RESEARCH

Health issues and quality of life among people with diabetes mellitus post infected COVID-19: A mixed methods study

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ABSTRACT

This study aimed to (1) explore the health issue experiences of post-COVID-19 and quality of life among people with Diabetes Mellitus (DM), (2) investigate the health issues and Quality of Life (QoL) post-COVID-19. A sequential exploratory mixed methods study was employed. A qualitative procedure was based on a grounded theory. Qualitative procedure: the 16 participants' home in communities and primary hospital those were people with DM aged 18 years and above. A cross-sectional study was employed with totaled 200 participants. Descriptive statistic, Pearson correlation coefficient, and independent t-test were used. The five major themes emerged (1) moderate of QoL (2) mild and severe conditions, (3) fear of recurrence COVID-19 (4), split opinions: for and against COVID-19 vaccination, and (5) prevention of COVID-19. PCS were 66.5%, 62.0% fear of reinfection and fear of being unable to work and self-reliance, 47.5% fatigue/activity intolerance, 36.0% allergy, 28.0% cough, 24.5% loss of appetite, and 20.5% sleep disturbance, respectively. Most participants (89.5%) were unwillingness to COVID vaccination. Comparisons of QoL of men was more than women, age ranged <65 was more than aged ≥ 65 years, and non-hospitalization was more than hospitalization. Finally, the health issue was a negative relation of QoL ($p < 0.01$, r-.218). Conclusion: This study discovered that people with DM still have a lot of long COVID, not only physical but also psychological. Implication: Additionally, nurses can play a vital role in collaborating with the multidisciplinary team to create a health care services program tailored to people with DM's needs.

Key Words: *Long COVID-19, Quality of life, Diabetes mellitus*

INTRODUCTION

Coronavirus disease 2019 (COVID-19) is global pandemic. It is caused by SARS-CoV-2, which has seriously impacted health, society, and the economy. Most people develop heath issues or long COVID or post-COVID syndrome (PCS) after their initial illness. Long COVID is defined as the development of new symptoms 3 months after the initial SARS-CoV-2 infection, that persist for more than 12 weeks and have not been explained yet. That included fatigue, shortness of breath and cognitive dysfunction over 200 different symptoms have been reported that can have an impact on everyday functioning [1-2]. The prevalence of long COVID was reported at 6 and 12 months, one or more symptom was reported by 71.5% and 70.7% respectively [3]. The most commonly reported symptoms beyond 12 weeks included fatigue, cognitive dysfunction, joint pain, concentration difficulties, dyspnea, cough, palpitation, anxiety, stress, etc. People with comorbidity such as Diabetes Mellitus (DM), hypertension, heart disease, overweight, etc. are high risk of mortality with COVID. The prevalence of mortality in hospitalized COVID-19 patients with DM was 82.0 % (1.82-time) higher than that in non-DM patients. Previous study revealed that long-COVID prevalence was at 77.7%, with the most frequently reported symptoms being fatigue and cough. Regarding mental health, depression was reported. Another study found Health Related QoL (HRQoL) is impaired after hospitalization due to COVID-19 but it is unclear how HRQoL is affected in patients suffering from PCS [4-6]. Therefore, PCS substantially affected health-related QoL. In Thailand, DM is a leading cause of death, with approximately 5.2 million people with DM. More than 40% of these do not know they are ill, while only 54.1% (2.8 million) received diagnosis and treatment. Moreover, the mortality rate is 200 people daily [7]. Therefore, people with DM are at higher risk of severe disease and high persistence of PCS. Unfortunately, there are minimal mixed methods study to explore post-COVID-19 syndrome (PCS) or long-COVID among people with DM. Regarding the

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researchers are instructors of nursing students and work in critical care nursing, adult and gerontological nursing. We intend to explore how health and QoL issues among people with DM post COVID-19 infection. A mixed methods approach integrated and quantitative and qualitative which qualitative procedure based on a grounded theory. A grounded theory is a strategy of inquiry in which the researchers derive a general, abstract theory of process and action grounded in the view of participants and is highly useful for uncovering [8-10]. It is an authentic experience of people with DM and infected COVID-19. It used quantitative data to assist in interpreting qualitative findings on quality of life. Thus, this study aimed to (1) explore the health issue experiences of post-COVID-19 and QoL among people with DM, (2) investigate the health issues or PCS, and QoL among people with DM.

