnosed with central precocious puberty and 38 who were considered normal with no evidence of pubertal development, from January 2021 to June 2022. A comparative study of behavioral problems was conducted using the Thai Youth Checklist for which parents are the respondents. Data were analyzed using the Independent T-Test to compare behavioral problem scores, while Fisher's Exact Test was used to compare behavioral problem levels. Significance was indicated by a p-value < 0.05.

RESULTS: The results showed T-scores of total behavior problems (95%CI: 3.70 - 10.38, p-value <0.001), internalizing problems (95%CI: 3.42 - 11.91, p-value < 0.001), and externalizing problems (95%CI: 2.66 - 11.28, p-value = 0.002) which were significantly higher in the girls in the central precocious puberty group. The behavioral problems of girls with central precocious puberty and normal girls had normal levels of 68.40% and 92.10%, respectively (p-value = 0.039).

CONCLUSION: Behavioral problems in girls with central precocious puberty were significantly higher than in normal girls. The results of this study support the idea that those girls with central precocious puberty had more behavioral problems.

KEYWORDS: behavioral problems, central precocious puberty, Thai youth checklist

INTRODUCTION

Precocious puberty is the early onset of puberty and secondary sexual characteristics in children, resulting from the activation and maturation of the hypothalamic-pituitary-gonadal axis[1]. The definition of precocious puberty is the development of secondary sexual characteristics before 8 years of age in girls and 9 years in boys. It is classified into two major categories based on the etiology: central precocious puberty 90-95%, and peripheral precocious puberty[2]. During puberty, there are changes in physical and sexual characteristics, along with new drives and motivations, as well as a wide range of social and emotional changes[3]. The brain changes during puberty and affects behavior, which contains sensory and association areas, motivation and reward, and behavioral control. Hormones, including estrogen in girls and testosterone in boys, affect the brain and behavior[4-6].

Puberty is a time of physical, emotional, mental, behavioral, and social changes. It depends on the brain, that is developed with increasing age, and is assisted by the surrounding society in

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adapting, so children who have precocious puberty exhibit physical changes that occur before other children of the same age. However, the brain that controls the emotions and mind is not yet fully developed, and therefore, there is a chance that it affects the mind and causes behavioral problems in children[7-9].

According to various research studies, it is indicated that precocious puberty can lead to specific behavioral problems and an increase in the need for psychological and social support[10-14]. However, previous studies of behavioral problems in precocious puberty in Thailand have found little information and are not widespread. Therefore, the researcher is interested in conducting a study to compare behavioral problems between girls with central precocious puberty and normal girls in the Faculty of Medicine, Vajira Hospital.

The study has the purpose of understanding the behavioral problems that tend to occur in precocious puberty so that doctors can apply the information to assess, treat, and advise girls with precocious puberty, along with their parents and families, in how to adapt to the changing body and mind, to provide them with physical, mental, emotional, and behavioral support, and a better social life.

METHODS

The study protocol was reviewed and approved by the Ethics Committee for Research in Humans, Institutional Review Board (COA 163/2021). We conducted a case-control study involving 76 girls aged 6-11 years, 38 girls of whom were diagnosed with central precocious puberty and 38 who were normal, from January 2021 to June 2022, and whose parents agreed they could participate. The girls were enrolled in this study and their parents provided informed consent and completed the Thai Youth Checklist [15].

In the girls aged 6-11 years, central precocious puberty was diagnosed in girls exhibiting 1) breast development at less than 8 years of age, 2) an advanced bone age, and 3) a basal luteinizing hormone (LH) level greater than 0.2 IU/L or a peak LH greater than 5 IU/L after 100 mcg gonadotropin releasing hormone analog stimulation test that has not previously been treated[16]. Meanwhile, the control group comprised normal girls aged 6-11 years with no evidence of pubertal development by history and physical examination. Subjects with previous underlying diseases and behavioral problems were excluded. The first section of the questionnaire covered demographic data and family information, and was followed by a behavioral problem assessment which was evaluated using the Thai Youth Checklist.

The Thai Youth Checklist is a child behavior survey which was developed and adapted from Thomas M. Achenbach's Child Behavior Checklist. There are behavior topics to be assessed, numbered from pages 1 to 135, but item 56 is divided into items A - J (9 items), so a total of 143 behavior topics are included. The standard criteria for girls aged 6-11 years divided behavior problems into 4 levels: clinical range (T-score > 70), moderate problem range (T-score 65.001 - 70), mild problem range (T-score 60.001 - 65), and normal range (T-score 0 – 60), with test – retest reliability = 0.81 ($p < 0.01$) and inter – interviewer reliability = 0.91 ($p < 0.01$).

Data were analyzed using descriptive statistics for continuous data, reported as means and standard deviations, while categorical data are presented as numbers and percentages. Statistically, the Independent T-Test was used to compare the behavioral problem scores and Fisher's Exact Test was used to compare the behavioral problem levels, with p-value of < 0.05 considered statistically significant. Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 28.0 (IBM Corp., Armonk, NY, Released 2019).

RESULTS

Of the 76 girls aged 6-11 years, there were 38 girls with central precocious puberty and 38 normal girls. The demographic data and family information are presented in Table 1. The mean ages were 8.63 ± 0.70 years and 8.45 ± 1.33 years (p-value = 0.453) for the two groups, respectively. The other demographic and family information such as birth weight, body weight, body mass index, GPA, parents' marital status, and total family income, also showed no statistically significant difference.

For the clinical characteristics of girls with central precocious puberty, numbering 38 girls, the bone age mean was 10.00 ± 1.44 years, chronological age mean was 8.51 ± 0.72 years, basal LH mean was 3.05 ± 5.75 IU/L, peak LH mean was 47.76 ± 44.37 IU/L, basal follicle stimulating hormone (FSH) mean was 4.66 ± 2.56 IU/L, peak FSH mean was 19.07 ± 7.85 IU/, estradiol mean was 38.29 ± 61.12 pg/ml, and onset mean was 7.57 ± 0.62 years. In the 38 girls with central precocious puberty, 42.10% had breast tanner stage II, 50% had stage III, and 7.90% had stage IV while 68.40% had pubic hair tanner stage I, 23.70% had stage II, and 7.90% had stage III, while 15.80% had axillary hair. The behavioral problem levels of girls with central precocious puberty and normal girls are shown in Table 2. There were normal levels of 68.40% and 92.10%, respectively, which were significantly different (p-value = 0.039).

Table 1 Demographic data and family information of girls with central precocious puberty and normal girls

	Precocious puberty (N = 38)		Control (N = 38)		P-value
Age (years)	8.63 ± 0.70		8.45 ± 1.33		0.453
Birth weight (gm)	3086.45 ± 464.22		3114.66 ± 550.16		0.813
Height (cm)	136.58 ± 7.82		129.15 ± 11.64		0.002
Body mass index (kg/m^2)	18.77 ± 3.80		17.55 ± 4.74		0.224
Normal	33	(86.80)	31	(81.60)	0.814
Overweight	3	(7.90)	4	(10.50)	
Obese	2	(5.30)	3	(7.90)	
GPA	3.82	(3.50 -4.00)	3.9	(3.40 - 4.00)	0.983
Parents' marital status					
Together	32	(84.20)	29	(76.30)	0.489
Separated/divorced	6	(15.80)	9	(23.70)	
Total family income (baht/month)	50000	(30000 - 100000)	60000	(35000 - 90000)	0.706

Abbreviations: cm, centimeter; gm, gram; GPA, Grade Point Average; kg/m^2, kilogram per square meter; N, number
Data are presented as number (%), mean ± standard deviation, or median (interquartile range)
P-values correspond to [t]Independent Samples T-Test, [m]Mann-Whitney U Test, [c]Chi-Square Test or [f]Fisher's Exact Test

Table 2 Comparison of behavioral problem levels between girls with central precocious puberty and normal girls

Total behavior problems	Precocious puberty (N = 38)	Control (N = 38)	P-value[a]
	N (%)	N (%)	
Normal range	26 (68.40)	35 (92.10)	0.039*
Mild problem range	8 (21.10)	2 (5.30)	
Moderate problem range	3 (7.90)	1 (2.60)	
Clinical range	1 (2.60)	0 (0.00)	

Abbreviations: N, number
[a]P-value corresponds to Fisher's Exact Test.
*Significant at p-value < 0.05

Table 3 showed the comparison of behavioral problems between the 38 girls with central precocious puberty and 38 normal girls. The results showed that the T-scores of total behavior problems (95%CI: 3.70 - 10.38, p-value < 0.001) were significantly different in the two groups. The T-scores of internalizing problem (95%CI: 3.42 - 11.91, p-value < 0.001) and in the internalizing problems sub-scale, the T-scores of depression/thought problems (95%CI: 3.83 - 12.25, p-value < 0.001), anxiety (95%CI: 2.76 - 11.36, p-value = 0.002), and social withdrawal (95%CI: 2.22 - 10.91, p-value = 0.004) were significantly different in the two groups. However, there was no statistical difference in the T-scores of somatic complaints. The T-scores of externalizing problem (95%CI: 2.66 - 11.28, p-value = 0.002) and in the externalizing problems sub-scale, the scores of aggressive behaviors (95%CI: 1.43 - 10.23, p-value = 0.010), and hyperactivity/impulsivity/social problems (95%CI: 2.90 - 11.48, p-value = 0.001) were significantly different in the two groups. However, there was no statistical difference in the T-scores of delinquent behavior.

DISCUSSION

In this study, there were T-scores of total behavior problems, T-scores of internalizing problems, and T-scores of externalizing problems which were significantly different in the two groups. The behavior problems level was also significantly different.

The results were consistent with the study of Kim, et al[10], which evaluated behavioral patterns and social competences in 34 girls with idiopathic precocious puberty and 39 normal girls. The mean age was 8.12 years in Korea, which used the Korean-Child Behavior Checklist (K-CBCL), and the result found T-scores of externalizing problems and total behavior problems on K-CBCL which were also significantly higher in the central precocious puberty group. In our study, the behavioral problems level of the two groups were normal levels of 68.40% and 92.10%, respectively, which were significantly different, consistent with the study of Sonis, et al[11]. who studied behavioral problems and social competence in 33 girls with true precocious puberty aged 6-11 years in the United States. The parents responded to a 120-item Child Behavior Checklist. The results showed 27% of precocious girls had an overall score of behavioral problems between 71 and 100, which is defined as the clinical range.

From the study, it was found that 22 of the 38 girls with central precocious puberty had

Table 3 Comparison of behavioral problems between girls with central precocious puberty and normal girls

	Precocious puberty (N = 38)	Control (N = 38)	Mean difference (95% CI)	P-value[a]
	Mean ± SD	Mean ± SD		
Total behavior problems	55.85 ± 7.38	48.81 ± 7.23	7.03 (3.70 - 10.38)	< 0.001*
Internalizing problems	53.83 ± 10.22	46.17 ± 8.25	7.67 (3.42 - 11.91)	< 0.001*
Somatic complaints	51.72 ± 10.83	48.28 ± 8.90	3.45 (-1.08 - 7.98)	0.134
Depression/thought problems	54.02 ± 11.19	45.98 ± 6.65	8.04 (3.83 - 12.25)	< 0.001*
Anxiety	53.53 ± 10.40	46.47 ± 8.30	7.06 (2.76 - 11.36)	0.002*
Social withdrawal	53.28 ± 10.24	46.72 ± 8.70	6.57 (2.22 - 10.91)	0.004*
Externalizing problems	53.48 ± 9.54	46.52 ± 9.32	6.97 (2.66 - 11.28)	0.002*
Aggressive behavior	52.91 ± 10.41	47.09 ± 8.77	5.83 (1.43 - 10.23)	0.010*
Delinquent behavior	51.11 ± 10.22	48.89 ± 9.78	2.22 (-2.35 - 6.79)	0.336
Hyperactivity/impulsivity/social problems	53.60 ± 9.22	46.40 ± 9.54	7.19 (2.9 - 11.48)	0.001*

Abbreviations: CI, confidence interval; N, number; SD, standard deviation
[a]P-value corresponds to Independent Samples T-Test.
*Significant at p-value < 0.05

breast tanner stage III-IV and 9 girls with behavioral problems had breast tanner stage III-IV, representing 40.90%. It was also found that 3 of 38 girls with central precocious puberty had their menstruation, with 2 out of 3 having their menstruation and experiencing behavioral problems. Therefore, other factors affecting behavioral problems should be studied as well. From this study, the interesting points to study further in the future are the relationship between behavioral problems in central precocious puberty and various other factors related to the condition, such as the duration of the condition before diagnosis, breast tanner staging, menarche, pubic hair tanner staging, hormone levels at diagnosis, etc., which should be useful in applying the data to better care for this group of patients.

The limitation of this study is that information on behavioral and emotional problems in girls with central precocious puberty is limited. Most of the studies were in girls and made use of parent-respondent questionnaires to assess behavioral problems. This may lead to bias in the results of the study. This study was a short-term study and did not follow up over the longer term. Furthermore, this study examined only the relationship between behavioral problems and girls with central precocious puberty. But it cannot be clearly concluded that are these behavioral problems are a result of central precocious puberty alone. There is no clear tool used to screen behavioral problems in patients with precocious puberty. From this research study, it is necessary to support and develop tools which can be used to screen for behavioral problems and other conditions in precocious puberty.

CONCLUSION

In summary, girls with central precocious puberty had more behavioral problems. This study helps in understanding the behavioral problems that tend to occur in precocious puberty so that we can apply the information to assess, treat, and advise girls with central precocious puberty, including parents and families, in adapting to the changing body and mind. This will provide patients with physical, mental, emotional, and behavioral support, leading to a better quality of life, allowing them to grow up as quality adults in society.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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DATA AVAILABILITY STATEMENT

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

REFERENCES

1. Poomthavorn P. Precocious puberty. Bangkok: Holistic Publishing; 2015.
2. Nathan BM, Palmert MR. Regulation and disorders of pubertal timing. Endocrinol Metab Clin North Am 2005;34(3):617-41.
3. Forbes EE, Dahl RE. Pubertal development and behavior: hormonal activation of social and motivational tendencies. Brain Cogn 2010;72(1):66-72.
4. Sisk CL, Foster DL. The neural basis of puberty and adolescence. Nat Neurosci 2004;7(10): 1040-7.
5. Korwuthikulrangsi M. Psychological and social impacts in precocious puberty. In: Poomthavorn P, editor. Precocious puberty. Bangkok: Holistic publishing; 2015. p. 136-40.
6. Peper JS, Hulshoff Pol HE, Crone EA, van Honk J. Sex steroids and brain structure in pubertal boys and girls: a mini-review of neuroimaging studies. Neuroscience 2011;191:28-37.

7. Dorn LD. Psychological and social problems in children with premature adrenarche and precocious puberty. In: Attarian H, editors. When puberty is precocious: scientific and clinical aspects. Totowa, NJ: Humana Press; 2007. p. 309-27.
8. Lee Y, Styne D. Influences on the onset and tempo of puberty in human beings and implications for adolescent psychological development. Horm Behav 2013;64(2):250-61.
9. Graber JA. Pubertal timing and the development of psychopathology in adolescence and beyond. Horm Behav 2013;64(2):262-9.
10. Kim EY, Lee MI. Psychosocial aspects in girls with idiopathic precocious puberty. Psychiatry Investig 2012;9(1):25-8.
11. Sonis WA, Comite F, Blue J, Pescovitz OH, Rahn CW, Hench KD, et al. Behavior problems and social competence in girls with true precocious puberty. J Pediatr 1985;106(1):156-60.
12. Baumann DA, Landolt MA, Wetterwald R, Dubuis JM, Sizonenko PC, Werder EA. Psychological evaluation of young women after medical treatment for central precocious puberty. Horm Res 2001;56(1-2):45-50.
13. Williams VSL, Soliman AM, Barrett AM, Klein KO. Review and evaluation of patient-centered psychosocial assessments for children with central precocious puberty or early puberty. J Pediatr Endocrinol Metab 2018;31(5):485-95.
14. López-Miralles M, Lacomba-Trejo L, Valero-Moreno S, Benavides G, Pérez-Marín M. Psychological aspects of pre-adolescents or adolescents with precocious puberty: a systematic review. J Pediatr Nurs 2022;64: e61-8.
15. Suwanlert S, Chaiyasit W. Manual for the Thai Youth Checklist. 4th ed. Bangkok: Chulalongkorn University Printing House; 1999.
16. Jaruratanasirikul S. Central precocious puberty in girls: diagnosis, management and outcome: central precocious puberty in girls. PSU Med J [internet]. 2021 Jul [cited 2023 Jan 21];1(2):69-76. Available from: https://he01.tci-thaijo.org/index.php/PSUMJ/article/view/246082

Original Article

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The Prevalence, Types, and Risk Factors of Chronic Heart Failure (CHF) in End-Stage Kidney Disease Patients with Symptomatic CHF

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ABSTRACT

OBJECTIVE: The objective of this study was to investigate the prevalence, types, and risk factors of chronic heart failure in Thai patients with end-stage kidney disease (ESKD).

METHODS: In this retrospective study, the authors examined patients with clinical heart failure in ESKD at Pranangklao Hospital between January 2021 and May 2022.

RESULTS: The study enrolled a total of 128 patients, with an average age of 58.82 ± 14.44 years, of which 56.30% were male. The average body surface area was 883.48 ± 398.41 m^2. The majority of patients received hemodialysis (65.60%). Hypertension and dyslipidemia were the most common comorbidities, and folic acid and statins were the most commonly prescribed medications. There were no statistically significant differences in left ventricular ejection fraction between patients receiving hemodialysis versus peritoneal dialysis. The study found that among the 3 different heart failure groups by left ventricular ejection fraction (LVEF) (LVEF ≤ 40%, 41-49%, ≥ 50%), the LVEF was 10 (7.81%), 7 (5.46%), and 111 (86.73%), respectively. Similarly, the diastolic function grades (grade I, II, III) were 62 (55.86%), 46 (41.44%), and 3 (2.70%), respectively. Patients with coronary artery disease had a significantly lower left ventricular ejection fraction.

CONCLUSION: Diastolic dysfunction and grade I diastolic dysfunction are common in Thai patients with ESKD.

KEYWORDS: chronic kidney disease, end-stage kidney disease, heart failure

INTRODUCTION

Presently, chronic kidney disease (CKD) is a common cause of suffering and death because the risk factors, such as obesity and diabetes mellitus, have increased in the general population. The number of people affected by CKD has also been rising, with an estimated 843.6 million people affected globally in 2017. Although end-stage kidney disease patients' mortality has decreased, end-stage kidney disease (ESKD) has become the leading cause of death globally[1]. It is of significant importance[2].