METHODS

Study design: A mixed methods study using a sequential exploratory design was employed. It included a three-phase approach: qualitative procedure: exploring with qualitative data and analysis, instrument development quantitative procedure: the data collection with a sample of a population [10].

Phase 1 Qualitative procedure: A qualitative procedure was based on a grounded theory because it is to move beyond description and discover a theory. It was a design of inquiry from sociology, which was people with PCS or long COVID experiences. Qualitative data was initially collected from all interviews and were conducted on site, and by video call and audio-recording. In-depth interviews were guided by the research questions. This study followed the research check list of the COREQ.

Phase 2 Building an instrument: A new instrument was built following the first phase because an existing instrument was not available [(e.g., new survey instrument, new variables and test this feature in a quantitative third phase). The content was validated by five participants.

Phase 3 Quantitative procedure: Quantitative procedure: a cross-sectional survey study was employed. The data was collected using questionnaires with a total of 200 participants. The instruments of health issues, and WHOQOL–BREF–THAI were used. In this phase, an entirely different sample from the first phase was used [8-10]. This is integration point in an exploratory sequential design. For a quantitative procedure, checklist of STROBE statement was used.

Setting and samples

Convenience and snowball sampling techniques were used. The setting was the key informant's home, or primary hospital for the onsite interview and via cellphone in the second and third times. During the interviews, family members were with the participants. Qualitative data was collected by observation and face-to-face in-depth interviews guided by the research questions. The inclusion criteria were Thai adults with DM and those aged ≥18 years who had been infected with COVID-19 and recovered within ≤ 6 months, not only through hospitalization but also non-hospitalization. They were not cognitively impaired, had no physical suffering, and were willing to provide rich information. The inclusion criteria were written informed consent. The exclusion criteria included cognitive impairment and visual and hearing impairment. Participants (key informants) comprised 16 adults and elders with pre-existing DM. In a grounded theory, the ultimate criterion for the final sample size is theoretical saturation, which relates to the development of theoretical categories and grounded theory methodology [8-10]. Moreover, a sample size of quantitative ones was calculated using G* power 3.1.9.7 which was based on an acceptable power level of 0.95, with a medium effect size of 0.50, and α of .05. For the independent t-test, the estimated sample size was 176 participants. This study required a sample size of 10% dropout; 200 participants were selected for quantitative survey research. This number comprised 110 from Nakhon Ratchasima Province and 90 from Ubon Ratchathani Province, Northeastern Thailand [11].

Instruments

Qualitative instruments were a semi-structured and in-depth interview, face-to-face, field notes, reflective notes, observation, and audio recording.

Quantitative: The health issue is an instrument used to measure the health issues. There are 20 items on it, each contains 0, 1 with the total score ranging 0-20. Additionally, there are 4 items of attitude toward vaccination. This instrument was applied from post COVID-19 effects of Hengyotmark and Kusoom. A pilot test was conducted, and Cronbach's α of .74. Moreover, the WHOQOL–BREF–THAI is a standard tool (in Thai version), used to measure QoL that divided into 26 items, physical, psychological, social relations, and environment questionnaires. Each item contains different score ranges (1-5), with the total score ranging from 26 to 130. The question score ranged from 1 (strongly disagree) to 5 (strongly agree). A pilot test was conducted, and Cronbach's α was 94. The total score ranges of QoL are grouped into very good (96-130), moderate (61-95), and poor quality of life (26-60).

Data collection

Qualitative data collection: After the Institutional Review Board (IRB) approval, we contacted the hospital administrators or leader of communities for permission from participants to speak with participants. Rapport and trust were established. The researchers reviewed the research procedure and obtain informed consent from participants. Before the interview, the study's objective, the interview's time, and the procedure of answering the questions were explained to the key informants. Informed consent was obtained from them beforehand. The research questions guided in-depth interviews. Some examples of questions were: "Could you please describe your experiences post-COVID-19?" "What negative effects on physical and mental did you experience?" "Could you describe your vaccination?" "What are you concerned about post-COVID?" etc. Observations were focused on their expressions of experiences. During the interviews, family members or significant others were with the participants. The data were saturated when the information collected in the study became fresh data, which no longer sparked new insights. All interviews were recorded with the key informant's permission. Each interview took approximately 30 to 45 minutes and was conducted twice to three times until the data information was completed. Researchers always possess a perspective of reality. The sample size was determined when the interview responses reached saturation; none of the participants refused to be interviewed or withdrew from the study. This process involves using multiple stages of data collection and the refinement and interrelationship of categories of information. In qualitative procedure: data were collected between

March 18, 2023 and April 30, 2023.Quantitative data was collected using either Google Forms or conventional questionnaires. Data were collected between June 18, 2023 and January 30, 2024. Once eligibility was confirmed, the study's purpose and methodology were explained to people with DM with infected COVID-19. Participants who agreed to participate in the study provided written informed consent. They were requested to complete a self-report questionnaires of health issues, and QoL. Surveys were administered directly in the patients' home in the community, and primary hospital. The process took approximately 10-15 minutes. There was no missing data.

Data analysis

The qualitative data were analyzed using five steps, following, Lincoln and Guba, and Creswell's strategy [10,13]. The five steps included (a) organizing and preparing the data for analysis, involving transcribing interviews, typing up field notes, (b) reading through all data several times to obtain an overall feeling for them, identifying significant phases or sentences that pertained directly to the experience, (c) coding the data/organizing the data by tagging areas and assigning code labels of the image, compiling all codes for the image on a separate sheet, reducing the codes to potential themes, (d) interrelating themes/descriptions. Additionally, themes were searched, mapped, and interrelated so that the meanings of the themes could be interpreted. Then, a grounded theory framework was illustrated. However, the theory was derived from the words of the key informants, which were not derived from another theoretical framework [10]. Quantitative data were analyzed using the software SPSS version 18 (IBM Corp. Released 2019. IBM SPSS Statistic for Windows, Version 28.0 (Armonk, NY, USA: IBM Crop.). Descriptive statistics, the independent t-test, and Pearson correlation coefficient were used. Statistical significance was analyzed by setting a two-tailed test at a significance of .05.

Rigor and trustworthiness

Four criteria were considered: credibility, transferability, dependability, a nd confirmability, and accumulatively contributing to trustworthiness [10, 13].

Credibility: Data was collected by the research team, and prolonged periods were spent conducting fieldwork, as persistent observation provides depth. Moreover, member-checking: the findings were verified by two participants.

Transferability: The researchers provided detailed demographic and post-COVID conditions to enhance the transferability of findings. Direct citations from interviews were in the research findings to distinctly convey the participants' experiences. The findings were evaluated to the extent to which the conclusions are transferable to other times, settings, situations, and people. 3) Dependability: Data was discussed by the research team. Moreover, multiple rounds of interviews were conducted.

Confirmability: The research team checked the reflexive data. These were carefully collected to make them meet the confirmability criteria. Two external consultants independently reviewed the entire research process and analysis concerning qualitative research. Moreover, transcripts were taken back to participants for comments [12]. There were no new data during validation.

Ethical considerations

The study was approved by the Institutional Review Board of Ubon Ratchathani University (approval No. UBU- REC-18/2023). The date of approval was March 6, 2023. Informed consent was obtained from all subjects involved in the study. They could withdraw from the study at any time without negative consequences. To protect confidentiality, pseudonyms were used by the participants. All audio recording and transcript data, as well as questionnaires, were stored securely. Participants who agreed to participate in the study provided written informed consent.

RESULTS

Demographic characteristics. A total qualitative method consisted of 16 participants with COVID-19. Ten of them were hospitalized, and the other six were non-hospitalized. Four of them were admitted to the ICU, 6 to the COVID ward Figure 1. There were 10 women and 6 men. Meanwhile, the participants of the quantitative group were 200, most of them were 60.0% women, and age ranged 57.0% ≥ 65 years; average 65.29 years, educational level; 62.0% elementary, history of hospitalized history; 73.0 % non-hospitalization, and COVID vaccination history; 74.0% vaccination. Moreover, they had more than 2 pre-exist comorbidity in table 1.