A very frequent complication is cardiovascular disease (CVD), which is the primary factor in death for ESKD patients receiving hemodialyzed (HD) treatment. When compared to the general population, this population has a 20-fold higher rate of CVD-related mortality, and CVD is present in the majority of patients with maintenance HD, which is both non-traditional and most likely brought on by ventricular hypertrophy. Risk factors include chronic volume overload, anemia, inflammation, oxidative stress, chronic kidney disease, mineral bone disorder,

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and other 'uraemic milieu' components. Knowing more about how these various CVD-related factors interact would be beneficial, for both prevention and treatment, and a crucial step in the right direction. We concentrated on non-conventional CVD risk factors in HD patients in this review[3-4].

Kidney transplantation is the most effective treatment for end-stage kidney disease, leading to a marked improvement in survival and quality of life compared to maintenance dialysis. Furthermore, the risk of CVD is decreased in patients with ESKD following a kidney transplant[5]. Patients with ESKD often experience fatigue, which may be caused by ESKD or heart failure. The European Society of Cardiology uses the New York Heart Association (NYHA)[6] classification system as the basis for diagnosing heart failure and related complications[6]. This classification categorizes patients based on the severity of symptoms, including exertional dyspnea and other symptoms that occur during normal activities or at rest. It also subdivides the types of heart failure in order to aid in the appropriate treatment[7].

Echocardiography[8], a diagnostic tool that uses high-frequency sound waves, is a primary method for assessing structural and functional abnormalities of the heart. Therefore, evaluating the parameters from echocardiography in end-stage kidney disease patients can aid in risk stratification and the prognostication of cardiovascular and vascular diseases in this population.

According to a population-based study conducted at Ain Shams Hospital in Egypt[9], the prevalence of grade I diastolic dysfunction in patients with end-stage kidney disease was 46. The purpose of this study was to investigate the prevalence, types, and risk factors of CHF in patients with ESKD.

METHODS

This was a retrospective, analytical, single-center study. The study protocol was approved by the Institutional Review Board, issued No. PE6528, which complies with the Declaration of Helsinki and CIOMS Guidelines and International Conference on Harmonization in Good Clinical Practice (ICH-GCP).

We queried the Pranangklao database between January 1, 2021 and May 31, 2022 in order to identify adults who underwent echocardiography; we identified ESKD and CHFe. We used the International Classification of Diseases, 10th Revision (ICD-10) Procedural Classification System codes beginning with N186 to identify ESKD. We used ICD-10-Clinical Modification (ICD-10-CM) codes, beginning with I50, to identify CHF.

ESKD is defined as patients with kidney failure who have undergone renal replacement therapy (RRT). Heart failure is defined as patients with a syndrome that consists of the symptoms of HF, such as shortness of breath or dyspnea[6]. There are 3 classifications for heart failure, according to LVEF: HF with reduced EF (HFrEF) LVEF ≤ 40%, HF with mildly reduced EF (HFmrEF) LVEF 41%–49%, and HF with preserved EF (HFpEF) LVEF ≥ 50%.

To select patients for the study, the following inclusion criteria were applied: patients with ESKD, aged 18 years or older and had undergone echocardiography examination due to clinical heart failure. However, patients with incomplete data or who were lost to follow-up, as well as those with arrhythmia heart rhythms, were excluded from the study.

Sample size was calculated based on the study of Ahmed A Elkaialy[9] using the following equation: $n = Z^2_{1-}\alpha/_2\, p(1-p) / d^2$. While n was the sample size, p was 0.78, d was 0.078, $\alpha = 0.05$, Z (0.975) was 1.96, and thus the number of patients required was 109.

RESULTS

From January 1, 2021 to May 31, 2022, there were a total of 128 patients diagnosed with ESKD, presenting with symptoms of HF and undergoing echocardiography heart examination.

From Table 1, the baseline characteristic of ESKD patients: the average age was 58.82 ± 14.44 years, and 56.30% were male. The average body surface area was 1.61 ± 0.18 m^2; 65.60% of the patients underwent hemodialysis, and the average hematocrit concentration was 31.57 ± 4.80. The majority of patients had comorbidities such as hypertension, hyperlipidemia, and diabetes mellitus. Those with a history of coronary artery disease and significant stenosis or occlusion of the coronary arteries demonstrated a significant increase in heart failure exacerbation. Most patients received folic acid, statins, and non-dihydropyridine CCB, in that order.

Table 1 The baseline characteristic of end-stage kidney disease patients (n = 128)

Demographic data	Total (n = 128)	Left ventricular systolic dysfunction function			
		HFrEF (n = 10) LVEF < 40	HFmrEF (n = 7) LVEF 40 - 50	HFpEF (n = 111) LVEF > 50	P-value
Age (years)	58.82 ± 14.44	60.6 ± 7.17	48 ± 14.25	59.34 ± 14.75	0.121
Male gender (%)	72 (56.30)	3 (30)	2 (28.60)	67 (60.40)	0.057
Body surface area (m^2)	1.61 ± 0.18	1.59 ± 0.11	1.70 ± 0.28	1.61 ± 0.18	0.384
Peritoneal dialysis (%)	44 (34.40)	5 (50)	1 (14.30)	38 (34.20)	0.311
Hemodialysis (%)	84 (65.60)	5 (50)	6 (85.70)	73 (65.80)	0.311
Hematocrit	31.57 ± 4.80	31.20 ± 4.48	31.29 ± 4.54	31.62 ± 4.87	0.954
Medical history					
Hypertension (%)	125 (97.70)	10 (100)	7 (100)	108 (97.30)	0.79
Diabetes mellitus (%)	84 (65.60)	7 (70)	5 (71.40)	72 (64.90)	0.897
Dyslipidemia (%)	120 (93.80)	9 (90)	6 (85.70)	105 (94.60)	0.564
Coronary artery disease (%)	35 (27.30)	7 (70)	4 (57.10)	24 (21.60)	0.001
Percutaneous coronary intervention (%)	16 (12.50)	4 (40)	2 (28.60)	10 (9)	0.007
Coronary artery bypass graft (%)	6 (4.70)	0 (0)	1 (14.30)	5 (4.50)	0.378
Previous stroke (%)	3 (2.30)	0 (0)	0 (0)	3 (2.70)	0.79
Medication					
Aspirin (%)	65 (50.80)	5 (50)	4 (57.10)	56 (50.50)	0.941
Clopidogrel (%)	28 (21.90)	2 (20)	3 (42.90)	23 (20.70)	0.385
Beta blocker (%)	70 (54.70)	5 (50)	5 (71.40)	60 (54.10)	0.638
Non-dihydropyridine calcium channel blocker (%)	87 (68)	4 (40)	6 (85.70)	77 (69.40)	0.095
Angiotensin-converting enzyme inhibitors/Angiotensin II receptor blockers (%)	53 (41.40)	2 (20)	3 (42.90)	48 (43.20)	0.359
Statins (%)	102 (79.70)	8 (80)	7 (100)	87 (78.40)	0.386
Furosemide (%)	82 (64.10)	8 (80)	5 (71.40)	69 (62.20)	0.486
Isosorbide dinitrate (%)	43 (33.60)	1 (10)	2 (28.60)	40 (36)	0.238
Sodium bicarbonate (%)	58 (45.30)	2 (20)	2 (28.60)	54 (48.60)	0.144
Calcium carbonate (%)	78 (60.90)	6 (60)	6 (85.70)	66 (59.50)	0.385
Ferrous fumarate (%)	75 (58.60)	5 (50)	4 (57.10)	66 (59.50)	0.842
Folic acid (%)	109 (85.20)	6 (60)	6 (85.70)	97 (87.40)	0.066
Erythropoietin (%)	51 (39.80)	3 (30)	2 (28.60)	46 (41.40)	0.64

Abbreviations: HFmrEF, heart failure mildly reduce ejection fraction; HFpEF, heart failure preserve ejection fraction; HFrEF, heart failure reduce ejection fraction; LVEF, left ventricular ejection fraction; m^2, meter^2; min, minute; mL, milliliter

From Table 2, which shows the characteristics of ESKD patients with echocardiographic findings, it was found that there were significant differences among the 3 groups divided by LVEF ≤ 40%, 41-49%, and ≥ 50%, in terms of the left ventricular internal dimension in diastole (LVIDd), which was 5.91 ± 0.78 cm, 5.24 ± 0.44 cm, and 4.57 ± 0.64 cm, respectively. The left ventricular mass index (LVmassIndex) also differed significantly among the 3 groups, with averages of 173.07 ± 30.68, 187.09 ± 49.25, and 137.1 ± 44.22, respectively. The left ventricular ejection fraction (LVEF by bi-plan) also varied significantly among the 3 groups, with averages of 30.47 ± 5.6, 45.81 ± 3.52, and 64.17 ± 7.19, respectively. Finally, the mean pulmonary arterial pressure (meanPAP), as measured by Abbas, also differed significantly among the 3 groups, with averages of 42.55 ± 14.35 mmHg, 37.1 ± 12.77 mmHg, and 24.22 ± 8.92 mmHg, respectively.

Table 2 Characteristics of end-stage kidney disease patients based on echocardiography findings (n = 128)

Demographic data	Total (n = 128)	Left ventricular systolic dysfunction function			
		HFrEF (n = 10) LVEF < 40	HFmrEF (n = 7) LVEF 40 - 50	HFpEF (n = 111) LVEF > 50	P-value
LVIDd (cm)	4.71 ± 0.74	5.91 ± 0.78	5.24 ± 0.44	4.57 ± 0.64	< 0.001
LVIDs (cm)	3.16 ± 0.85	5.13 ± 0.65	3.90 ± 0.62	2.94 ± 0.58	< 0.001
LVEF by Teicholz method (%)	60.48 ± 14.79	27.61 ± 7.16	48.21 ± 15.22	64.22 ± 10.66	< 0.001
Relative wall thickness	1.07 ± 5.97	0.41 ± 0.10	0.57 ± 0.07	1.16 ± 6.41	0.908
LV mass index (g/m^2)	142.64 ± 45.64	173.07 ± 30.68	187.09 ± 49.25	137.1 ± 44.22	0.001
LVEF by Bi-plane method (%)	60.53 ± 11.93	30.47 ± 5.60	45.81 ± 3.52	64.17 ± 7.19	< 0.001
LA volume index (mL/m^2)	44.69 ± 15.24	61.06 ± 13.06	47.90 ± 8.87	43.01 ± 14.90	0.001
TAPSE (cm)	2.30 ± 0.46	1.77 ± 0.58	2.21 ± 0.13	2.35 ± 0.44	< 0.001
Right atrium pressure (mmHg)	6.28 ± 3.95	10.30 ± 4.32	9 ± 2.65	5.75 ± 3.73	< 0.001
TR Vmax (m/s)	2.95 ± 1.21	4.40 ± 3.75	3.31 ± 0.82	2.79 ± 0.53	< 0.001
RVSP (mmHg)	39.68 ± 16.17	47.53 ± 21.31	55.21 ± 21.99	38 ± 14.65	0.006
meanPAP (mmHg)	26.36 ± 11.05	42.55 ± 14.35	37.1 ± 12.77	24.22 ± 8.92	< 0.001
PAEDP (mmHg)	15.46 ± 19.46	22.86 ± 8.66	21.46 ± 5.91	14.41 ± 20.52	0.299
Med E (cm/s)	94.84 ± 32.04	106.99 ± 31.94	120.89 ± 40.08	92.11 ± 30.82	0.031
Med A (c/s)	102.87 ± 30.18	86.72 ± 38.83	85.90 ± 49.96	105.40 ± 27.27	0.052
E/A	1.01 ± 0.53	1.41 ± 0.58	1.85 ± 1.20	0.92 ± 0.39	< 0.001
MV dec time (ms)	227.82 ± 70.48	180.10 ± 47.35	192.57 ± 76.33	234.34 ± 70.03	0.025
Med E' (cm/s)	7.58 ± 28.23	4.07 ± 1.78	4.99 ± 1.50	8.06 ± 30.30	0.886
Med A' (cm/s)	8.06 ± 2.64	5.13 ± 2.28	7.65 ± 3.40	8.35 ± 2.47	0.001
Med E'/A'	0.73 ± 0.58	0.87 ± 0.39	0.78 ± 0.44	0.71 ± 0.61	0.688
Med E/e'	20.15 ± 9.44	29.36 ± 10.98	26.13 ± 10.96	18.94 ± 8.66	0.00
Lat E'	7.58 ± 3.53	5.55 ± 1.25	7.96 ± 2.49	7.74 ± 3.67	0.163
Lat A'	10.33 ± 3.36	6.49 ± 2.39	10.52 ± 2.84	10.66 ± 3.27	0.001
Lat E'/A'	0.90 ± 1.34	0.97 ± 0.43	0.81 ± 0.32	0.90 ± 1.44	0.973
E/avg E'	12.03 ± 5.01	17.29 ± 4.99	16.09 ± 6.82	11.3 ± 4.51	< 0.001

Abbreviations: cm, centimeter; g, gram; LA volume index, left atrial volume index; LV mass index, left ventricular mass index; LVEF, left ventricular ejection fraction; LVIDd, left ventricular internal diameter diastolic; LVIDs, left ventricular internal diameter systolic; m^2, meter^2; meanPAP, mean pulmonary artery pressure; min, minute; mL, milliliter; mmHg, millimeter of mercury; ms, milliseconds; MV dec time, mitral valve deceleration time; PAEDP, pulmonary artery ends diastolic pressure; RVSP, right ventricular systolic pressure; s, second; TAPSE, tricuspid annular plane systolic excursion; TR Vmax, tricuspid regurgitation velocity maximum

From Table 3, the characteristics of chronic decompensated heart failure patients with diastolic dysfunction grade III who had a history of bypass surgery were found to have an average age of 59.34 ± 14.75 years, with 56.3% being male. The average body surface area was 1.61 ± 0.18 m^2, and the average glomerular filtration rate was 7.01 ± 2.99 mL/min/1.73m^2; 65.6% of the patients underwent hemodialysis, and the average hematocrit was 31.62 ± 4.87%. Most patients had comorbidities such as hypertension, hyperlipidemia, and diabetes, in that order. The history of bypass surgery was significantly associated with grade III diastolic dysfunction. The majority of patients received folic acid, statins, and non-dihydropyridine CCB, in that order.

Table 3 Characteristics of end-stage kidney disease patients in diastolic dysfunction group based on baseline characteristic findings (n = 111)

Demographic data	Total (n = 111)	Left ventricular diastolic dysfunction			
		Grade I (n = 62)	Grade II (n = 46)	Grade III (n = 3)	P-value
Age (years)	59.34 ± 14.75	60.65 ± 14.72	58.04 ± 13.64	52.33 ± 31.66	0.472
Male gender (%)	67 (56.3)	32 (51.60)	33 (71.70)	2 (66.70)	0.104
Body surface area (m^2)	1.61 ± 0.18	1.63 ± 0.17	1.59 ± 0.18	1.43 ± 0.23	0.141
Peritoneal dialysis (%)	38 (34.4)	25 (40.30)	12 (26.10)	1 (33.30)	0.305
Hemodialysis (%)	73 (65.6)	37 (59.7)	34 (73.90)	2 (66.70)	0.305
Glomerular infiltration rate (mL/min/1.73m^2)	7.01 ± 2.99	7.06 ± 3	7.04 ± 3.05	5.33 ± 2.08	0.620
Hematocrit	31.62 ± 4.87	31.59 ± 5.17	31.63 ± 4.45	32.13 ± 6.62	0.982
Medical history					
Hypertension (%)	108 (97.70)	59 (95.2)	46 (100)	3 (100)	0.296
Diabetes mellitus (%)	72 (65.60)	38 (61.30)	33 (71.70)	1 (33.30)	0.271
Dyslipidemia (%)	105 (93.80)	57 (91.90)	45 (97.80)	3 (100)	0.374
Coronary artery disease (%)	24 (27.30)	12 (19.40)	11 (23.90)	1 (33.30)	0.751
Percutaneous coronary intervention (%)	10 (12.50)	4 (6.50)	6 (13)	0 (0)	0.426
Coronary artery bypass graft (%)	5 (4.70)	2 (3.20)	2 (4.30)	1 (33.30)	0.049
Previous stroke (%)	3 (2.30)	2 (3.20)	1 (2.20)	0 (0)	0.906
Medication					
Aspirin (%)	56 (50.80)	29 (46.80)	24 (52.20)	3 (100)	0.189
Clopidogrel (%)	23 (21.90)	12 (19.40)	11 (23.90)	0 (0)	0.566
Beta blocker (%)	60 (54.70)	29 (46.80)	28 (60.90)	3 (100)	0.094
Non-dihydropyridine calcium channel blocker (%)	77 (68)	39 (62.90)	37 (80.40)	1 (33.30)	0.058
Angiotensin-Converting enzyme inhibitors/Angiotensin II Receptor Blockers (%)	48 (41.40)	24 (38.70)	23 (50)	1 (33.30)	0.474
Statins (%)	87 (79.70)	48 (77.40)	37 (80.40)	2 (66.70)	0.822
Lasix (%)	69 (64.10)	38 (61.30)	29 (63)	2 (66.70)	0.97
Isosorbide dinitrate (%)	40 (33.60)	18 (29)	21 (45.70)	1 (33.30)	0.205
Sodamint (%)	54 (45.30)	30 (48.40)	22 (47.80)	2 (66.70)	0.817
Calcium carbonate (%)	66 (60.90)	37 (59.70)	29 (63)	0 (0)	0.098
Ferrous sulfate (%)	66 (58.60)	39 (62.90)	25 (54.30)	2 (66.70)	0.648
Folic acid (%)	97 (85.20)	54 (87.10)	40 (87)	3 (100)	0.8
Espogen (%)	46 (39.80)	29 (46.80)	16 (34.80)	1 (33.30)	0.439

Abbreviations: m^2, $meter^2$; min, minute; mL, milliliter

Table 4 shows the characteristics of ESKD patients according to their echocardiographic findings. There were significant differences among the 3 groups in LVmass index, LA volume index, TAPSE, RAP, TR Vmax, RVSP, meanPAP, Med E, Med A, E/A, MV dec time, Med E/e', Lat A', and E/avg E'.

DISCUSSION

This study investigated the prevalence, types, and risk factors of CHF in ESKD patients with the symptoms of heart failure at Phranangklao Hospital. The study population included patients who underwent peritoneal dialysis or hemodialysis. The duration of their kidney disease was unknown.