TABLE 1
The participants' demographic characteristics (n=200)

Participants' Demographic Characteristics Quantitative, n = 200	Frequency	Percent (%)
Gender		
Men	81	40.5
Women	119	59.5
Age (years)		
< 65	92	46
≥ 65	108	54
Educational level		
Elementary	124	62
High school or vocational school	21	10.5

Bachelor degree	43	21.5
Graduate school	12	6
Occupation		
Unemployed	42	21
Employed	144	67
Retirement	24	12
Average monthly income (Baht)		
< 5000	96	48
5,000 - 10,000	27	13.5
>10,000 - 20,000	17	8.5
> 20,000	60	30
Comorbidity (more than DM)		
No	20	10
Yes	180	90
Hospitalization history		
Hospitalization	54	27
Non-hospitalization	146	73
Vaccination history (number of doses)		
No	23	11.5
Yes:-One	9	4.5
Two	66	33
Three	64	32
Four	37	18.5
Five	1	

Note: Most participants had more than two conditions

In this mixed methods study, the qualitative and quantitative data were integrated. From the analysis of data, five major themes emerged with eleven sub-themes.

Qualitative findings: Explore health issues and QoL. There were 32 codes. Through grounded theory, 5 major themes emerged: 13 sub-themes were as following, in table 2.

TABLE 2

Themes and sub-themes related to experience health issues and QoL post-COVID-19 among people with DM

S. No	Themes	Sub-Themes
1	Moderate of QoL	Moderate of QoL, improved health conditions.
2	Mild and severe conditions	PCS: Stoke, cardiac arrhythmia, coronary artery disease, memory impairment.
		Health conditions: influenza, fatigue, allergy, sleep disturbance, numbness, joint pain, weight gain, weight loss, etc.
3	Fear of recurrent COVID-19	Uncertainty of COVID-19 in the future.
		Fear of severe COVID effects.
		DM as a high-risk factor for COVID-19 severity.
4	Split opinions: For and against COVID vaccination	Infected COVID-19 post-vaccination.
		Negative effects post-vaccination: weakness, fever, chill, muscle pain, diarrhea, etc.
		Death of some people due to vaccination.
5	Prevention of COVID-19	Getting a COVID test every having fever, sore throat, or muscle pain.
		Staying at home, wearing a mask while leaving the house, and hand washing frequently.

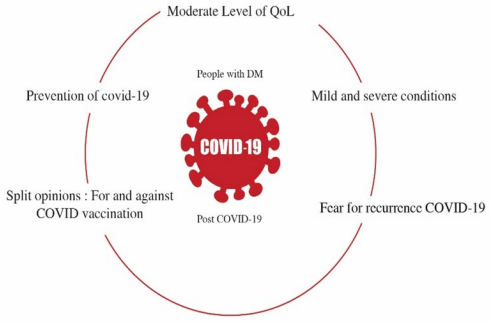

Figure 1) *Conceptual model of health issues post-COVID-19, and QoL among people with DM*

Theme 1 Moderate of QoL

Participants' QoL eight participants were at moderate level, and four participants were high level. However, four participants were low QoL. One-man participant has given an account of his experience when he was sick with COVID. "I fell ill with COVID, and I took a rest lying down, taking pills to bring down fever and to relieve aches and pains. After 7 days, my health conditions started to improve for the better, and I was on the road to recovery. Little by little, I could carry out my normal work routine. Meanwhile, I started to experience allergy, causing me to cough, to sneeze, and to develop itchy rashes on my arms and legs. In spite of my health issues, I think my quality of life lies in medium range." (Participant No.11).

Theme 2 Mildand severe health issues

Most of the participants had mild and severe conditions of post-COVID. Severe health conditions included embolic stroke, chest pain, palpitation, cardiac arrhythmia, lung impairment, etc. Mild conditions were fatigue, activity intolerance, sleep disorder, loss of appetite, muscle pain, etc. Some of them had non-conditions. "Owing to the fact that, I have been diabetes, hypertension, heart disease and overweight. After the infection, the doctor said I have several other co-existing diseases, including stroke, left-side weakness, heart problem, and unable to walk. So, I need two physiotherapists to help me home". (Participant No. 1) "I had heart disease and received three stents insertion before COVID. After catching COVID, I experienced chest pain and palpitation. I thought that I was in serious condition, then my kids took me to go to the hospital. "(Participant No.2)

"I have recovered after I took some rest for a week. I felt tired easily and decreased work tolerance." (Participant No.10,12)

Theme 3 Fear for Recurrences of COVID19

The participants anticipated uncertainty and worries about whether a recurrence of COVID-19 should take place. The participants were fearful of having complications, especially those who were among the risk group, including the elderly, those with DM, hypertension, Chronic Kidney Disease (CKD), SLE, rheumatoid arthritis, etc. "I know I am among the risk group because I am diabetic (DM) with high blood pressure and SLE. If I contact COVID again, I am not sure how severe the symptoms are going to be. At present, I experience fatigue and loss of appetite, and on top of that, I have dialysis twice a week. I am so afraid of being unable to work and end up being dependent on other people." (Participant No.3)

"I am very fearful of catching the COVID virus again. Since I am sick with many Iillnesses, my different organs may not be functioning to their maximum capacity, which may result in long COVID disease. My greatest fear is to lose my ability to look after my own welfare or to work. Then, financial problems will occur from not earning enough income." (Participant No.5)

Theme 4 Split opinions: for and against COVID vaccination

A participant has given rather important information on whether vaccination against COVID-19 was effective. Many unpleasant incidents were reported on those unfortunate people who fell gravely ill after having been vaccinated against COVID-19. Some patients experienced very high blood sugar levels and had to be admitted to the ICU. Some patients were not vaccinated against COVID-19, but their symptoms were mild. So, they decided against COVID-19 vaccination. However, there was a sad incident concerning one elderly patient with Heart Valve Regurgitation. After her first vaccination shot, she came down with fever, tiredness, muscle aches, and pains. Unfortunately, she passed away before she could be taken to the hospital. Her death had cast doubts about whether a vaccine against COVID-19 was the cause of her untimely death. Another case was a patient who had been vaccinated against COVID-19 four times, but this patient became sick with the SARS-CoV-2-virus infection five times. However, the causes of contracting COVID-19 so many times might stem from the adverse health conditions of this patient, such as diabetes, obesity and chronic kidney failure with daily dialysis performed through the abdomen.

"My wife had been vaccinated against COVID 2 times. Seven days after the vaccination, she developed severe symptoms like other patients infected with the COVID-19 virus. My wife is diabetic but refuses to take care of her health issue, which causes her blood sugar level to be dangerously high. She was then admitted to the ICU for seven (7) days. I, myself, had a stroke and diabetes. I have received Medicare and was confined to my home. I did not have any vaccination against COVID-19 for fear of the harm the vaccine may cause to my health. I contracted COVID-19, but the symptoms were not serious. I did not have to stay in the hospital. In my opinion, vaccination does not have any effect in preventing the COVID virus, and the vaccine does not minimize the degree of the severity of the symptoms of the illness (The symptoms stay severe.)" (Participant No. 9)

"The elderly people in my village hardly had been vaccinated because they were worried whether the vaccine was safe. As the elderly with diabetes, I did not dare to be vaccinated. My children and grandchildren are also against COVID vaccination." (Participant No. 10)

Theme 5 Prevention of COVID-19

The majority of participants giving information for this small research had changed their daily life behavior, such as wearing masks when out in public areas, avoiding places with big gatherings of people, washing hands more often, keeping a strict schedule in taking medicines to treat their ailments, keeping distance from other people, no visitation to patients in hospital, resorting to Antigen Test Kits (ATK) or to see a doctor or to take a rest when experiencing fever, cough sor a sore throat.

"Nowadays, I avoid social functions, visitation to patients in hospital, wearing a mask when going outside my home and routinely washing my hands" (Participant 15).

"We have ATK handy in our home. Whenever I have a fever, cough, or a sore throat, I use the ATK to screen myself and take medication according to the symptoms. Then I visit the doctor." (Participant 1,

16).

Quantitative procedure

This procedure is integration point in an exploratory sequential design [10]. According to this study, there are a lot of health and QoL issues among people with DM post COVID-19. This study needs to investigate the following:

1. How many people are experiencing health issues?
2. What are the people's opinions on COVID-19 vaccination?
3. What is the QoL of people with post COVID-19?