The study found that patients with ESKD and the symptoms of HF were classified based on the function of their left ventricle. Most patients (86.73%) had heart failure with preserved ejection fraction, which is consistent with previous research[9]. In addition, risk factors for

Table 4 Characteristics of end-stage kidney disease patients in diastolic dysfunction group based on echocardiography findings (n = 111)

Demographic data	Total (n = 111)	Left ventricular diastolic dysfunction			
		Grade I (n = 62)	Grade II (n = 46)	Grade III (n = 3)	P-value
LVIDd (cm)	4.57 ± 0.64	4.47 ± 0.61	4.69 ± 0.68	4.57 ± 0.40	0.217
LVIDs (cm)	2.94 ± 0.58	2.87 ± 0.58	3 ± 0.58	3.37 ± 0.61	0.209
LVEF by Teicholz method (%)	64.22 ± 10.66	64.13 ± 12.17	65.13 ± 7.78	52.17 ± 11.64	0.124
Relative wall thickness	1.16 ± 6.41	1.63 ± 8.58	0.56 ± 0.15	0.52 ± 0.13	0.688
LVmass index (g/m^2)	137.1 ± 44.22	121.98 ± 28.66	156.29 ± 53.63	155.3 ± 41.30	< 0.001
LVEF Bi-plane method (%)	64.17 ± 7.19	63.34 ± 6.95	65.56 ± 6.98	60 ± 13.46	0.169
LA volume index (mL/m^2)	43.01 ± 14.90	36.49 ± 13.60	50.46 ± 10.94	63.6 ± 25.50	< 0.001
TAPSE (cm)	2.35 ± 0.44	2.27 ± 0.38	2.47 ± 0.49	2.03 ± 0.15	0.024
Right atrium pressure (mmHg)	5.75 ± 3.73	4.95 ± 3.19	6.63 ± 4.04	8.67 ± 6.03	0.025
TR Vmax (m/s)	2.79 ± 0.53	2.47 ± 0.28	3.18 ± 0.48	3.52 ± 0.39	< 0.001
RVSP (mmHg)	38 ± 14.65	29.65 ± 7.23	47.90 ± 15.02	58.67 ± 8.74	< 0.001
meanPAP (mmHg)	24.22 ± 8.92	20.21 ± 7.13	29.47 ± 8.42	26.53 ± 9.3	< 0.001
PAEDP (mmHg)	14.41 ± 20.52	14.06 ± 27.16	14.9 ± 5.29	14.27 ± 4.21	0.978
Med E (cm/s)	92.11 ± 30.82	75.08 ± 19.72	112.14 ± 28.26	136.67 ± 35.02	< 0.001
Med A (cm/s)	105.40 ± 27.27	101.8 ± 26.55	113.64 ± 24.32	53.47 ± 9.38	< 0.001
E/A	0.92 ± 0.39	0.76 ± 0.20	1.02 ± 0.31	2.57 ± 0.21	< 0.001
MV dec time (ms)	234.34 ± 70.03	250.23 ± 81.56	216.17 ± 43.11	184.67 ± 77.05	0.019
Med E' (cm/s)	8.06 ± 30.30	5.27 ± 1.48	11.95 ± 4.05	5.92 ± 2.15	0.527
Med A' (cm/s)	8.35 ± 2.47	9.27 ± 2.25	7.34 ± 2.15	4.83 ± 2.96	< 0.001
Med E'/A'	0.71 ± 0.61	0.6 ± 0.22	0.84 ± 0.88	1.03 ± 0.59	0.091
Med E/e'	18.94 ± 8.66	15.29 ± 6.06	23.59 ± 9.47	23.2 ± 6.88	< 0.001
Lat E'	7.74 ± 3.67	7.96 ± 2.89	7.36 ± 4.53	9.07 ± 4.10	0.575
Lat A'	10.66 ± 3.27	11.41 ± 3.23	9.90 ± 3.040	7 ± 3.36	0.008
Lat E'/A'	0.90 ± 1.44	1.03 ± 1.89	0.73 ± 0.37	0.93 ± 0.42	0.555
E/avg E'	11.30 ± 4.51	8.75 ± 2.50	14.63 ± 4.47	12.80 ± 4.22	< 0.001

Abbreviations: cm, centimeter; g, gram; LA volume index, left atrial volume index; LV mass index, left ventricular mass index; LVEF, left ventricular ejection fraction; LVIDd, left ventricular internal diameter diastolic; LVIDs, left ventricular internal diameter systolic; m^2, $meter^2$; meanPAP, mean pulmonary artery pressure; min, minute; mL, milliliter; mmHg, millimeter of mercury; ms, milliseconds; MV dec time, mitral valve deceleration time; PAEDP, pulmonary artery ends diastolic pressure; RVSP, right ventricular systolic pressure; s, second; TAPSE, tricuspid annular plane systolic excursion; TR Vmax, tricuspid regurgitation velocity maximum

heart failure, such as abnormal cardiac contractility, were significantly associated with a history of coronary artery disease, which is consistent with previous research.

It was found that grade I diastolic dysfunction was the most common type of diastolic dysfunction, accounting for 55.86% of cases, which is consistent with research from other countries. Grade II diastolic dysfunction was found in 41.44% of cases, and grade III diastolic dysfunction in 2.70%. Prevention of diastolic dysfunction can reduce the severity and incidence of death from heart and vascular diseases in patients with renal failure[10]. With the data from this study, there is an opportunity to study the prevention and treatment of abnormal relaxation-type heart failure in the future.

The progression of CKD is characterized by uremic toxin accumulation. Uremic toxin retention gets worse over time without treatment because CKD is a progressive condition by nature. A growing body of evidence suggests that uremic toxins are to blame for CVD, which is the leading cause of death in the population with CKD[11].

All types of HF can be effectively treated to extend life and lower hospitalization rates. The recommendations state that the main factors contributing to the underuse of renin-angiotensin-aldosterone system inhibitors, particularly aldosterone receptor antagonist, in clinical practice are renal dysfunction and hyperkalemia. By encouraging the tolerance of small or moderate drops in eGFR, it will be possible to prevent needless dose reductions or discontinuations of HF medications, which will reduce cardiovascular mortality while concurrently slowing the rate of CKD progression over the long term[12].

Overall, this study provides valuable information on the prevalence and risk factors of CHF in ESKD patients. The findings can stimulate further research on the mechanisms and treatments of abnormal cardiac contractility in this population. The present study had some limitations. First, the study population was recruited from a single center and thus might be generalizable. Second, this study was a retrospective study with a small sample size and thus might be underpowered for the purpose of evaluating some risk factors. Therefore, a larger study is needed in the future.

CONCLUSION

Diastolic dysfunction of the heart is common in patients with ESKD. There is a significant correlation between heart failure with preserved ejection fraction and a history of coronary artery disease and/or left ventricular hypertrophy. This highlights the importance of preventing and managing diastolic dysfunction in order to reduce the incidence of heart failure and its associated complications.

CONFLICT OF INTEREST

The authors report no conflict of interest for this article.

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DATA AVAILABILITY STATEMENT

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

REFERENCES

1. Kovesdy CP. Epidemiology of chronic kidney disease: an update 2022. Kidney Int Suppl (2011) 2022;12(1):7-11.
2. Centers for Disease Control and Prevention. National chronic kidney disease fact sheet: general information and national estimates on chronic kidney disease in the United States, 2014. Atlanta: US Department of Health and Human Services, Centers for Disease Control and Prevention; 2014.

3. Cozzolino M, Mangano M, Stucchi A, Ciceri P, Conte F, Galassi A. Cardiovascular disease in dialysis patients. Nephrol Dial Transplant 2018;33(suppl 3):iii28-34.
4. Saran R, Li Y, Robinson B, Abbott KC, Agodoa LY, Ayanian J, et al. US renal data system 2015 annual data report: epidemiology of kidney disease in the United States. Am J Kidney Dis 2016;67(3 Suppl 1):S1-305.
5. Rangaswami J, Mathew RO, Parasuraman R, Tantisattamo E, Lubetzky M, Rao S, et al. Cardiovascular disease in the kidney transplant recipient: epidemiology, diagnosis and management strategies. Nephrol Dial Transplant 2019;34(5):760-73.
6. McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M, et al. 2021 ESC guidelines for the diagnosis and treatment of acute and chronic heart failure. Eur Heart J 2021;42(36):3599-726.
7. Tsilonis K, Sarafidis PA, Kamperidis V, Loutradis C, Georgianos PI, Imprialos K, et al. Echocardiographic parameters during long and short interdialytic intervals in hemodialysis patients. Am J Kidney Dis 2016;68(5):772-81.
8. Nagueh SF, Smiseth OA, Appleton CP, Byrd BF, Dokainish H, Edvardsen T, et al. Recommendations for the evaluation of left ventricular diastolic function by echocardiography: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. Eur Hear J-Cardiovasc Imaging 2016;17(12):1321–60.
9. Elkaialy AA, Walid MS, Thabet SS, Gharieb MA. Prevalence of left ventricular diastolic dysfunction by tissue doppler imaging in patients with end stage renal disease undergoing regular dialysis with preserved systolic function. Int J Med 2021;114 Suppl 1.
10. Han JH, Han JS, Kim EJ, Doh FM, Koo HM, Kim CH, et al. Diastolic dysfunction is an independent predictor of cardiovascular events in incident dialysis patients with preserved systolic function. PLoS One 2015;10(3):e0118694.
11. Lekawanvijit S. Cardiotoxicity of uremic toxins: a driver of cardiorenal syndrome. Toxins (Basel) 2018;10(9):352.
12. Edwards NC, Price AM, Steeds RP, Ferro CJ, Townend JN. Management of heart failure in patients with kidney disease-updates from the 2021 ESC guidelines. Nephrol Dial Transplant 2023;38(8):1798-806.

Original Article

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Mortality and Outcomes of Very Low Birth Weight Infants in Faculty of Medicine Navamindradhiraj University

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ABSTRACT

OBJECTIVE: To determine the mortality and morbidity rate of very low birth weight infants (VLBW) who were admitted to the neonatal care unit of Faculty of Medicine Vajira Hospital, Navamindradhiraj University.

METHODS: A retrospective review of statistical data from the medical record of VLBW infants who were admitted between January 1, 2014 to December 31, 2020 (7 years). The statistical data include data collected until infants were discharged from hospital.

RESULTS: A total of 217 VLBW infants were analyzed. The mortality rate among VLBW infants during the 7-year study is 12%. The infant's mortality rates of birth weight (BW) 1,000-1,499 g and 500-999 g were 5% and 25%, respectively. The mean gestational age was 29.4 ± 2.7 weeks, the mean BW was 1079.8 ± 255.9 g . The common morbidities were respiratory distress syndrome (65%), bronchopulmonary dysplasia (34.1%), hemodynamic significant patent ductus arteriosus (41%) and culture positive late onset sepsis (35.9%). On the 28th day after birth, the survival rate of birth weight 1,000-1,499 g was 95.7% and significantly higher than birth weight 500-999 g extremely low birth weight (ELBW) (80.3%). In addition, when comparing BW in two groups, it was found that the mortality and morbidity rate were higher in ELBW group with statistically significant (p-value < 0.001). The trend of mortality rate for VLBW infants were 23.3%, 20.7% and 18.2% in 2015-2017. However, the mortality rate was decreased to 7.9%, 3% and 7.3% in 2018-2020.

CONCLUSION: The mortality and morbidity rates are significantly correlated to BW. The mortality and morbidity rate of VLBW infants tend to decrease each year.

KEYWORDS: morbidity rate, mortality rate, survival rate, very low birth weight infants

INTRODUCTION

In Southeast Asia, preterm neonatal morbidity accounts for 37% of the mortality of newborn[1] and is considered the most critical cause. In Thailand, first nationwide study showed the incidence of extremely low birth weight (ELBW) infants was 1.8 per 1,000 live births and mortality rate was 36.9% in hospital[2]. The risk factors contributing to the preterm labor and morbidity include teenage pregnancy, maternal under and overweight, long and short gestational intervals, chronic diseases, maternal infectious diseases, depression conditions, maternal smoking, etc[3].

The preterm infants account for 10% of all live newborns at Faculty of Medicine Navamindradhiraj University from data record in neonatal unit. The rates of mortality and morbidity are inversely proportional to the gestational age (GA) and birth weight (BW) of the preterm infants. Some preterm infants who survived have high risk of delayed growth development, chronic illness, and other long-term health issues[3-4].

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Nowadays, treatment modality and strategies include administration of prenatal corticosteroids, surfactants, use of non-invasive ventilator, and gentle ventilator techniques administration can reduce morbidity conditions such as necrotizing enterocolitis (NEC), nosocomial infection, severe intraventricular hemorrhage (IVH), retinopathy of prematurity (ROP), bronchopulmonary dysplasia (BPD), and hemodynamic significant patent ductus arteriosus (hsPDA). Despite these treatments, post-discharge complications such as chronic lung disease in infants can still be found . It is important that the health monitoring system for preterm infants after discharge from hospital is implemented to develop more comprehensive and holistic care measures and methods[3-5].

The health incidences related to preterm, very low birth weight infants (VLBW), remain alarmingly high. In addition to maternal physical condition, other factors such as family/living environment, socio-economic status, and community health conditions can contribute to these health incidences [5]. Therefore, a holistic research program that links various facets of preterm infant causes, preventions, and medical care together is warranted. Faculty of Medicine Vajira Hospital, Navamindradhiraj University is actively working towards being the center of excellence for preterm newborn health care. The study regarding mortality and morbidity rates of VLBW infants preterm is important to improve and develop health care strategies and quality of neonatal care. This study aims determine and analyze mortality rate, morbidity rate, and their related factors of VLBW infants at Vajira Hospital.

METHODS

This is a retrospective cohort study. The data were collected from the neonatal patients diagnosed as VLBW infant who were born in Vajira Hospital or were transferred from other hospitals and admitted into the neonatal unit from January 1, 2014 to December 31, 2020. Preterm patients with genetic abnormalities and major congenital anomalies, periviable infants (GA < 24 weeks or BW < 500 g and VLBW infants who were referred to the other hospitals before discharge were excluded.

Information collected from mothers with live VLBW infants includes age, underlying diseases, pregnancy history, antenatal risk factors including pregnancy induced hypertension (PIH), gestational diabetes mellitus (GDM), risk sepsis (preterm labor, prolonged preterm premature rupture of membrane (PPPROM) and inadequate intrapartum antibiotic prophylaxis), multiple pregnancy and no antenatal care (ANC), treatment received before delivery and methods of delivery , number of referral and number of birth before arrival (BBA). Information collected from VLBW infants includes gender, birth weight (categorized as small for gestational age (SGA) and appropriate for gestational age (AGA), gestational age determined by obstetric measures (eg, last menstrual period and ultrasonography) or by clinical assessment using Ballard score system, APGAR score, morbidities IVH as defined in Papile GM/IVH classification, which grade3/4 IVH was considered severe grade, periventricular leukomalacia (PVL), RDS, culture positive-late onset sepsis (LOS), central line-associated bloodstream infection (CLABSI) as defined in infectious diseases society of America 2020, septicemia/ meningitis, ventilator associated pneumonia (VAP), urinary tract infection (UTI), NEC as defined in Modified Bell's staging criteria for necrotizing enterocolitis, BPD as defined in national of health consensus conference (NIH) criteria, hsPDA which was diagnosed based on both echocardiogram and clinical findings by pediatric cardiologist, ROP as defined in International Classification of ROP, treatments received including surfactant therapy, hsPDA medical treatment and surgical intervention, ROP requiring intervention or surgical treatment/ severe ROP, and NEC medical and surgical treatment, and cause of death.

Statistical analyses for this study were performed using SPSS version 17.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics (n, mean

and standard deviation) were used in summarizing continuous variables. Frequency and percents were used in summarizing categorical variables. Comparisons between birth weight categories, t-test was used in comparisons for continuous variables. Chi-square test or Fisher's exact test was used in comparisons for categorical variables. Kaplan-Meier was used in estimating survival rates and log-rank test was used in comparison the survival curves between the two birth weight categories. When appropriate, logistic regression was used in analyzing binary categorical outcomes by adjusting for key prenatal variables. Unless otherwise indicated, the statistical significance level was 0.05.

The sample size calculation for this study was based on mortality rate of VLBW infants at Chaing Mai University in 2010 and 2015 with alpha level of 0.05 and estimation error of 0.05. The minimum sample size needed to achieve these criteria was 144 people. However, in this particular study, the number of participants was 239, which provides a more robust result. The larger sample size ensures that the results are more representative of the population being studied and reduces the risk of random error in the estimation of the proportion.

This study was approved by internal review board of Faculty of Medicine Vajira Hospital, Navamindradhiraj University. The COA number of this project is 200/64E. All information had been through the research ethics consideration and was used for research purposes only. No personal information is disclosed.

RESULTS

Between January 1, 2014 and December 31, 2020, there were 239 newborns diagnosed as VLBW infants (birth weight lower than 1,500 g) in Vajira Hospital. Of these 239, 22 were excluded due to major organ anomalies (9 cases), chromosome abnormalities (5 cases), periviable birth (1 case), and referral to other hospitals due to medicare (7 cases). The total number of VLBW infants admitted into Vajira's neonatal unit had increased over this study period. The ELBW (birth weight 500-999 g) infants represented a significant portion, with high records up to 42.4% (14 cases) in 2017 and 39.5% (15 cases) in 2018. In 2020, the incidence of BW 1,000–1,499 g was of the highest (28 cases) during these 7 years (figure 1). There are two categories of preterm infants, ELBW infants (500–999 g) and birth weight 1,000–1,499 g. The maternal ages of ELBW (28.7 ± 7.4 years) was not significantly different. There was no significant difference in terms of maternal risk complications and mode of delivery between two groups, however maternal of ELBW infants received completed prenatal dexamethasone lower than other group with statistically significant. Risk sepsis was the most common complication of preterm delivery. (table 1)

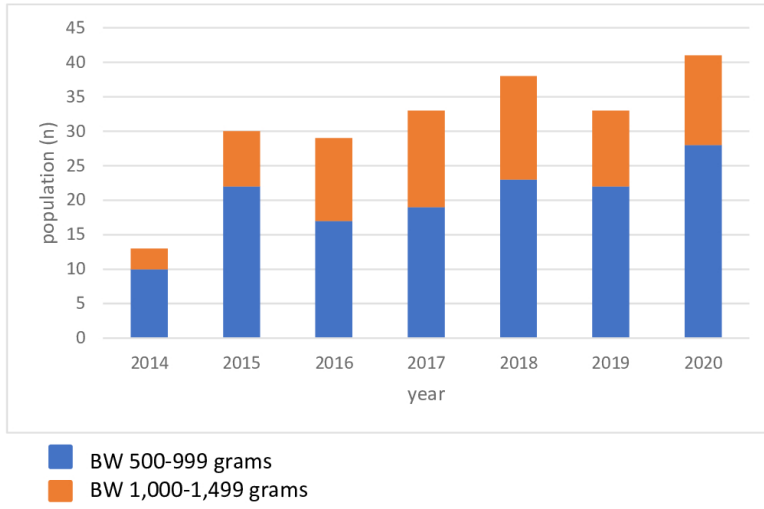

Figure 1 Total numbers of VLBW infants at Vajira Hospital

Table 1 Maternal characteristics (2014-2020; N = 217)

Characteristics	Total (N = 217)	Birth Weight (g)		P-value
		500-999 (N = 76)	1,000-1,499 (N = 141)	
Maternal age (years)	27.9 ± 7.2	28.7 ± 7.4	27.6 ± 7.1	0.267
Normal (21-34 years)	132 (60.8)	43 (56.6)	89 (63.1)	0.370
Teenage (≤ 20 years)	42 (19.4)	14 (18.4)	28 (19.9)	
Elderly (≥ 35 years)	43 (19.8)	19 (25.0)	24 (17.0)	
Maternal complication	135 (62.2)	41 (53.9)	94 (66.7)	0.065
Risk sepsis	165 (76.0)	60 (78.9)	105 (74.5)	0.461
PIH	61 (28.1)	16 (21.1)	45 (31.9)	0.090
GDM	12 (5.5)	4 (5.3)	8 (5.7)	1.000
Multiple pregnancy	33 (15.2)	10 (13.2)	23 (16.3)	0.537
No ANC	7 (3.2)	3 (3.9)	4 (2.8)	0.698
Dexamethasone	190 (87.6)	68 (89.5)	122 (86.5)	0.530
Complete course	87 (40.1)	20 (26.3)	67 (47.5)	0.002
Refer	40 (18.4)	16 (21.1)	24 (17.0)	0.465
BBA	10 (4.6)	4 (5.3)	6 (4.3)	0.743
Mode of delivery				
Cesarean section	127 (58.5)	37 (48.7)	90 (63.8)	0.031
Normal delivery	90 (41.5)	39 (51.3)	51 (36.2)	

Abbreviations: ANC, antenatal care; BBA, birth before arrival; g,gram; GDM, gestational diabetes mellitus; N, number; PIH, pregnancy-induced hypertension; PROM, premature rupture of membranes
Data are presented as number (%), mean ± standard deviation or median (interquartile range).
P-value corresponds to [t]Independent Samples T-Test, [m]Mann-Whitney U Test, [c]Chi-Square Test or [f]Fisher's Exact Test.