What is the relation between health issues and QoL? Additionally, for the patients under study, how is QoL different depending on genders, age ranges, and histories of hospitalization?

Quantitative results

Investigate health issues and QoL post COVID-19. The findings revealed that health issues post-COVID-19 found physical and psychological impacts were 66.5%. There was fatigue, allergy, anxiety and fear of reinfection, etc. (Table 3). QoL was at a moderate level. Additionally, out of 200 participants, the QoL of 163 (81.5%) participants were at a moderate level, 21 (10.5%) participants' QoL was at a high level. While 16 (8.0 %) participants' QoL was at a low level in table 4. Meanwhile, health issues and QoL was negative relation (r -0.218, p.<01) in table 5. And comparisons of the mean differences of QoL between men and women, QoL of men was more than women (t 2.28, p <.05). QoL of age ranged < 65 group was more than aged ≥ 65 years (t=4.21, p <.001). Moreover, the QoL of non-hospitalization was more than that of the hospitalization group (t =7.12, p <.001) in table 6.

TABLE 3
Description of health issues post-COVID-19

Variables	Total N=200	
	n	%
Health issues		
No	67	33.5
Yes	133	66.5
Physical		
Fatigue/ activity intolerance	95	47.5
Allergy	72	36
Cough/ sore throat	56	28
Loss of appetite	49	24.5
Sleep disturbance	41	20.5
Hair loss/ skin integrity impairment	34	17
Memory impairment	33	16.5
Muscle pain/joint pain/back pain	26	13
Palpitation/ chest pain	24	12
Flu/ fever	24	12
Brain fog	16	8
Gout/ rheumatoid, SLE	4	2
Weight gain	3	1.5
Weight loss	5	2.5
Ischemic stroke	2	1
Psychological		
Anxiety and fear of reinfection, complication and fear of being unable to self-reliance	124	62
Inattention	6	3
Low self esteem	3	1.5
Negative feeling	3	1.5
Unhappy	3	1.5
Split opinions: for and against COVID vaccination		
(attitude toward vaccination)	174	87

Receiving vaccine		
(From receiving vaccine, n= 174)		
Negative effect of COVID vaccination	125	71.8
Fear of the side effect of COVID vaccination	187	93.5
Unwillingness to vaccination	179	89.5

Note: SLE: systemic lupus erythematosus, most participants had more than two conditions.

TABLE 4
Description of QoL

Variables	Total N = 200		
	Min-Max	M ± SD	Level of QoL
Physical health	10-21	19.14 ± 3.98	-
Psychological	12-30	19.10 ± 3.98	-
Social relationship	6-14	9.45 ± 1.75	-
Environment	15-34	24.71 ± 4.59	-
Satisfaction of health, and QoL	2-10	5.77 ± 1.66	-
QoL	52-102	78.17 ± 13.66	Moderate

Note: QoL: Quality of Life, M: Mean, SD: Standard Deviation.

TABLE 5
Description variables and Correlation between health issues and QoL

Variables	Min-Max	M ± SD	95% CI		r	*p*
			Lower	Upper		
Health issues	0-13	3.25 ± 2.66	2.89	3.68	-0.218	0.002**
QoL	52-112	78.17 ± 13.66	76.43	80.45		

*Note: QoL: Quality of Life, M: Mean, SD:Standard Deviation, CI :Confidence Interval, **p<0.01, Two-Tailed.*

TABLE 6
Differences in variables of QoL between (1) Men and women groups, (2) Age ranged <65 and ≥ 65 groups, and (3) Non hospitalization and hospitalization groups

Variables	QoL		
	M ± SD	t-test	p-value
Gender: (N =160) Men 81 (n=80) Women (n=80)	79.80 ± 15.34 74.95 ± 1.22	2.28	0.024*
Age (years) (N=172) < 65 (n=86) ≥ 65(n=86)	73.80 ± 11.65 66.73 ± 10.32	4.21	<0.001***
Hospitalization history (N=108) Hospitalization (n=54) Non hospitalization (n=54)	67.90 ± 9.74 81.68 ± 10.35	7.12	<0.001***