The survival rate in first 28 days of life of infants in BW 1,000-1,499 g group was significantly higher than ELBW infants as shown in figure 2. The GA means of BW 500-999 g (ELBW) and BW 1,000-1,499 g were 27.3 ± 2.4 weeks and 30.6 ± 2.0 weeks, respectively; however, the majority (61.8%) of ELBW had < 28 weeks while the majority (53.2%) of BW 1,000-1,499 g group had 28-30 weeks of GA (table 2). The infants in both groups were mostly AGA. Resuscitation at birth of ELBW infants had a significantly higher intubation rate than infants of BW 1,000-1,499 g (p-value < 0.001). The rate of birth asphyxia of ELBW infants (52.6%) was significantly higher than that of BW 1,000-1,499 g group (22.7%) (p-value < 0.001). The incidences of severe asphyxia were found in both groups but there was no significant difference.

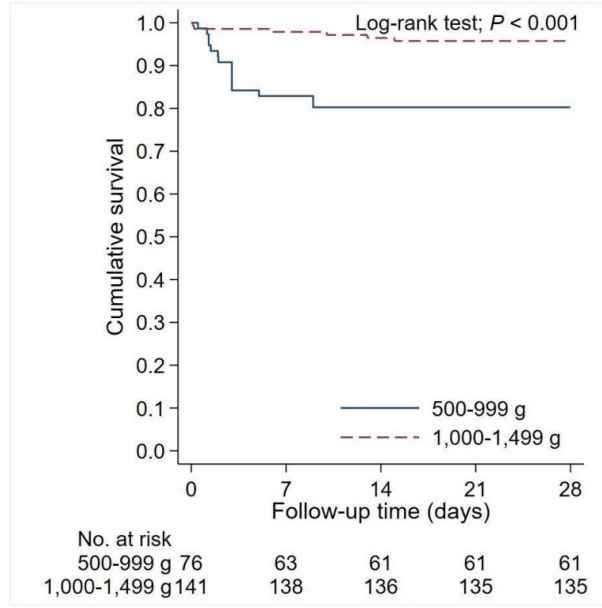

Figure 2 Cumulative survival rate according to BW (P < 0.001)

Table 2 Infant characteristics (2014 - 2020; N = 217)

Characteristics	Total (N = 217)	Birth Weight (g)		P-value
		500-999 (N = 76)	1,000-1,499 (N = 141)	
Gestational age (weeks)	29.4 ± 2.7	27.3 ± 2.4	30.6 ± 2.0	< 0.001
< 27	55 (25.3)	47 (61.8)	8 (5.7)	< 0.001
28-30	100 (46.1)	25 (32.9)	75 (53.2)	
31-32	35 (16.1)	1 (1.3)	34 (24.1)	
> 32	27 (12.4)	3 (3.9)	24 (17.0)	
Type				
AGA	176 (81.1)	61 (80.3)	115 (81.6)	0.817
SGA	40 (18.4)	15 (19.7)	25 (17.7)	
LGA	1 (0.5)	0 (0.0)	1 (0.7)	
Endotracheal intubation	125 (57.6)	69 (90.8)	56 (39.7)	< 0.001
Asphyxia	72 (33.2)	40 (52.6)	32 (22.7)	< 0.001
Severe asphyxia	21 (9.7)	9 (11.8)	12 (8.5)	0.428

Abbreviations: AGA, average for gestational age; g,gram; LGA, large for gestational age; N, number; SGA, small for gestational age
Data are presented as number (%), mean ± standard deviation or median (interquartile range).
P-value corresponds to [t]Independent Samples T-Test, [m]Mann-Whitney U Test, [c]Chi-Square Test or [f]Fisher's Exact Test.

On the 28th day after birth, the survival rate of infants in BW 1,000-1,499 g group (95.7%) was significantly higher than ELBW's (80.3%). BW is likely a good indicator of survival rate – the higher BW, the better survival rate. As for the final outcome, the total 19 out of 76 ELBW infants did not survive and 12 ELBWs (63.2%) died during the first 7 days after birth. The deaths of VLBW infants were more spread out during the first 28 days and were likely a result of many care treatment attempts to keep these infants alive (table 3). In 2014, there was no mortality case in VLBW infants because only 13 cases of VLBW infants. The trend of mortality rate for VLBW infants were 23.3%, 20.7% and 18.2% in 2015-2017, however, the mortality rate was decreased to 7.9%, 3% and 7.3% in 2018-2020. (figure 3)

The incidences of critical morbidity conditions RDS, ROP, IVH, BPD, hsPDA, CLABSI and VAP and intubation rate were significantly lower in infants of BW 1,000-1,499 g group compared to ELBW (figure 4, 5). There is no correlation in yearly morbidity conditions and care interventions.

Table 3 Mortality rate of VLBW infants categorized by birth weight (2014-2020; N = 217)

Variables	Total (N = 217)	Birth Weight (g)		P-value
		500-999 (N = 76)	1,000-1,499 (N = 141)	
Number of survival by day 28	196 (90.3)	61 (80.3)	135 (95.7)	< 0.001
Total number of death	26 (12.0)	19 (25.0)	7 (5.0)	< 0.001
Total number of survival	191 (88.0)	57 (75.0)	134 (95.0)	

Abbreviations: g,gram; N,number
Data are presented as number (%), mean ± standard deviation or median (interquartile range).
P-value corresponds to [t]Independent Samples T-Test, [m]Mann-Whitney U Test, [c]Chi-Square Test or [f]Fisher's Exact Test.

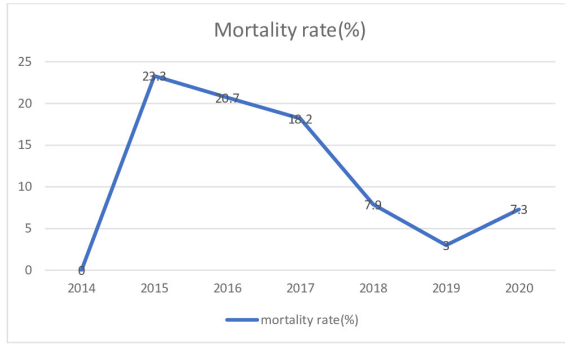

Figure 3 Trend of VLBW infants' mortality

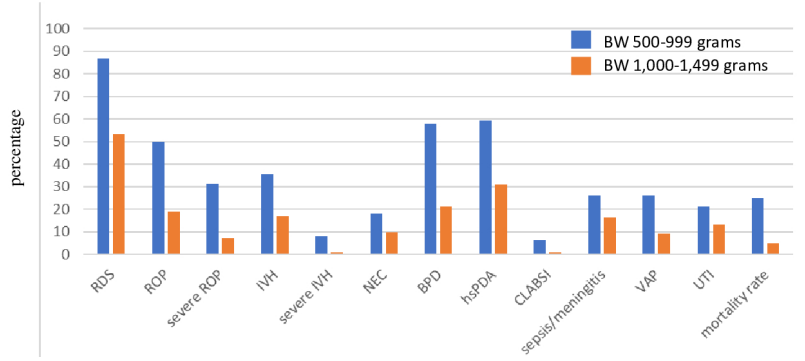

Figure 4 Mortality and morbidities of Infants

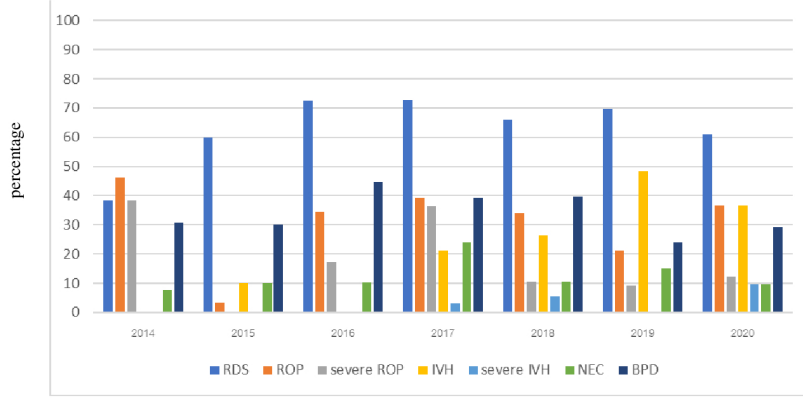

Figure 5 Morbidities by year of VLBW infants

DISCUSSION

The incidence of VLBW infants admitted to the neonatal unit of Vajira Hospital from January 1st, 2014, to December 31st, 2020, has increased every year. The infant mortality rate in this study accounted for 12%, which is similar to that reported by other institutions in Thailand[4-6] and developed countries such as Japan[7], Korean[8], Germany[9], and United State of America[10]. This study has shown that mortality and morbidities among VLBW infants significantly correlate with BW. ELBW infants had a higher mortality rate than BW 1,000-1,499 g group. The mortality rates of both groups were 25% and 5%, respectively. The mortality rate of ELBW infants in Faculty of Medicine Navamindradhiraj University is close to other tertiary hospital in Thailand[6], which are around 20-26%. Same as the mortality rate of VLBW infants that is around 5-10% from other tertiary care research[4-6]. Current study in mortality

rate of ELBW infant in Thailand, which data collected from National Health Coverage Scheme in 2015-2020 showed in-hospital mortality rate of ELBW infant was 36.9%. However, among all ELBW infants of this study, 65.1% were born at tertiary-level hospitals[2]. The most common cause of death in both groups was sepsis (76%), followed by PPHN (11.5%) and severe birth asphyxia (11.5%). Similar to other tertiary hospital in Thailand that found the survival rate of VLBW infants is higher than ELBW infants. We also found that on the 28th day after birth, the survival rate of BW 1,000-1,499 g infants was significantly higher.

The critical morbidities in the ELBW group were RDS, ROP, BPD, PDA and intubation rates and these were significantly higher than BW 1,000-1,499 g group. Based on the treatment results each year, it was found that there was no difference in mortality and morbidity rates in this study. However, the results showed a decreasing trend for both rates due to wildly used of surfactant treatment, non-invasive ventilators, t-pieces resuscitation in delivery room, peripheral inserted central catheter and protocol of infectious control in our unit started at year 2018. Despite of increasing in population of VLBW infants in 2018-2020, VLBW infants' mortality still declined. This correlates with the previous study, proving that better medical tools and technology reduce mortality and morbidity rate[8,11]. For this study, the morbidities such as RDS, ROP, IVH, PDA, and culture positive-late onset neonatal sepsis remained high. High incidence of RDS positively correlated with increased surfactant administration. However, there was a decrease in intubation rate due to current less invasive surfactant administration techniques and t-piece resuscitator in resuscitation room. The intubation rate's decline also reduced the incidence of BPD, moderate BPD, and VAP. ROP is still found in a large amount, about 37% of all VLBW infants in 2020, but the severe ROP or ROP that requires intervention were found to have reduced to 12.2%, which is consistent with the findings of research in Thailand[4-5]. The decline of severe ROP may be resulted from the decreased intubation rate and reduced exposure to high concentrations of oxygen. IVH and severe IVH are also found in large numbers, compared to about 7.5% found in studies in developed countries[9-10]. The risk factors of IVH are low GA, low BW, and asphyxia. From this study, the incidence of asphyxia and severe asphyxia accounted for 33% and 9.7%, respectively. PDA is still found to be high compared to those from Thai research[4-5]. The factors that contribute to increased hsPDA were low in GA, BW, low Apgar score for in-room resuscitation, and RDS requiring a surfactant therapy[12-13]. From this study, high incidence of hsPDA is likely associated with low GA and BW, high incidence of asphyxia, and high incidence of RDS requiring a surfactant therapy, which tends to increase every year.

Sepsis is another still very common condition, similar to research findings in Thailand[4-5]. The incidence of CLABSI and UTI is still high, while septicemia and pneumonia show a decreasing trend. Most common organisms were gram negative bacilli species such as *Escherichia coli* and *Klebsiella pneumoniae*. It may be necessary to find additional risk factors for CLABSI and UTI to reduce these problems therefore our unit set up the quality improvement team to management about infectious control in ICU. NEC is another condition that tends to decrease in both medically and surgically NEC. Currently, Vajira Hospital has a feeding protocol, that may improve this problem.

The strength of this study is that it is the first study to examine mortality and morbidity rates in VLBW infants at Vajira Hospital. For the limitations, since this is a retrospective cohort study, some data may be incomplete, such as maternal exposure to antibiotics and prenatal steroids, which, if completed, could more clearly reveal risk factors for morbidities. In addition, the population of this study was hospital based rather than population-based. For further study, we plan to assess the detailed causes of death during the NICU stay and after hospital discharge in each subject and consider the short and long-term financial burden in each patient. This study can be further used to assess the quality of care, such as infants who are referred versus infants who are treated at Vajira Hospital from birth.

CONCLUSION

The mortality and morbidity rates are significantly correlated to BW. The mortality in VLBW infants in Faculty of Medicine Vajira Hospital, Navamindradhiraj University are close to other tertiary hospitals in Thailand. The most common cause of death is neonatal sepsis. The morbidities; RDS, ROP, IVH, PDA and LOS were still high, requiring further study to identify risk factors to reduce these morbidities in VLBW infants.

CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

ACKNOWLEDGEMENT

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DATA AVAILABILITY STATEMENT

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

REFERENCES

1. World health organization. Born too soon: the global action report on preterm birth [internet]. 2012 [cited 2022 Sep 25]. Available from: https://www.who.int/publications/i/item/9789241503433
2. Kiatchoosakun P, Jirapradittha J, Paopongsawan P, Techasatian L, Lumbiganon P, Thepsuthammarat K, et al. Mortality and comorbidities in extremely low birth weight Thai infants: a nationwide data analysis. Children (Basel) 2022;9(12):1825.
3. Blencowe H, Krasevec J, de Onis M, Black RE, An X, Stevens GA, et al. National, regional, and worldwide estimates of low birthweight in 2015, with trends from 2000: a systematic analysis. Lancet Glob Health 2019;7(7): e849-60.
4. Klinratree K, Kosarat S, Tantiprabha W. Mortality and short term outcomes of very low birth weight infants in Chiang Mai University Hospital in 2010 and 2015. Thai J Pediatr 2017;56:51-9.
5. Niemtant Th, Chamnanvanakij S. Outcome of very low birth weight infants: 10-year experiences at Phramongkutklao Hospital. RTA Med J 2015;68(1):27-34.
6. Thaithumyanon P. Neonatal morbidity and mortality of very low birth weight infants at King Chulalongkorn Memorial Hospital. Chula Med J 2008;52(4):255-64.
7. Itabashi K, Horiuchi T, Kusuda S, Kabe K, Itani Y, Nakamura T, et al. Mortality rates for extremely low birth weight infants born in Japan in 2005. Pediatrics 2009;123(2):445-50.
8. Chung SH, Bae CW. Improvement in the survival rates of very low birth weight infants after the establishment of the Korean neonatal network: comparison between the 2000s and 2010s. J Korean Med Sci 2017;32(8):1228-34.
9. Jeschke E, Biermann A, Günster C, Böhler T, Heller G, Hummler HD, et al. Mortality and major morbidity of very-low-birth-weight infants in Germany 2008-2012: a report based on administrative data. Front Pediatr 2016;4:23.
10. Stoll BJ, Hansen NI, Bell EF, Shankaran S, Laptook AR, Walsh MC, et al. Neonatal outcomes of extremely preterm infants from the NICHD Neonatal Research Network. Pediatrics 2010;126(3):443-56.
11. Lee HC, Liu J, Profit J, Hintz SR, Gould JB. Survival without major morbidity among very low birth weight infants in California. Pediatrics 2020;146(1):e20193865.
12. Chen YY, Wang HP, Chang JT, Chiou YH, Huang YF, Hsieh KS. Perinatal factors in patent ductus arteriosus in very low-birthweight infants. Pediatr Int 2014;56(1): 72-6.
13. Nizarali Z, Marques T, Costa C, Barroso R, Cunha M. Patent ductus arteriosus: perinatal risk factors. J Neonatal Biol 2012;1(3):1-3.

Original Article

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The Incidence and Factors Related to the Retinopathy of Prematurity in a Tertiary Hospital in Bangkok, Thailand

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ABSTRACT

OBJECTIVE: To address the incidence, treatment outcomes, and risk factors of retinopathy of prematurity (ROP).

METHODS: The medical records were retrospectively reviewed of preterm infants who were examined for ROP at Vajira Hospital during 2015-2020. All demographic data, prenatal, postnatal conditions, ophthalmic findings, and treatment were collected.

RESULTS: Of 142 screened infants, 54 infants (38%) had ROP and 28 of them had sight-threatening ROP (24 infants with prethreshold type 1; 4 infants with prethreshold type 2). All ROP infants were born with a gestational age of fewer than 30 weeks or birthweight less than 1500 g. In multivariate analysis, low gestational age (≤ 30 weeks) and hypoglycemia were associated with any stage of ROP development. While duration of endotracheal intubation of more than 30 days and inguinal hernia were independently associated with severe ROP. Most ROP infants were finally regressed. Only 4 infants were referred out for vitreoretinal surgery.

CONCLUSION: The overall ROP incidence was 38%. Even though a majority of ROP patients recovered, recognizing possible factors helped in ROP detection and progression awareness.

KEYWORDS: incidence, outcomes, retinopathy of prematurity, risk factor

INTRODUCTION

Retinopathy of prematurity (ROP) is a major cause of childhood visual impairment and blindness in Thailand[1]. The prevention of ocular complications from ROP is early detection and treatment. Faculty of Medicine, Vajira Hospital, has adopted the American Academy of Ophthalmology (AAO) screening policy[2] into a current screening guideline which includes infants born with gestational age (GA) at birth ≤ 30 weeks or birth weight (BW) ≤ 1500 g or birth weight between 1500-2000 g with unstable clinical courses.

As the Vajira hospital is a tertiary referral center as well as a medical school, many preterm infants were born with very low GA and BW. Therefore, a screening protocol should be customized upon our hospital conditions because the patient's conditions may differ from the standard guideline that was developed in North America.

This study aims to report on our current ROP database, including the incidence and outcomes of ROP treatment, as well as the factors affecting ROP development, in order to improve the quality of ROP screening and care of preterm infants.

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METHODS

This study was conducted at Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand, and approved by Vajira Institutional Review Board (COA 132/2563). Data were obtained retrospectively through an electronic medical chart review from January 1st, 2015 to December 31st,2020. All infants screened for ROP were reviewed. Our screening policy included all preterm infants born with GA ≤ 30 weeks or BW ≤ 1500 g. Other preterm infants whose GA or BW was above the requirement may be included in the screening due to poor medical conditions under a neonatologist's request. The inclusion criteria were preterm infants who had completed the ROP screening exam and followed up until retinal vascularization reached zone 3 or ROP was regressed. Exclusion criteria were infants with incomplete medical records and infants who lost follow-up exams before the postmenstrual age of 35 weeks. Before 2017, most screening examinations were performed by a retina specialist (Tanyakittikul P). After 2017, either a pediatric ophthalmologist (Bunyavee Ch) or a retina specialist (Hemarat K) examined by using indirect ophthalmoscopy with scleral depressions. ROP staging, zoning, and plus assessment were based on the International Classification of Retinopathy of Prematurity[3] and the Early Treatment of Retinopathy of Prematurity study[4]. In addition to prethreshold type 1 with plus disease, any stage zone 1 ROP with preplus disease and stage 2,3 zone 2 ROP with preplus disease were included in prethreshold type 1 ROP. Severe ROP was defined as ROP requiring treatment which was either laser photocoagulation or intravitreal bevacizumab or combined. Laser photocoagulation was performed under general anesthesia or at the bedside and intravitreal bevacizumab injection was performed in some type 1 ROP, particularly in zone 1 disease or infants who cannot tolerate a laser procedure. The follow-up visit timing complied with the AAO ROP screening policy[2].

Patient demographic data, prenatal, perinatal, and postnatal history during the infant's admission were collected. All clinical diagnoses were retrieved from the pediatrician's records. The ophthalmic findings were collected from ROP record forms. The primary outcome was the incidence of ROP. Secondary outcomes were final ROP findings and associated factor with ROP development.

The preterm infants' baseline continuous data including GA, BW, and maternal age were described as means ± standard deviation or median with interquartile range depending on the normality of distribution. Continuous data were analyzed by sample T-test or Mann–Whitney U test. Categorical data were analyzed by Chi-squared test or Fisher's exact test. GA and BW were categorized according to AAO guideline and compared across 3 groups of the final ROP findings (no ROP, spontaneous regressed ROP, and ROP requiring treatment). For the possible risk factors for the ROP development including GA, BW, duration of oxygen treatment, duration of endotracheal intubation, maternal and infants' comorbidities such as gestational diabetes mellitus, preeclampsia, eclampsia, premature rupture of membrane, chorioamnionitis, patent ductus arteriosus, pulmonary complications (apnea of prematurity, bronchopulmonary dysplasia, respiratory distress syndrome, pneumothorax, persistent pulmonary hypertension of the newborn and pulmonary hemorrhage), intraventricular hemorrhage, brain complications (hypoxic ischemic encephalopathy, intraventricular hemorrhage, periventricular leukomalacia, neonatal seizure, epilepsy, cerebral atrophy), necrotizing enterocolitis, anemia, thrombocytopenia, hyperglycemia, hypoglycemia, pneumonia, urinary tract infection, meningitis, sepsis, inguinal hernia, osteopenia, history of general anesthesia and beta-blocker usage were analyzed with univariate analysis. The factors with p-value < 0.05 were selected for multivariable analysis. The binary logistic regression was used to calculate p-value and odd ratio. Statistical analysis was performed by using IBM SPSS statistics version 23.

RESULTS

There were 162 preterm infants screened for ROP during 2015-2020 at Vajira Hospital. Only 142 cases were included in this study. Seventeen patients were excluded due to lost follow-up, and three were excluded due to incomplete medical records.

The mean GA at birth was 29.9 ± 2.8 weeks. The mean birth weight was 1196.0 ± 395.9 g. The mean postmenstrual age at the first exam was 34.2 ± 2.5 weeks. Baseline patients demographic data were shown in Table 1. The median GA at birth and the mean birth weight in infants with ROP were statistically significantly lower than the infants who had no ROP ($p < 0.001$).

Most infants (120 of 142 [85%]) were screened due to GA less than 30 weeks and/or BW less than 1500 g. Other 22 infants (15%) whose GA and BW were above the screening criteria but were screened owing to unstable clinical courses such as having noninvasive/invasive oxygen ventilation, sepsis, necrotizing enterocolitis, and post-arrest.

ROP was found in 54 infants (38%). Prethreshold ROP was 19.7% (24 infants with prethreshold type 1; 4 infants with prethreshold type 2). All prethreshold ROP infants were born with GA ≤ 30 weeks or BW less than 1500 g. Only 2 infants who were born above the screening criteria had ROP but required no treatment. The mean GA at the birth of non-ROP infants was 31.0 ± 2.3 weeks, and for severe ROP infants were 26.9 ± 1.9 weeks. The mean BW of non-ROP infants was 1341.7 ± 371.7 g, and that severe ROP infants were 826.3 ± 201.2 g. The severity of ROP classified to GA and BW was shown in Table 2.

Table 1 Baseline characteristics of 142 neonates screened for ROP

	No ROP	Any ROP	P-value
Median gestational age at birth (weeks) (median, IQR)	31 (29,33)	28 (27,30)	< 0.001[a]
Mean birth weight (grams) (mean, SD)	1341.7 ± 371.7	958.6 ± 312.4	< 0.001[b]
Mean maternal age (years) (mean, SD)	29.3 ± 7.1	29.9 ± 7.0	0.64[b]
Route of delivery (n, %)			0.619[c]
Vaginal delivery	29 (33.0%)	20 (37.0%)	
Cesarean delivery	59 (67.0%)	34 (63.0%)	
Multiple births (n, %)			0.158[c]
Singleton	71 (80.7%)	38 (70.4%)	
Multiple (twin, triplet)	17 (19.3%)	16 (29.6%)	
Maternal complications (n, %)			
GDM/DM			0.373[d]
Yes	6 (6.8%)	6 (11.1%)	
No	82 (93.2%)	48 (88.9%)	
Pre/eclampsia			0.025[c]
Yes	26 (29.5%)	7 (13.0%)	
No	62 (70.5%)	47 (87.0%)	
PROM			0.526[c]
Yes	22 (25.0%)	11 (20.4%)	
No	66 (75.0%)	43 (79.6%)	
Chorioamnionitis			0.635[d]
Yes	2 (2.3%)	2 (3.7%)	
No	86 (97.7%)	52 (96.3%)	

Abbreviations: DM, diabetes mellitus; GDM, gestational diabetes mellitus; IQR, interquartile range; n, number; PROM, premature rupture of membranes; ROP, retinopathy of prematurity; SD, standard deviation
[a] p-value by Mann–Whitney U Test
[b] p-value by Independent T-Test
[c] p-value by Chi-Square
[d] p-value by Fisher's Exact Test

Table 2 Severity of ROP according to gestational age and birthweight

	No ROP	Spontaneously regressed ROP	Severe ROP requiring treatment	P-value
Gestational age				< 0.001[a]
≤ 30 weeks	38 (43.2%)	21 (75%)	25 (96.2%)	
> 30 weeks	50 (56.8%)	7 (25%)	1 (3.8%)*	
Birthweight				0.010[b]
≤ 1500 g	65 (73.9%)	25(89.3%)	26 (100%)	
1500-2000 g	20 (22.7%)	2 (7.1%)	0 (0%)	
> 2000 g	3 (3.4%)	1 (3.6%)	0 (0%)	
Gestational age and birthweight				0.005[b]
GA > 30 weeks and BW > 1500 g	20 (22.7%)	2 (7.1%)	0 (0%)	
Others	68 (77.3%)	26 (92.9%)	26 (100%)	

Abbreviations: BW, birthweight; g, gram; GA, gestational age; ROP, retinopathy of prematurity
[a] p-value by Chi-Square
[b] p-value by Fisher's Exact Test
*Note: This infant was born at GA 31 weeks and had BW of 1160 g.

The mean postmenstrual age at the first abnormal detected ROP was 35.7 ± 2.9 weeks (ranging, 32-44 weeks). The mean postmenstrual age at the first intervention was 37.2 ± 2.3 weeks (ranging, 33-45 weeks)

All type 1 prethreshold ROP infants were treated by laser photocoagulation and/or intravitreal bevacizumab. Intravitreal bevacizumab injection was done in 5 infants with prethreshold type 1 zone 1 disease; three of them had a recurrence and required subsequent laser treatment. Two of type 2 ROP infants (zone 2 stage 3 ROP without plus disease) were treated by laser, and the other 2 infants (zone 1 stage 1 ROP without plus disease) regressed without treatment. Four infants of severe ROP progressed to stage 4/5 ROP. Three of them (stage 4a, 4b, 5) occurred during 2017-2018 and only one stage 4A ROP was referred out after that.

The mean postmenstrual age at the last visit for infants without ROP was 43.0 ± 4.0 weeks and for infants with ROP was 46.9 ± 5.8 weeks. No life-threatening condition or intraocular infection was reported following ROP examination/treatment.

The risk factors associated with developing any stage of ROP were described in Table 3 GA ≤ 30 weeks (OR = 4.4; 95%CI = 1.0-18.4, p = 0.045) and hypoglycemia (OR = 0.1; 95%CI = 0.0-0.4, p = 0.002) showed significant correlation with ROP. While the significant risk factors associated with severe ROP (shown in table 4) were duration of endotracheal intubation of more than 30 days (OR = 17.9; 95%CI = 1.8-180.8, p = 0.015) and inguinal hernia (OR = 15.8; 95%CI = 1.4-177.1, p = 0.025)

Table 3 Analysis for risk factors of any stage of ROP (n = 142)

Risk characteristics	No ROP n (%)	Any ROP n (%)	Crude OR	P-value	Adjusted OR	P-value
GA				< 0.001		0.045
≤ 30 weeks	38 (45.2%)	46 (54.8%)	7.6 (3.2–17.9)		4.4 (1.0-18.4)	
> 30 weeks	50 (86.2%)	8 (13.8%)	1		1	
BW (g)				0.005		0.382
≤ 1500 g	65 (56.0%)	51 (44.0%)	6.0 (1.7-21.2)		2.1 (0.4-10.7)	
> 1500 g	23 (88.5%)	3 (11.5%)	1		1	

Table 3 Analysis for risk factors of any stage of ROP (n = 142) (continued)

Risk characteristics	No ROP n (%)	Any ROP n (%)	Crude OR	P-value	Adjusted OR	P-value
Duration of oxygen supplement (n = 135)				< 0.001		0.287
0-30 days	48 (84.2%)	9 (15.8%)	1		0.5 (0.1-1.9)	
more than 30 days	37 (47.4%)	41 (52.6%)	5.9 (2.6-13.7)		1	
Duration of ETT (n = 135)				< 0.001		0.241
0-10 days	74 (77.9%)	21 (22.1%)	1		1	
11-30 days	7 (30.4%)	16 (69.6%)	8.1 (2.9-22.6)		3.1 (0.7-13.9)	
more than 30 days	4 (23.5%)	13 (76.5%)	11.5 (3.4-38.8)		3.5 (0.6-22.2)	
Pulmonary complications				0.004		0.183
Yes	65 (55.6%)	52 (44.4%)	9.2 (2.1-40.8)		4.0 (0.5-29.9)	
No	23 (92%)	2 (8%)	1		1	
PDA				0.001		0.145
Yes	32 (47.8%)	35 (52.2%)	3.2 (1.6-6.5)		0.40 (0.1-1.4)	
No	56 (74.7%)	19 (25.3%)	1		1	
Brain complications				0.001		0.624
Yes	18 (41.9%)	25 (58.1%)	3.4 (1.6-7.1)		1.4 (0.4-5.3)	
No	70 (70.7%)	29 (29.3%)	1		1	
NEC				0.536		
Yes	25 (58.1%)	18 (49.1%)	1.3 (0.6-2.6)			
No	63 (63.6%)	36 (36.4%)	1			
Anemia requiring transfusion (n = 130)				< 0.001		0.145
Yes	45 (50.6%)	44 (49.4%)	7.0 (2.5-19.6)		2.9 (0.7-11.8)	
No	36 (87.8%)	5 (12.2%)	1		1	
Thrombocytopenia requiring transfusion (n = 130)				0.002		0.176
Yes	10 (37.0%)	17 (63.0%)	4 (1.6-9.6)		2.7 (0.6-11.7)	
No	72 (69.9%)	31 (30.1%)	1		1	
Hyperglycemia				NA		
Yes	4 (100%)	0 (0%)	NA			
No	84 (60.9%)	54 (39.1%)				
Hypoglycemia				0.026		0.002
Yes	22 (81.5%)	5 (18.5%)	0.3 (0.1-0.9)		0.1 (0.0-0.4)	
No	66 (57.4%)	49 (42.6%)	1		1	
Pneumonia				0.001		0.239
Yes	19 (42.2%)	26 (57.8%)	3.4 (1.6-7.1)		2.1 (0.6-7.4)	
No	69 (71.1%)	28 (28.9%)	1		1	
Urinary tract infection				0.02		0.046
Yes	13 (43.3%)	17 (56.7%)	2.7 (1.2-6.0)		3.7 (1.0-13.1)	
No	75 (67.0%)	37 (33.0%)	1		1	
Meningitis				0.203		
Yes	7 (46.7%)	8 (53.3%)	2.0 (0.7-5.9)			
No	81 (63.8%)	46 (36.2%)	1			
Sepsis				0.111		
Yes	73 (59.3%)	50 (40.7%)	2.6 (0.8-8.2)			
No	15 (78.9%)	4 (21.1%)	1			

Table 3 Analysis for risk factors of any stage of ROP (n = 142) (continued)

Risk characteristics	No ROP n (%)	Any ROP n (%)	Crude OR	P-value	Adjusted OR	P-value
Inguinal hernia				0.006		0.467
Yes	4 (26.7%)	11 (73.3%)	5.4 (1.6-17.9)		1.9 (0.3-11.2)	
No	84 (66.1%)	43 (33.9%)	1		1	
Osteopenia				0.004		0.412
Yes	10 (37%)	17 (63%)	3.6 (1.5-8.6)		1.8 (0.5-7.1)	
No	78 (67.8%)	37 (32.2%)	1		1	
Surgery under GA				0.001		0.447
Yes	9 (32.1%)	19 (67.9%)	4.8 (2.0-11.6)		2.0 (0.4-10.9)	
No	79 (69.3%)	35 (30.7%)	1		1	
Betablockers				0.272		
Yes	4 (44.4%)	5 (55.6%)	2.1 (0.6-8.4)			
No	84 (63.2%)	49 (36.8%)	1			

Abbreviations: BW, birthweight; ETT, endotracheal intubation; g, gram; GA, gestational age; GA, general anesthesia; IVH, intraventricular hemorrhage; n, number; NA, not available; NEC, necrotizing enterocolitis; OR, odd ratio; PDA, patent ductus arteriosus; ROP, retinopathy of prematurity

Binary logistic regression, significant level at $p < 0.05$, adjusted for GA, BW, duration of oxygen supplement, duration of ETT, pulmonary complications, PDA, brain complications, anemia requiring transfusion, thrombocytopenia requiring transfusion, hypoglycemia, pneumonia, urinary tract infection, inguinal hernia, osteopenia, surgery under GA

Table 4 Analysis for risk factors of severe treatment-requiring ROP (n = 114)

Risk characteristics	No ROP n (%)	Severe ROP n (%)	Crude OR	P-value	Adjusted OR	P-value
GA				0.001		0.293
≤ 30 weeks	38 (60.3%)	25 (39.7%)	32.9 (4.3-253.7)		4.1 (0.3-55.6)	
> 30 weeks	50 (98%)	1 (2%)	1		1	
BW (g)				NA		
≤ 1500 g	65 (71.4%)	26 (28.6%)	NA			
> 1500 g	23 (100%)	0 (0%)				
Duration of oxygen supplement (n = 109)				0.001		0.942
0-30 days	48 (98.0%)	1 (2.0%)	1		1	
more than 30 days	37 (61.7%)	23 (38.3%)	29.8 (3.9-231.2)		0.90 (0.1-14.7)	
Duration of ETT (n = 135)				< 0.001		
0-10 days	74 (94.9%)	4 (5.1%)	1		1	
11-30 days	7 (43.8%)	9 (56.3%)	23.8 (5.8-97.4)		7.06 (0.8-60.2)	0.074
more than 30 days	4 (26.7%)	11 (73.3%)	50.9 (11.1-233.5)		17.9 (1.8-180.8)	0.015
Pulmonary complications				NA		
Yes	65 (71.4%)	26 (28.6%)	NA			
No	23 (100%)	0 (0%)				
PDA				< 0.001		0.109
Yes	32 (58.2%)	23 (41.8%)	13.4 (3.7-48.2)		4.9 (0.7-34.5)	
No	56 (94.9%)	3 (5.1%)	1		1	
Brain complications				< 0.001		0.225
Yes	18 (54.5%)	15 (45.5%)	5.3 (2.1-13.5)		3.2 (0.5-21.1)	
No	70 (86.4%)	11 (13.6%)	1		1	

Table 4 Analysis for risk factors of severe treatment-requiring ROP (n = 114) (continued)