*Note: M: Mean, SD: Standard Deviation; *p <0 .05, ***p <0 .001, two-tailed.*

DISCUSSION

This study focusing on health issues experiences or PCS among people with DM. Explore the health issue experiences of post-COVID-19 and QoL among people with DM, they experienced mild and severe health conditions in one and six months. This study's findings showed that PCS were 66.5%, and mild conditions were 33.5%. Severe health issues included palpitation/chest pain, ischemic stroke, and gout rheumatoid arthritis, and SLE. Two participants experienced ischemic/embolic stroke, 3 or 4 months after the initial SARS-CoV-2 infection, then they had hemiplegia and facial palsy. Previous study found that the recovered COVID-19 patients presented a higher risk of ischemic stroke compared to people who did not have COVID-19 [14]. Meanwhile, mild PCS included anxiety fear of reinfection and being unable to work and self-reliant, fatigue, cough, allergies, loss of appetite, sleep disturbance, memory impairment, brain fog, inattention, low self-esteem etc. Moreover, they were fearful of having complications, especially those who were among the risk group, including the elderly, those with DM, hypertension, CKD. Some of them experienced asymptomatic conditions that recovered to normal living but they felt tired easily and decreased work tolerance. Previous studies found that prevalence of long COVID was reported at six and 12 months, one or more symptom was reported by 71.5% and 70.7% respectively [3]. Those effects can exacerbate tachycardia, sarcopenia/muscle fatigue, anxiety and fear of abnormal lungs, dyspnea, allergy, and microvascular dysfunction/organ damage in patients with DM. Patients with co-prevalence of cardiovascular disease, DM and COVID had a higher risk of fatality [15-16].

The most common persistent symptoms in DM patients with COVID infection were fatigue, headaches, and cough, etc. Advanced age and use of antidiabetic medications were independently associated with COVID-19-related complications in diabetic patients. Similarly, several studies revealed that survivors had persistent symptoms, decreased activity tolerance, fatigue, anxiety/fear abnormal lungs, dyspnea, insomnia, memory loss, anxiety, and depression [17-18]. The main risk factors to develop PCS are being women, having three or more co-morbidities. Split opinions: for and against COVID vaccination: 93.5 % of participants had fear of the side effect of COVID vaccine, and 89.5 % unwillingness to vaccination. In conclusion, this study shows more negative attitude against COVID vaccination. The studies generally showed more negative attitudes towards vaccination. In addition, the association between negative attitudes towards vaccination in general and uptake of a booster dose was weaker among those who reported a higher level of psychological reluctance. The COVID-19 variants emerge rapidly, but the efficacy of vaccination against newly emerging variants seems uncertain. A meta-analysis showed that the efficacy of three major types of COVID-19 vaccines, including mRNA-based vaccine, viral vector vaccine, and inactivated vaccine, decreased when faced with the B.1.617.2 (delta) variant [19-20]. They experienced post-COVID-19 vaccination effects or long post-COVID-19 vaccination syndromes. Another study finds, 14% of respondents displayed high levels of mistrust about vaccines across one or more domains. Overall, that 16% of respondents reported unwillingness to receive a vaccine for COVID-19, whilst 23% were unsure. On the other hand, the study suggested a strong association between COVID-19 vaccination before infection and reduced risk of receiving a diagnosis of post-COVID conditions. Primary vaccination against COVID-19 is essential to reduce the population burden of post-COVID-19 conditions [21-22]. The effectiveness of the vaccines against COVID-19 declined after the delta variant became predominant. The effectiveness against hospitalization remained high, with modest declines limited to BioNTech COVID-19 vaccine and mRNA recipients of 65 years or older [23]. Prevention of COVID-19: Participants' behavioral changes included living habits by wearing a mask when leaving home. They had a positive attitude toward prevention and control of infection. Hand Hygiene (HH) is essential to prevent the spread of the COVID-19 virus. It also interrupts the transmission of other viruses and bacteria, causing common colds, flu and pneumonia, thus reducing the general burden of disease. Community mask-wearing is an effective no pharmacologic intervention to reduce the spread of this infection, mainly as source control to prevent the spread from infected persons and as protection to reduce wearers 'exposure to infection [24-25]. Moreover, social distancing leads to a reduction in the spread of infection. A study finding is that infection rates are reduced drastically when social distancing intervention is implemented between 80% and 100% [26]. Investigate the health