Risk characteristics	No ROP n (%)	Severe ROP n (%)	Crude OR	P-value	Adjusted OR	P-value
NEC				0.044		0.964
Yes	25 (65.8%)	13 (34.2%)	2.5 (1.0-6.2)		1.0 (0.2-5.7)	
No	63 (82.9%)	13 (17.1%)	1		1	
Anemia requiring transfusion (n = 106)				0.005		
Yes	45 (65.3%)	24 (34.8%)	19.2 (2.5-148.8)			
No	36 (97.3%)	1 (2.7%)	1			
Thrombocytopenia requiring transfusion (n = 106)				0.002		0.504
Yes	10 (50%)	10 (50%)	5.1 (1.8-14.7)		1.9 (0.3-12.4)	
No	72 (83.7%)	14 (16.3%)	1		1	
Hyperglycemia				NA		
Yes	4 (100%)	0 (0%)	NA			
No	84 (76.4%)	26 (23.6%)				
Hypoglycemia				0.156		
Yes	22 (88%)	3 (12%)	0.39 (0.1-1.4)			
No	66 (74.2%)	23 (25.8%)	1			
Pneumonia				0.001		0.167
Yes	19 (55.9%)	15 (44.1%)	5.0 (2.0-12.5)		3.6 (0.6-21.7)	
No	69 (86.3%)	11 (13.8%)	1		1	
Urinary tract infection				0.158		
Yes	13 (65.0%)	7 (35.0%)	2.1 (0.8-6.1)			
No	75 (79.8%)	19 (20.2%)	1			
Meningitis				0.041		0.925
Yes	7 (53.8%)	6 (46.2%)	3.5 (1.1-11.5)		1.1 (1.0-12.7)	
No	81 (80.2%)	20 (19.8%)	1		1	
Sepsis				0.252		
Yes	73 (75.3%)	24 (24.7%)	2.5 (0.5-11.6)			
No	15 (88.2%)	2 (11.8%)	1			
Inguinal hernia				< 0.001		**0.025**
Yes	4 (30.8%)	9 (69.2%)	11.1 (3.1-40.3)		15.8 (1.4-177.1)	
No	84 (83.2%)	17 (16.8%)	1		1	
Osteopenia				< 0.001		0.486
Yes	10 (45.5%)	12 (54.5%)	6.7 (2.4-18.4)		2.0 (0.3-14.9)	
No	78 (84.8%)	14 (15.2%)	1		1	
Surgery under GA				< 0.001		0.382
Yes	9 (45.0%)	11 (55.0%)	6.4 (2.3-18.2)		0.4 (0.0-3.5)	
No	79 (84.0%)	15 (16.0%)			1	
Betablockers				0.532		
Yes	4 (66.7%)	2 (33.3%)	1.8 (0.3-10.1)			
No	84 (77.8%)	24 (22.2%)	1			

Abbreviations: BW, birthweight; ETT, endotracheal intubation; g, gram; GA, gestational age; GA, general anesthesia; IVH, intraventricular hemorrhage; N, number; NA, not available; NEC, necrotizing enterocolitis; OR, odd ratio; PDA, patent ductus arteriosus; ROP, retinopathy of prematurity

Binary logistic regression, significant level at $p < 0.05$, adjusted for GA, duration of oxygen supplement, duration of ETT, PDA, brain complications, thrombocytopenia requiring transfusion, pneumonia, meningitis, inguinal hernia, osteopenia, surgery under GA

DISCUSSION

The different patients' conditions and neonatal care in each hospital may affect the incidence and outcomes of ROP. There are many complicated newborn cases at the Faculty of Medicine, Vajira hospital which is the tertiary referral center in Bangkok, Thailand. The incidence of ROP in this study was 38% of the screened infants. Young GA (≤ 30 weeks), hypoglycemia, duration of endotracheal intubation (≥ 30 days) and inguinal hernia were associated with ROP development. Most ROPs were spontaneously regressed or resolved after treatment. Only a few of them were referred for retinal surgery.

The incidence of ROP in Thailand varies from 10-40%[5-10]. When compared to the same type of hospitals, Queen Sirikit National Institute of Child Health, the biggest children's hospital in Thailand, had similar ROP incidences as our study that were approximately 40%[5-6]. While the incidence at Siriraj Hospital, the biggest tertiary hospital in Thailand, was only 14%[7]. Even though the mean GA of ROP infants at Siriraj Hospital was 27.2 weeks which was close to our ROP infants, there must be some dissimilar factors contributing to ROP development.

Both GA and BW were proven for associated with ROP by systematic review and meta-analysis studies[11-12]. In this study, we found only GA was associated with ROP infants. Infants who were born early or at 30 weeks had 4.36 times more risk of developing ROP. While low birthweight (≤ 1500 g) appeared to be significant. But after adjusting with other factors, it was found no difference between 2 groups (no ROP vs ROP).

In the aspect of oxygen supplement, it is mainly involved in the pathophysiology of ROP. So, infants who had respiratory problems and required oxygen therapy were susceptible to ROP. However, after adjusting these respiratory related factors, we found only the duration of mechanical ventilation was strongly significant with severe ROP. Infants who needed endotracheal intubation more than 1 month had 17.9 times more risk of developing severe ROP. These oxygen-related factors were not reported in the Siriraj study and its ROP incidence was quite low. We hypothesized that oxygen saturation control may differ in each hospital.

Inguinal hernia is one of the common problems in preterm infants. After 32 weeks of gestational age, the testicles go down into the scrotum followed by the contraction of processus vaginalis at the inguinal canal. Infants who are born prematurely have a greater risk of developing this condition and the lower GA has a higher risk. Brooker et al. reported the association of inguinal hernia and mechanical support[13]. They proposed that prolonged increased intraabdominal pressure from a respiratory ventilator may push a force on the inguinal canal and cause an inguinal hernia. In this study, we discovered that inguinal hernia was associated with severe ROP with 15.80 times more risk. Although inguinal hernia is not involved in the ROP development, the association between inguinal hernia and ROP may be explained by its association with mechanical ventilation which we also identified as one of the ROP risk factors

Recently, some studies suggested that hyperglycemia was associated with the risk of developing ROP[14-16]. Hyperglycemia played an important role in retinal blood flow and vascular endothelial growth factor (VEGF) which impacted angiogenesis and vascular permeability[17]. In this study, we had a small number of infants with hyperglycemia, so we cannot conclude this correlation. On the other hand, we found hypoglycemia as a protective factor for developing ROP but only a small effect (OR = 0.1; 95%CI = 0.0-0.4). No studies have ever suggested a correlation between hypoglycemia and ROP development. Further studies are required.

Beta-blockers have been introduced to the role of ROP prevention given that beta-2 receptors are involved in the regulation of VEGF levels. Nevertheless, the systematic review showed limited evidence of beta-blockers as prophylactics and there was no significant effect of oral beta-blockers

on ROP progression[18]. This study showed similar results that beta-blockers were not related to ROP development.

According to our current ROP screening guideline which we have applied the AAO screening policy, we examined all preterm infants who were born at GA ≤ 30 weeks or BW ≤ 1500 g. Every ROP infant in this study was born at GA ≤ 30 weeks or BW ≤ 1500 g. Furthermore, the incidence of ROP infants whose GA or BW were above the criteria was about 10 percent and all of them spontaneously regressed. Therefore, the AAO screening criteria are applicable to our hospital.

Most treatment-requiring ROP was treated by laser photocoagulation and successfully regressed. Some zone 1 ROP infants were treated by intravitreal anti-VEGF but many of them recurred when the duration of the drug subsided. Therefore, a close follow-up examination was necessary if anti-VEGF had been applied.

The limitation of this study was the number of subjects, which may have affected the statistical interpretation. Also, there may be some variations in diagnosis and treatment among examiners. Further, some data were difficult to retrieve, such as the fraction of inspired oxygen (FIO2), which may be inconsistent, and the hematological value of anemia, which varied depending on the gestational age of the preterm infants. Future studies are planned as the conditions of infants may differ from the current situation.

CONCLUSION

The overall ROP incidence was 38%. Even though a majority of the ROP patients recovered, recognizing possible factors helped in ROP detection and progression awareness.

CONFLICT OF INTEREST

The authors report no conflicts of interest for this article.

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DATA AVAILABILITY STATEMENT

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

REFERENCES

1. Wongkittirux K. Blindness, low vision and eye diseases in Thai children 2006-2007. J Health Sys Res 2012;6(4):501-12.
2. Fierson WM. Screening examination of premature infants for retinopathy of prematurity. Pediatrics 2018;142(6): e20183061.
3. International Committee for the Classification of Retinopathy of Prematurity. The international classification of retinopathy of prematurity revisited. Arch Ophthalmol 2005;123(7): 991-9.
4. Early Treatment For Retinopathy Of Prematurity Cooperative Group. Revised indications for the treatment of retinopathy of prematurity: results of the early treatment for retinopathy of prematurity randomized trial. Arch Ophthalmol 2003; 121(12):1684-94.
5. Thitiratsanont U, Wutthiworavong B, Supangkasen I, Keyurapan B, Saowaprut Ch, Amphornphruet A. Screening for retinopathy of prematurity in Queen Sirikit National Institute of Child Health: Bangkok, Thailand. Thai J Ophthalmol 2011;25:9-16.
6. Bowe T, Nyamai L, Ademola-Popoola D, Amphornphruet A, Anzures R, Cernichiaro-Espinosa LA, et al. The current state of retinopathy of prematurity in India, Kenya, Mexico, Nigeria, Philippines, Romania, Thailand, and Venezuela. Digit J Ophthalmol 2019;25(4):49-58.
7. Chutasmit K, Wongsiride P, Sommai K, Siriwaeo S, Insawang P, Kitsommart R. Incidence and risk factors of retinopathy of prematurity, a 10-year experience of a single-center, referral, hospital. Siriraj Med J 2021;73(12):777-85.

8. Thongthong K. Prevalence and risk factors for retinopathy of premature infants in KamPhaeng Phet Hospital. Reg 11 Med J 2018;32(4):1261-8.
9. Duangsang S. Incidence and factors associated with retinopathy of prematurity (ROP) in Roiet Hospital. Srinagarind Med J 2017; 32(1):10-6.
10. Saleewan Kh. Incidence and risk factors of retinopathy of prematurity. Med J Srisaket Surin Buriram Hosp 2016;31(2):99-110.
11. Azami M, Jaafari Z, Rahmati S, Farahani AD, Badfar G. Prevalence and risk factors of retinopathy of prematurity in Iran: a systematic review and meta-analysis. BMC Ophthalmol 2018;18(1):83.
12. Yu CW, Popovic MM, Dhoot AS, Arjmand P, Muni RH, Tehrani NN, et al. Demographic risk factors of retinopathy of prematurity: a systematic review of population-based studies. Neonatology 2022;119(2):151-63.
13. Brooker RW, Keenan WJ. Inguinal hernia: relationship to respiratory disease in prematurity. J Pediatr Surg 2006;41(11):1818-21.
14. Lei C, Duan J, Ge G, Zhang M. Association between neonatal hyperglycemia and retinopathy of prematurity: a meta-analysis. Eur J Pediatr 2021;180(12):3433-42.
15. Almeida AC, Silva GA, Santini G, Brízido M, Correia M, Coelho C, et al. Correlation between hyperglycemia and glycated albumin with retinopathy of prematurity. Sci Rep 2021; 11(1):22321.
16. Ahmadpour-Kacho M, Motlagh AJ, Rasoulinejad SA, Jahangir T, Bijani A, Pasha YZ. Correlation between hyperglycemia and retinopathy of prematurity. Pediatr Int 2014;56(5):726-30.
17. Mohamed S, Murray JC, Dagle JM, Colaizy T. Hyperglycemia as a risk factor for the development of retinopathy of prematurity. BMC Pediatr 2013;13:78.
18. Kaempfen S, Neumann RP, Jost K, Schulzke SM. Beta-blockers for prevention and treatment of retinopathy of prematurity in preterm infants. Cochrane Database Syst Rev;3(3):CD011893.

Original Article

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Effects of the Health Belief Model Educational Program on Perceptions and Preventive Behaviors of COVID-19 in Secondary School Students

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ABSTRACT

OBJECTIVE: The research objective was to study the effects of the Health Belief Model Educational Program by comparing the mean score levels, before and after program participation of perceptions to prevent COVID-19 and preventive behaviors of COVID-19 in the secondary school students.

METHODS: This research was quasi-experimental research with one group pre- and post-test design. The 105 samples were the secondary school students of Wat Suttharam Secondary School, Bangkok who were selected by purposive sampling. Research tool was the Becker's Health Belief Model Educational Program. The samples who participated in the program received knowledge of COVID-19 and perceptions to prevent COVID-19 with the application of the Health Belief Model. The program was implemented for 13 hours (3 days). The data were collected by questionnaire and analyzed by percent, mean, standard deviation and paired t-test.

RESULTS: The results showed that, before and after program participation, the samples had a very good level of overall perceptions to prevent COVID-19 scores ($\overline{X}$ = 16.10 and 16.50 respectively) and the score was better after program participation with statistical significance ($p < 0.01$). The samples had a very good level of preventive behaviors of COVID-19 score ($\overline{X}$ = 2.22 and 2.34 respectively) and the score was better after program participation with statistical significance ($p < 0.01$).

CONCLUSION: The Health Belief Model Educational Program on perceptions to prevent COVID-19 and preventive behaviors of COVID-19 was effective. The heath care teams and school teachers could apply the program to promote knowledge of prevention of COVID-19 and respiratory diseases to other secondary school students.

KEYWORDS: COVID-19, perceptions, preventive behaviors, secondary school students

INTRODUCTION

COVID-19 is an emerging disease with the first epidemic found in Wuhan, China in December 2019 and has become pandemic worldwide[1]. It can be easily transmitted by respiratory system and enter lungs. The mortality rate is 1-2%[2]. The risk groups that are easily infected and have a high mortality rate are 60 years and older people and patients with chronic diseases, i.e. respiratory diseases, cardiovascular diseases, cerebrovascular diseases, obesity, cancer, diabetes mellitus and pregnant women[3]. Thailand began prevention and control program by screening body temperature of travelers at international disease control checkpoints since 3 January 2020 after China announced an outbreak of pneumonia of unknown pathogen in Wuhan, Hubei County. The first COVID-19 case was detected in a Chinese traveler on 8 January 2020. On 31 January 2020, Thailand reported

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the first COVID-19 Thai patient who was a taxi driver and never went abroad and spread the disease to his family and contact persons. The Public Health Ministry and related agencies were able to contain the infection in a limited area by surveillance and contact case finding. However, COVID-19 was respiratory transmitted disease and there were no effective medicines and vaccines at that time. Therefore, the outbreak occurred in waves[1]. The Department of Disease Control reported[3] waves of COVID-19 outbreak[4]. The first wave occurred during January to November 2020 which was detected at a boxing stadium and gambling dens in Bangkok. There were 3,998 cumulative cases with 60 deaths. The second wave occurred during December 2020 to March 2021. The starting point of this wave was the shrimp central market in Samut Sakhon Province. There were 24,855 new COVID-19 cases and 34 deaths. The mortality rate was 0.14%. The third wave occurred during April to November 2021 with 1,883,161 new COVID-19 cases and 19,111 deaths. The mortality rate was 1.01%. It was the largest wave of outbreak and the starting point was the entertainment venues at Thonglor area in Bangkok. Most of the patients who died had the history of chronic diseases or risk factors such as obesity, pregnancy or older people[1,5]. The older people had a mortality rate of 2.60%. The most common area of outbreak was in Bangkok[6].

According to statistics, the most common mortalities were found in the older people and the risk groups. However, the group of secondary school students also needed particular attention. They usually gathered in a group, in the same classroom and in the same school. Therefore, there were risks of COVID-19 carriers and they could transmit the viruses to their family members. The family members could spread the disease to other people when they went to work outside that might cause another wave of outbreak. COVID-19 outbreak had a major impact on the education system. There were more than 1,500 million students around the world who had to stop going to schools and learning from home with online learning. There were 70% of youth (age 15-19 years) who experienced increase in stress and anxiety. 27,188 students had no access to online learning. In 2020, there were 57,500 students who dropped out of schools and 65,000 students who dropped out in 2021[7-8]. Since COVID-19 is a contagious respiratory disease, the secondary school students should be urgently promoted with correct knowledge of COVID-19 prevention during the outbreak. The COVID-19 Situation Administration Center (CCSA) reported the decline of the outbreak after the second wave in March 2021[9]. On 31 March 2021 there were only 42 new COVID-19 cases and no death. The government announced the Royal Decree on Public Administration in Emergency Situations B.E. 2015 on 26 March 2020 to control and prevent the disease in 8 measures[1] by applying the Becker's Health Beliefs Model (Becker, 1974)[10].

Becker's Health Beliefs Model explained that perceptions could affect personal health behaviors if a person perceived disease risk and severity with high mortality, he would seek health information and follow the advice. And if he perceived the benefits, he would accept the recommended health action which would lead to appropriate health behaviors. There were several researchers who used Becker's Health Beliefs Model to study perceptions and preventive behaviors in the secondary school students and adolescents with results that benefited the health care system such as Onla, et al[11], Wattanaburanon, et al[12] and Waehayi[13]. However, there were no experimental studies related to Becker's Model and the students' perceptions and preventive behaviors against COVID-19.

The researchers believe that, after the health team provides correct COVID-19 knowledge, prevention and reduction of the disease spread through the Becker's Health Beliefs Model, the secondary school students would practice correct health behaviors and would not become COVID-19 carriers to their families. The research was conducted in the secondary school students in Bangkok

since Bangkok had the highest numbers of older adults and secondary school students[14-15]. The objective of this research was to study the effects of the Health Belief Model Educational Program by comparing the mean levels, before and after program participation of perceptions to prevent COVID-19 and preventive behaviors of COVID-19 in the secondary school students of Wat Suttharam Secondary School, Bangkok. Hypothesis: the secondary school students of Wat Suttharam Secondary School had a higher level of perceptions to prevent COVID-19 and preventive behaviors of COVID-19 after participating in the Health Belief Model Educational Program. The conceptual framework was applied from the Becker's Health Beliefs Model (Becker, 1974) [10]. (figure 1)

METHODS

A Quasi-experimental research with one group pre-test and post-test design was conducted in April 2021 in Bangkok. The study populations were the secondary school students of Wat Suttharam Secondary School with a total of 440 students. The samples were purposively selected from Mathayomsuksa 5 students of Wat Suttharam Secondary School. The inclusion criteria included the Mathayomsuksa 5 students who volunteered to participate in the research on the specified dates with their parents' consents, regardless of genders and grade point averages (GPA). The sample size was calculated by G*Power 3.1.3 Program (Faul, et al)[16]. Prior power analysis was performed by a one-way test with the test power was set to 0.80, the confidence (α) was 0.05, and the effect size was 0.05. The samples size of 27 students were calculated. Since this was a countable, single group and non-mobile population with intention from the class teachers, the researchers purposively selected the samples of 105 students.

The research tools included: the Health Belief Model Educational Program on perceptions and preventive behaviors of COVID-19 which was constructed by the researchers from the concept of Becker's Health Belief Model (Becker, 1974)[10]. The questionnaire to collect data created by the researchers which consisted of 3 parts: Part 1 General information of the samples. Part 2 The perceptions to prevent COVID-19 questionnaire. There were 20 questions in total. The answers were either true (score 1) or false (score 0). The questionnaire consisted of two part: Part 2.1 Risk perceptions of COVID-19 (total scores of 12) to assess the risk perceptions from the area at risk of COVID-19 infection, self-protection when entering a place where there was a risk of COVID-19, traveling in vehicles that were at risk of contracting COVID-19 and risk groups who were carriers of COVID-19. Part 2.2 The perceptions of severity and treatment of COVID-19 (total scores of 8) to assess the perceptions of initial symptoms, severity, treatment and vaccines of COVID-19. The perceptions to prevent COVID-19 scores, overall, part 2.1 and part 2.2 were interpreted as followed.

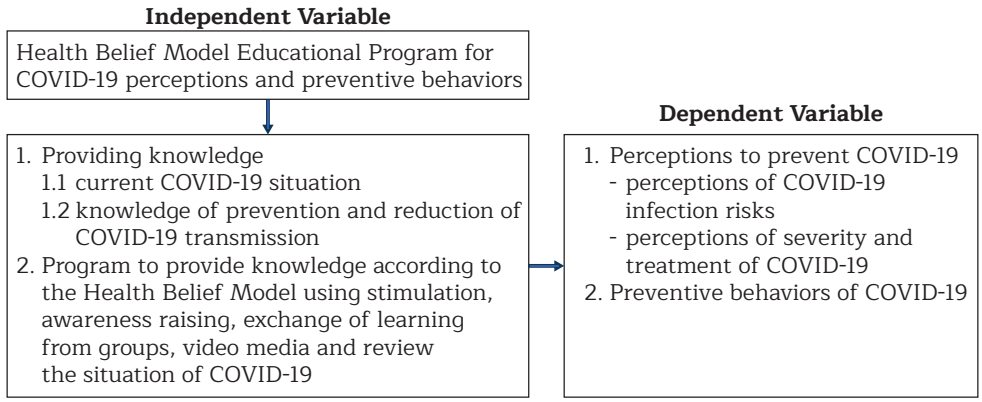

Figure 1 Health Belief Model Educational Program for COVID-19 perceptions and preventive behaviors

A very good level was mean at 81-100%, a good level was mean at 71-80% , a moderate level was mean at 61-70%, a low level was mean at 50-59%, and a very low level was mean less than 50%[17]. Part 3 The COVID-19 Preventive Behaviors Questionnaire. There were 14 questions in total. The questionnaire had the reliability of 0.92. Each answer was on a 3-level rating scale: frequently practiced (3), sometimes practiced (2), and rarely practiced (1). The preventive behaviors against COVID-19 scores were interpreted into 3 levels: a good level was 2.33-3.00, a moderate level was 1.67-2.32 and a low level was 1.00-1.66[18].

The quality of the research tools was determined by content validity and reliability. The researchers had three experts in the field of pediatric nursing, adult nursing and geriatric nursing review content validity of the questionnaire and made improvements as recommended by the experts and selected the items that had the Content Validity Index (CVI) equal to or greater than 0.66. The questionnaires were then tried out for reliability with Mathayomsuksa 5 students in other secondary schools in Bangkok. The group of 30 students, who were not the research samples, answered the questionnaire. The reliability of the questionnaire of perceptions to prevent COVID-19 was calculated by KR-20 formula. The reliability of the questionnaire of COVID-19 preventive behaviors was calculated by Cronbach's alpha coefficient. The questionnaire had the reliability of 0.94 and 0.92 respectively.

The research was conducted in April 2021 for the duration of 13 hours (3 days)[1,4,7]. The period was after the second wave of outbreak with the decline of COVID-19 infection. The research experiment was conducted in a conference room of Wat Suttharam Secondary School, Bangkok which was a tall and large hall. The electric fans were used instead of air conditioners. There was a distance of 1.50 meters between each seat and each student must wear a mask all the time. The research experiments included:

Activity 1/ day 1 (duration 5 hours)

9:00-10:00 a.m. - Building relationships, clarifying research objectives and pre-test

10:00-12:00 a.m. - Providing information on the COVID-19 situation as of 1 April, 2021[1,19] and the situation in order of the occurrence of COVID-19 infections and deaths of the first, the second and the third wave of outbreaks[1,4] .

1.00-3:00 p.m. - Providing information and knowledge on the topic of the nature of COVID-19 virus, the survival time of the virus in different environment, symptoms and signs of infection, disease transmission, danger and severity of the disease. The samples watched the two sets of video media on "Get to know and how to prevent Coronavirus disease (COVID-19)[20]" and "Thai children unite to fight against COVID-19[21]".

Activity 2/Day 2 (duration 5 hours)

9:00-11:00 a.m. - Providing knowledge on the topic of the severity of the new Coronavirus compared to other Coronaviruses, meaning and understanding of contact cases, patients and close contacts, treatment and disease prevention with vaccines in general population, children, adolescents and working people, and self-care during the COVID-19 outbreak.

11:00-12:00 a.m. - Giving information, knowledge, practice to prevent infection and reduce the spread of infection on the topic of self-observation, disease prevention for the general public, asymptomatic cases, behaviors of the persons with respiratory symptoms i.e. fever, cough, runny nose, sneezing and sore throat, and behaviors of the persons at risk of infection with a new strain of COVID-19 virus without symptoms.

1:00- 3:00 p.m. - Providing information and knowledge on daily living to be safe from COVID-19 with the personal hygiene care guidelines using the DMHTT principles to prevent and reduce the spread of COVID-19 in the following topics: 1) spacing 2) wearing a cloth mask 3) frequent hand washing 4) separation of personal belongings 5) choices of food 6) regular exercise and relaxation 7) checking body

temperature regularly 8) using the Thai Chana App and 9) self-observation for COVID-19 screening[1]. The samples watched the third set of video media on "How to protect yourself from COVID-19[22]".

During the lectures, the researchers encouraged the samples, raised awareness, exchanged learning from the groups and showed video materials on COVID-19 risks, disease severity, benefits and barriers to treatment. The samples were encouraged to share possible solutions or alternatives to solve the problems and obstacles to behave safely when they were away from home. Then the researchers advised the samples to apply the knowledge received from the 2-day group participation to protect themselves from COVID-19 in daily living.

Activity 3/ 7 days from day 1 (duration 3 hours)

9.00-10.00 a.m. - Building relationships and post-test with the same set of questionnaire.

10.00-12.00 a.m. - Reviewing the perceptions of COVID-19 acquired during the past 2 days of program participation and the problems in applying the knowledge into practice by open group discussion with the researchers.

Data analysis for general information was described by percent. Comparison data of perceptions to prevent of COVID-19 and preventive behaviors of COVID-19, before and after program participation, were analyzed by mean, standard deviation and paired t-test.

This research received certificate of ethics code COA.2-012/2022 from Rajabhat Suan Sunandha University. For protection of samples' rights, the researchers conducted the research by taking into account the confidentiality and the impact on the samples throughout the research with the informed consents from the parents to participate in the program.

RESULTS

General information of the samples: there were 105 samples who were Mathayomsuksa 5 students of Wat Suttharam Secondary School. There were 45 samples (42.85%) who had a grade point average (GPA) 3.00-3.49. 80 samples (76.18%) were 17 years old and 69 samples (65.71%) were males. There were 51 samples (48.57%) whose fathers graduated from secondary schools and 73 samples (69.52%) whose fathers were employees. There were 54 samples (51.42%) whose mothers finished primary schools and 74 samples (70.47%) whose mothers were employees. There were 84 students (80.00%) who received knowledge of COVID-19 from television and 55 students (52.38%) whose family incomes were sufficient.

Comparing the mean score levels, before and after participating in the Health Belief Model Educational Program on perceptions to prevent COVID-19. The results showed that, before and after program participation, the samples had a very good level of overall perceptions to prevent COVID-19 scores ($\overline{X}$ = 16.10 and 16.50 respectively and the score was better after program participation with statistical significance ($p < 0.01$) as Table 1. The perceptions of COVID-19 categorized by items of the risk of infection showed that the samples had a good level of the risk of infection score ($\overline{X}$ = 9.46) before program participation. After program participation, they had a very good level of perceptions of the risk of infection score ($\overline{X}$ = 9.73) which was better than the score before program participation with statistical significance ($p < 0.01$). The perceptions of the severity and treatment before and after program participation scores ($\overline{X}$ = 6.63 and 6.77 respectively) were at a very good level and the score was better after program participation with statistical significance ($p < 0.01$) as Table 1.

Comparing the mean score levels, before and after participating in the Health Belief Model Educational Program on preventive behaviors of COVID-19. Before program participation, the samples had a moderate level of preventive behaviors of COVID-19 score ($\overline{X}$ = 2.22). After program participation, they had a good level of preventive behaviors of COVID-19 score ($\overline{X}$ = 2.34) which was better than the score before program participation with statistical significance ($p < 0.01$) as Table 1.

Table 1 Comparison of perceptions to prevent COVID-19 and preventive behaviors of COVID-19 in the secondary school students, before and after program participation

Items	Total level	Mean	SD	Interpretation	Paired t-test
Perceptions to prevent of COVID-19					
- Overall					
After program participation	20	16.50	2.41	Very good	6.67**
Before program participation	20	16.10	2.22	Very good	p < 0.01
- Risk of infection					
After program participation	12	9.73	1.78	Very good	5.62**
Before program participation	12	9.46	1.72	Good	p < 0.01
- Severity and treatment					
After program participation	8	6.77	1.17	Very good	3.27**
Before program participation	8	6.63	1.06	Very good	p < 0.01
Preventive behaviors					
After program participation	3	2.34	0.22	Good	7.31**
Before program participation	3	2.22	0.17	Moderate	P < 0.01

**statistical significant at p < 0.01

Abbreviation: SD, standard deviation

DISCUSSION

The results showed that, before and after program participation, the samples had a very good level of overall perceptions to prevent COVID-19 scores ($\overline{X}$ = 16.10 and 16.50 respectively and the score was better after program participation with statistical significance ($p \leq 0.01$). The perceptions of COVID-19 of the risk of infection showed that the samples had a good level of the risk of infection score ($\overline{X}$ = 9.46) before program participation. After program participation, they had a very good level of perceptions of the risk of infection score ($\overline{X}$ = 9.73) which was better than the score before program participation with statistical significance ($p < 0.01$). The perceptions of the severity and treatment before and after program participation scores ($\overline{X}$ = 6.63 and 6.77 respectively) were at a very good level and the score was better after program participation with statistical significance ($p < 0.01$). The samples had a very good level of preventive behaviors of COVID-19 score ($\overline{X}$ = 2.22 and 2.34 respectively) and the score was better after program participation with statistical significance ($p < 0.01$). The findings were consistent with the Becker's Health Belief Model (Becker, 1974)[10] which stated that perception affected a person's health. If a person perceived that he was at risk of disease and the severity of the disease had a high mortality rate, he would seek health information and followed the advice. And if a person perceived the benefits of practice, it could lead to proper practice and behaviors. When considering the perceptions to prevent of COVID-19 before participating the program, it was found that the samples already had a good level of perceptions of COVID-19 prevention. It could result from the information from mass media and public relation of the government about COVID-19 disease, its dangers, treatment, prevention, etc. via television, Line application, YouTube and Facebook[23]. The level of perceptions to prevent of COVID-19 was increased after program participation with statistical significance. It showed that the Health Belief Model Educational Program was effective. It could be applied as a model to promote knowledge of other communicable diseases in the future. Program participation helped filling the gap of knowledge in COVID-19 prevention. The program focused on providing the samples the knowledge of COVID-19 related to perceived risk opportunities, disease severity, benefits and obstacles to treatment. As a result, the samples took action and practiced proper COVID-19 preventive behaviors. After participating in the program, the samples had preventive behaviors of COVID-19 increased from a moderate level to a good level with statistical significance. This resulted in appropriate behaviors

to prevent COVID-19 and would not become carriers of COVID-19 that spread the disease to their family members and the public. The finding was consistent with the survey research of Onla, et al[11] which found that the samples of the secondary school students, aged 12-19 years, had a high level of COVID-19 knowledge, perceived severity of the disease and perceptive behaviors of COVID-19 . It was also consistent with Wattanaburanon, et al[12] who found that the secondary school students in Bangkok had a high level of perception of the severity of COVID-19 and perceptive behaviors of COVID-19. And it was consistent with Waehayi who found that teenagers had a high level of perception of the severity of COVID-19 at 87.10% and perceptive behaviors of COVID-19 at 91.40%.

The strengths of this research was the health belief model educational program and generalizability. The health belief model educational program on perceptions and preventive behaviors of COVID-19 was based on the Becker's Health Belief Model (Becker, 1974)[10]. The program provided knowledge in COVID-19 prevention and allowed the samples to share possible solutions for safety behaviors against COVID-19. The generalizability of the research could be applied to other secondary school students to promote COVID-19 prevention.

This research had two limitations. The first limitation was the research design which was quasi-experimental research with one group pre- and post-test design without control group. There was no comparison between intervention and control groups. The result could have confounding variables. The second limitation was no follow-up study of perception to prevent COVID-19 and perceptive behaviors after 6 months of program participation. It was due to the high increase of COVID-19 infection rate from April to November 2021.

CONCLUSION

The research results showed that the Health Belief Model Educational Program was effective. The health team could use the program as a model to promote knowledge of COVID-19 to other students or other respiratory diseases. However, during the COVID-19 outbreak, the team must consider the appropriate time and prepare a research design that would prevent the spread of COVID-19 during the program implementation.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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DATA AVAILABILITY STATEMENT

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

REFERENCES

1. Division of General Communicable Diseases. Guidelines for control, prevention and surveillance of Covid-19 for medical and public health personnel [internet]. 2021 [cited 2021 Jan 21]. Available from: https://ddc.moph.go.th/uploads/publish/1150920210610033910.pdf
2. Sirinawin S. Covid-19 knowledge to wisdom, practice development. Faculty of Medicine Ramathibodi Hospital, Mahidol University. Bangkok: O.S. Printing House; 2020.
3. Department of Disease Control. Guidelines for the prevention of Covid-19 for general public and risk groups [internet]. 2021 [cited 2021 April 21]. Available from: https://ddc.moph.go.th/viralpneumonia/file/int_protection/int_protection_030164.pdf
4. Bureau of Epidemiology. Covid-19 situation review report and global preventive measures

and in Thailand [internet]. 2021 [cited 2021 October 21]. Available from: http://www.thaincd.com/document/file/download/knowledge/ Covid 19.65.pdf
5. Department of Disease Control. Report an emergency situation case of Covid-19 Coronavirus 2019 [internet]. 2021 [cited 2022 Jan 11]. Available from: https://ddc.moph.go.th/viralpneumonia/file/situation/situation-no590-150864.pdf
6. Center for Covid-19, Situation Administration. Report of the Covid-19 situation in Thailand, data as of 15 May 2021 [internet]. 2021 [cited 2021 June 13]. Available from: https://media.thaigov.go.th/uploads/public_img/source/150564.pdf
7. Poovorawan Y. Educational impact [internet]. 2022 [cited 2022 June 16]. Available from: https://learningcovid.ku.ac.th/course/?c=7&l=4
8. Sukkamnoed D. Impact of Covid-19 to the learning of children and youth [internet]. 2022 [cited 2022 June 18]. Available from: https://think.moveforwardparty.org/news/1601/
9. Center for Covid-19, Situation Administration. Report of the Covid-19 situation in Thailand, data as of 31 March 2021 [internet]. 2021 [cited 2021 April 21]. Available from: https://media.thaigov.go.th/uploads/public_img/source/310364.pdf
10. Becker MH. The health belief model and sick role behaviors. Health Educ Monogr 1974; 2(4):409-19.
11. Hatyai University. Predictors of behaviors in prevention of Coronavirus disease 2019 (Covid-19) in 7th-12th grade students. The 13th Hatyai National and International Conference; 2022 May 12; Hatyai; 2022.
12. Wattanaburanon A, Sirichote M, Piyaaramwong P, Sattayathewa S. Perceptions and preventive behaviors of the Covid-19 among high school students in Bangkok, Thailand. J Liberal Arts Maejo Univ 2021;9(1):36-49.
13. Waehayi, H. Severity perceptions and preventive behaviors on the Coronavirus disease -2019 among youth at Sateng-Nok subdistrict, Muang district, Yala province. J Community Public Health 2020;6(4):159-68.
14. Department of Older Persons. Statistics of the elderly in Thailand 77 as of December 31, 2019 [internet]. 2020 [cited 2021 February 3]. Available from: www.dop.go.th/th/know/1/275.
15. Office of the Basic Education Commission. Educational statistics, year 2021 [internet]. 2021 [cited 2021 April 20]. Available from: http://www.bopp.go.th/?page_id=319
16. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G* power 3.1: tests for correlation and regression analyses. Behav Res Methods 2009;41(4):1149-60.
17. Bloom BS. Handbook on formative and summative evaluation of student learning. New York: McGraw–Hill; 1971.
18. Best JW. Research in education. 3rd ed. New York: Englewood Cliffs New Jersey Prentice Hall; 1971.
19. Center for Covid-19, Situation Administration. Report of the Covid-19 situation in Thailand, data as of 1 April 2021 [internet]. 2021 [cited 2021 June 2]. Available from: https://media.thaigov.go.th/uploads/public_img/source/010464.pdf
20. The Community Health Security Fund. Get to know and how to prevent Coronavirus disease (Covid-19) [internet]. 2020 [cited 2021 Jan 18]. Available from: https://www.youtube.com/watch?v=9SZMyqtpMEg
21. Department of Disease Control. Thai children unite to fight against Covid-19 [internet]. 2020 [cited 2021 August 1]. Available from: https://www.youtube.com/watch?v=9XYUBb79LGY
22. Department of Disease Control. How to protect yourself from Covid-19 [internet]. 2020 [cited 2021 August 1]. Available from: https://www.youtube.com/watch?v=KdRXe6ZfK6w&t=20s
23. Saiseesod S. Information exposure behaviors and awareness of Udon Thani students during the Covid-19 epidemic. Journal of Humanities and Social Science Valaya Alongkorn 2021;11(1):13-25.

Review Article

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What is Diabetes Self-Management Education and Support?

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ABSTRACT

Diabetes is a non-communicable disease that has become an epidemic in many countries around the world, with a significant increase in the number of cases. Patients are required to have good glycemic control and maintain a normal level of HbA1c. However, some patients are still uneducated and uninformed about their conditions, resulting in ineffective planning and treatment. Diabetes self-management and support (DSMES) is a service that can help patients practice their decision-making and goal-setting skills and improve their quality of life. DSMES can come in various styles, including websites, digital applications, and gamification. Each method has a different approach to patients in terms of the process; however, they share a common theme of patient-centered service.

KEYWORDS: body mass index, diabetes mellitus, gamification, HbA1c, self-management

INTRODUCTION

Diabetes is a chronic, non-communicable disease which affects the body's ability to convert food into energy. The body's mechanism when sugar enters the bloodstream is to release the insulin hormone to regulate the blood sugar level. In consequence, abnormal blood sugar levels can occur, including hyperglycemia and hypoglycemia as the medical terms for high and low levels of blood sugar, respectively[1]. Nowadays, there are a total of 537 million diabetes patients and it is expected to rise to 643 million by 2030[2]. Moreover, the number of patients diagnosed with diabetes is rising rapidly, from 108 million to 422 million in 34 years, especially in low and middle income countries[3]. Nevertheless, the mortality rate has increased by 3% in the last two decades. In 2019, diabetes and diabetes related diseases are responsible for 1.5 million deaths[3-4].

According to the Centers for Disease Control and Prevention, there are three main types of diabetes, which include type 1, type 2 and gestational diabetes[1]. Type 1 diabetes can occur as a result of the autoimmune reaction of the body which causes the body to terminate the making of insulin. It accounts for 5-10% of all diabetes cases. It is commonly found among teens and young adults. Meanwhile, type 2 diabetes is frequently found in adults and approximately 90-95% of all diabetes cases as a result of the inefficient use of insulin by the body[1]. While diabetes type 1 and 2 are caused by insulin related complications, gestational diabetes occurs during pregnancy[3-4]. Women who have gestational diabetes can face many complications. Furthermore, the risk of their children developing diabetes increases. However, there are other risk factors affecting a patient's chance of getting diabetes; for instance, a patient's family history and ethnicity[5].

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Even though these three types of diabetes have many symptoms, it may not be present in all patients. This includes frequent urination, feeling thirsty, blurry vision, slow healing wounds, and others. With the listed symptoms, patients with diabetes can develop other diabetes related drawbacks, including kidney, cardiovascular, and neuropathy diseases[5]. Nevertheless, gestational diabetes presents its own complications for both the mother and baby. The mother and baby can further develop type 2 diabetes and a low blood sugar level.

As a diabetes patient, early diagnosis and treatment are essential. It can be done by testing blood sugar level, glycated hemoglobin, body screening for signs, creatinine level, and body mass index ratio[6]. However, many treatments rely on the patient's self-management which includes diet and physical activity. With many complications that can happen, patients are also advised against the use of tobacco products and other products that may increase blood pressure[3]. Patient's self-management is important for the treatment. A service that can help and delay the complications is Diabetes Self-Management and Support (DSMES)[7]. This research will contain information about the general information, types, National Standards, obstacles, and the impacts of diabetes self-management education and support.

GENERAL INFORMATION

DSMES is a process that is essential for diabetes patients to learn the skills and implementations about their behaviors to manage their conditions beyond the hospital. It offers services that can help patients with factors that can interfere with their treatment, such as limitations, family support, financial status, medical history, decision making and nevertheless, the treatment itself. According to the American Diabetes Association, its goal is to increase the availability of diabetes education for patients and improve treatment outcomes[6,8]. In addition, the COVID-19 pandemic affected the healthcare system. Therefore, the service provided by DSMES is recommended for hospitals and government agencies to utilize in accordance with the National Standards.

TYPES OF DSMES

1. Diabetes self-management and support (DSMS)

DSMS is the support structure for diabetes patients to improve their skills to manage diabetes. This includes group meetings; connections to friends online and offline, asking healthcare professionals on managing medication and group discussions. It is crucial that it is easily approachable through clinics, churches, and pharmacies[6-8]. Even though maintaining and sustaining DSMS follow ups and support is challenging because of limited resources, which include time and caseloads, it offers patients the opportunity to get customized plans and methods following their preferences[9].

2. Diabetes self-management and education (DSME)

DSME is the process of educating patients on their knowledge of diabetes and their ability to manage essential self-care[6-8]. In other words, it is another form of traditional diabetes training that includes a variation of physical and behavioral interference. Furthermore, it introduces patients with individual objectives, self-monitoring medication adherence, and other skills[9].

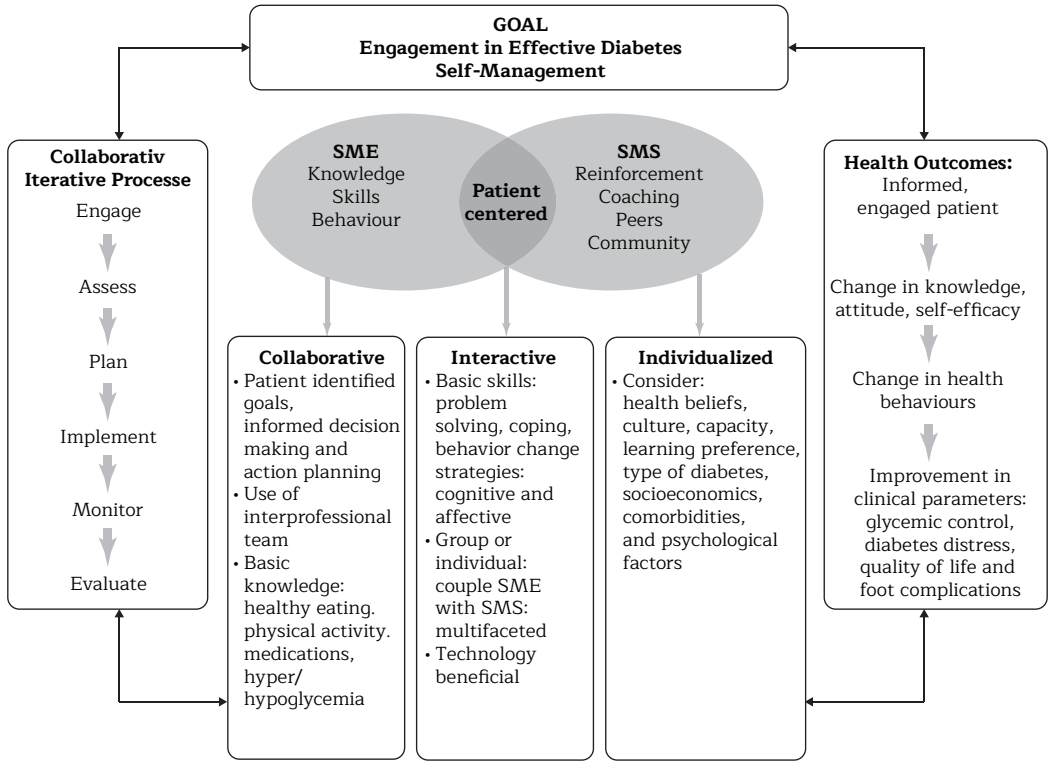

Figure 1 model for self-management education (SME) and self-management support (SMS)[9]

These two types can be associated with gamification methods to encourage more patients to attend and improve with the DSMES service. Gamification is used as an integration to the learning process while maintaining some of the aspects of playing games such as the competitiveness. It attracts patients into an interactive and innovative learning environment, which will result in an increase in engagement in game-based learning spaces[9-10].

The American Diabetes Association started off the initiative phase of diabetes self-management and support with developers from universities, clinics, and hospitals. When the service is in the process of acceptance, it will be promoted through volunteers and different channels, including websites and other social media platforms. The feedback from the patients would be sent back to the developers to improve the program. On the other hand, when the program is not accepted by the providers, it would be displayed on the ADA website along with the availability of professionals and support[6,8]. Likewise, the Center for Disease Control and Prevention or CDC, offers an online toolkit for developers and organizations to follow[7].

2022 NATIONAL STANDARDS FOR DSMES

The number of patients with diabetes in the United States are at an estimated 34.2 million patients with many having increased risk of hyperglycemia complications. The National Standards is a source that has evidence-based guidance for DSMES. It stresses the importance of cultural diversities, social risk factors, and the development of new technological platforms which can be implemented into the access of DSMES[8].

The first standard provides a guide to components that can result in sustainability, which consist of sponsor organizations and internal leadership. It can help service providers to overcome barriers which can result in the low utilization of DSMES, including financial and personnel barriers. All of these aspects contribute to the availability and variety

of methods of delivering DSMES services to patients. In addition, service DSMES contributors must determine their target group to magnify the suitability of processes and methods. It can be done by taking characteristics into account such as cultural background and accessibility of technological equipment. Each DSMES team must carefully review the curriculum to guarantee the consistency of service among individuals and the efficient use of resources. Which leads to service delivery, which includes monitoring the patient's medication, identifying risks, and being able to solve problems. Subsequently, a person-centered DSMES is available for patients. Which will include a personal plan based on their preferences and priorities that would be designed by professional medical personnel. The final stage is to illustrate how the patients have improved. This is the job of the tracking team to identify the behavior changes and other evaluations. These evaluations are vital for the team to build on. Eventually, the outcomes can be categorized as process, clinical, behavioral, patient-reported, and health generated[11-13].

OBSTACLES OF DSMES

Identifying the barriers of the DSMES service is crucial for providers to acknowledge in order to sustain and develop the program. These barriers can be categorized into three categories according to the CDC Toolkit, programmatic, provider, and individual barriers. This barrier consists of the lack of resources and personnel in the area of service. It can lead to complications of sustaining and maintaining the standards of DSMES. Lack of knowledge and accessibility leads to confusion among both patients and providers. Nevertheless, concerns and negative experiences can occur following the confusion. This includes the individual errors and the competition between providers. On the other hand, these barriers can be overcome with the toolkit provided by the CDC. Moreover, enhancing the follow up for patients and increasing the regularity of classes can be the solutions for overcoming individual barriers[7].

In Thailand, research was conducted with the cooperation of 613 hospitals both public and private, in order to identify the obstacles of DSMES. In 2017, only 53.5% of medical personnel counseled more than 10 patients per day. Factors including patients' reluctance, time deficiency, and disinterest are found to be significant. Patients are unenthusiastic to change their unhealthy lifestyle and attend learning sessions. This can result from other difficulties, which include transportation and poor scheduling. Ultimately, the DSMES service proved to be ineffective in these circumstances[14]. In addition, research from Montana State University using electronic health records shows the number of improvements in patients. Conversely, many obstacles are illustrated, which include poor cooperation among patients, the online system, and patient's refusal[15].

THE IMPACTS OF DSMES

The impact of DSMES can be measured by the improvements in a patient's glycemic levels as a result of good decision making and self-management including physical activities and good medication monitoring. In research with 696 patients and the use of mobile applications. It shows that the application has a little to medium effect on the patient's medication, HbA1c level, and BMI. The mean difference in HbA1c level is -3.14, which indicates that patients in this trial have decreased HbA1c levels as per the initial measure. The application itself is said to be well rounded and appropriate for use, although the ability to use the functions of the mobile phone is essential[16-17].

Additionally, research with 22,947 adults with diabetes at an average age of 58.5 years was conducted to see the improvements in the HbA1c level. HbA1c level illustrates the amount of glucose in the blood. The participants are separated into two groups, a controlled and intervention group with 11,093 and 11,854

participants in each group correspondingly. Four types of interventions are presented, including combination, group based, individual based, and remote. With combination interventions being having the most significant impact at 86%. The average change in the HbA1c level in the intervention group is 0.7%. Conversely, the change in the control group is only 0.2%. The levels of HbA1c are separated into 4 quartiles < 7.7, 7.7 to < 8.3, > 8.3 to < 9, and > 9%. Moreover, this study shows that the number of hours of DSMES can have a small impact on patients' HbA1c levels as well. The total average change of HbA1c level in the intervention group with more than 10 hours of DSMES by 0.8%. Meanwhile, patients' HbA1c levels who have less than 10 hours of DSMES decrease by 0.7%[18-19].

CONCLUSION

Diabetes Self-Management and Support is a patient centered service which is aimed to increase the availability of diabetes education and improve treatment outcomes for patients by helping patients with factors that can interfere with their treatment, including limitations, family support, financial status, medical history, and decision making. DSMES can be a tool for patients to self-educate without becoming monotonous. It can be presented in many styles which includes group discussions, digital based applications and gamification. As a result, improved levels of HbA1c can be seen in patients after using DSMES.

REFERENCES

1. Centers for Disease Control and Prevention. What is diabetes? [internet]. 2023 [cited 2022 Nov 24]. Available from: https://www.cdc.gov/diabetes/basics/diabetes.html
2. IDF Diabetes Atlas. IDF diabetes Atlas 10th edition [internet]. 2021 [cited 2022 Nov 24]. Available from: https://diabetesatlas.org/
3. World Health Organization. Diabetes [internet]. 2023 [cited 2022 Nov 24]. Available from: https://www.who.int/news-room/fact-sheets/detail/diabetes
4. World Health Organization. Diabetes [internet]. 2019 [cited 2022 Nov 24]. Available from: https://www.who.int/health-topics/diabetes#tab=tab_1
5. Mayo Clinic. Diabetes [internet]. 2023 [cited 2022 Nov 24]. Available from: https://www.mayoclinic.org/diseases-conditions/diabetes/symptoms-causes/syc-20371444
6. Aekplakorn W, Stolk RP, Neal B, Suriyawongpaisal P, Chongsuvivatwong V, Cheepudomwit S, et al. The prevalence and management of diabetes in Thai adults: the international collaborative study of cardiovascular disease in Asia. Diabetes Care 2003;26(10):2758-63.
7. Centers for Disease Control and Prevention. When diabetes self-management education is emergency medicine [internet]. 2022 [cited 2022 Nov 24]. Available from: https://www.cdc.gov/diabetes/dsmes-toolkit/staffing-delivery/DSMES-emergency-medicine.html
8. Powers MA, Bardsley JK, Cypress M, Funnell MM, Harms D, Hess-Fischl A, et al. Diabetes self-management education and support in adults with type 2 diabetes: a consensus report of the American diabetes association, the association of diabetes care & education specialists, the academy of nutrition and dietetics, the American academy of family physicians, the American academy of PAs, the American association of nurse practitioners, and the American pharmacists association. Diabetes Care 2020;43(7):1636-49.
9. Sherifali D, Berard LD, Gucciardi E, MacDonald B, MacNeill G. Self-management education and support. Can J Diabetes 2018;42 Suppl 1:S36-41.
10. Asadzandi S, Sedghi S, Bigdeli S, Sanjari M. A systematized review on diabetes gamification. Med J Islam Repub Iran 2020;34:168.
11. Habibzadeh H, Sofiani A, Alilu L, Gillespie M. The effect of group discussion-based education on self-management of adults with type 2 diabetes mellitus compared with usual care:

a randomized control trial. Oman Med J 2017;32(6):499-506.
12. Davis J, Fischl AH, Beck J, Browning L, Carter A, Condon JE, et al. 2022 National standards for diabetes self-management education and support. Sci Diabetes Self Manag Care 2022;48(1):44-59.
13. Piccinino LJ, Devchand R, Gallivan J, Tuncer D, Nicols C, Siminerio LM. Insights from the national diabetes education program national diabetes survey: opportunities for diabetes self-management education and support. Diabetes Spectr 2017;30(2):95-100.
14. Preechasuk L, Sriussadaporn P, Likitmaskul S. The obstacles to diabetes self-management education and support from healthcare professionals' perspectives: a nationwide survey. Diabetes Metab Syndr Obes 2019;12:717-27.
15. Amy AG. Improving the utilization of diabetes self-management education and support (DSMES) for patients with type II diabetes in the primary care setting [internet]. 2022 [cited 2022 Nov 24]. Available from: https://scholarworks.montana.edu/xmlui/handle/1/16828
16. Enricho Nkhoma D, Jenya Soko C, Joseph Banda K, Greenfield D, Li YJ, Iqbal U. Impact of DSMES app interventions on medication adherence in type 2 diabetes mellitus: systematic review and meta-analysis. BMJ Health Care Inform 2021; 28(1):e100291.
17. Nkhoma DE, Soko CJ, Bowrin P, Manga YB, Greenfield D, Househ M, et al. Digital interventions self-management education for type 1 and 2 diabetes: a systematic review and meta-analysis. Comput Methods Programs Biomed 2021;210:106370.
18. Chrvala CA, Sherr D, Lipman RD. Diabetes self-management education for adults with type 2 diabetes mellitus: a systematic review of the effect on glycemic control. Patient Educ Couns 2016;99(6):926-43.
19. Jerawatana R, Siripitayakunkit A, Anothaisintawee T, Pattanaprateep O, Reutrakul S. The effects of diabetes self-management education and support program in Thailand: a systematic review and meta-analysis. J Med Assoc Thai 2021;104(6): 1050-8.

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Retraction notice to: Incidence of Prostate Cancer in Physical Checkup Population with Rising of Serum Prostatic Specific Antigen

Naravejsakul K, Pothisa Th, Saenrak N. Incidence of prostate cancer in physical checkup population with rising of serum prostatic specific antigen. Vajira Med J 2022;66(5):361-8.

This article has been retracted at the request of the editor-in-chief as well as the authors. The authors have duplicated submission of the paper that appears in Thai Journal of Surgery. Furthermore, the paper also plagiarizes contents and figure from other papers as the reference details below. These are considered unethical. One of the conditions of paper submission for publication is that authors declare explicitly that their work is original and has not appeared in a publication elsewhere. Re-use of any data should be appropriately cited. As such this paper represents a severe abuse of the scientific publishing system. Vajira Medical Journal: Journal of Urban Medicine's editorial board takes a very strong view on this matter and apologies are offered to readers of the journal that this was not detected during the submission process.

REFERENCES

1. Naravejsakul K, Pothisa Th, Saenrak N. Incidence of prostate cancer in physical checkup population with rising of serum prostatic specific antigen. Vajira Med J 2022;66(5):361-8.
2. Sathitkarnmanee E, Sirithanaphol W, Chotikawanich E. Prevalence of prostate cancer in northeastern Thailand. J Med Assoc Thai 2012;95 Suppl 11:S38-41.
3. Srinualnad S, Charoenkraikamol Ch, Toraksa S, Uiprasertkul M, Amornvesukit T, Taweemonkongsap T, et al. Prevalence of prostate cancer in aging males receiving PSA (prostate specific antigen) screening test (a campaign for celebration of Siriraj Established Day). J Med Assoc Thai 2006;89(1):37-42.

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