issues or PCS, and QoL among people with DM. Participants' QoL was a moderate level. While the QoL of the remaining 16 (8%) participants were at a low level (poor level) due to serious health issues from contracting COVID-19. A long period of hospitalization, which resulted in many residual symptoms of long-COVID-19 among the affected ex-patients, which included decreased activity tolerance, fatigue, dyspnea, depression, anxiety and fear of reinfection, etc. [27]. Previous symptomatic infection was associated with poorer QoL, impairment across all daily activities including breathlessness, palpitation, chest pain, etc. A previous study found resilience exhibited a negative correlation with anxiety and depression while showing a positive correlation with sleep quality. Meanwhile, another study found that in patients with DMs (without COVID-19), their QoL was high, and their OoL and blood glucose levels had a negative relation. However, the poorer glycemic control related to health problems and comorbidity and low QoL of patients with type 2 DM [28-29]. Comparisons of the mean differences of QoL between men and women groups; men's QoL was more than women, QoL of age ranged <65 was more than aged ≥ 65 years. The QoL of non-hospitalization was more than that of the hospitalization groups because they had pre-existing comorbidities with Non-Communicable Diseases (NCDs) such as DM, hypertension, heart disease, overweight, etc. Moreover, most participants were older adults with comorbidity who were at high risk for severe conditions relating to QoL. The study identified the negative impact of fatigue, pain, low physical activity, and cognitive-communication problems on health-related QoL, and an early and accurate evaluation and management are required for post-COVID recovered older adults. Previous study found that the COVID-19 pandemic had a negative impact on patients with chronic NCDs QoL. The QoL was significant by age, gender, educational status, duration of illness. Older people have a higher risk of long COVID than younger people. Frail older adults remain at elevated risk of mortality from COVID [30-32]. Additionally, long COVID is particular concern among older people (aged 65 years or older) who are at greater risk than younger people of persisting symptoms associated with COVID-19 [33]. However, health issue and QoL was a negative relation. Because of they experienced a lot of health conditions not only physical but also mental health which affected to QoL. Similarly, previous study revealed that long-COVID prevalence was at 77.7%, with the most frequently reported symptoms being fatigue and cough. Regarding mental health, depression was reported anxiety, and poor sleep quality. Another study found that health related QoL (HRQoL) is impaired after hospitalization due to COVID-19. This mixed methods study discovered people with DM post-infected with COVID-19 having a lot of health issues, not only physical but also psychological, and QoL. Therefore, long-term post-COVID-19 care should be concerned with differential health assessment of symptoms and providing health care services among people with fragility, such as older people, DM, and other comorbid diseases. Those can improve their physical, psychological, and QoL.

Limitations

1. The participants in this study were people with DM who were infected with COVID-19 in Nakhon Ratchasima Province and Ubon Ratchatani Province, in the northeastern region of Thailand.
2. The sample was convenient, and the snowball sampling technique totaled 200 participants. Therefore, it could not be generalized to a broader area in Thailand.
3. The number of participants in the hospitalization group was lower than that of the non-hospitalization group.
4. This study's first instrument was developed from grounded data in the initial phase. Finally, the development of an instrument and factor analysis is needed.

CONCLUSIONS

The findings supported five themes related to health issues and QoL among people with DM post-infected with COVID-19. This study highlights (1) moderate level of the OoL, (2) mild and severe conditions, (3) fear of recurrent COVID-19, (4) split opinions: for and against COVID-19 vaccination, and (5) prevention of COVID-19. Post-COVID-19 health issues were 94.5%, 62.0 % fear of reinfection and being unable to work and self-reliant, 47.5% fatigue/activity intolerance, 31.5% allergies, 25.6% loss of appetite, 21% sleep disturbance, 12% flu/ fever, respectively. This study confirmed that QoL was at a moderate level. The health issue was a negative relation of QoL (r-.218, p<01). Comparisons of QoL, the findings: men's QoL was more than women (t 2.28, p<05) age ranged <65 group was more than aged ≥ 65 years' group (t 7.12, p <0.001). The QoL of non-hospitalization was more than that of the hospitalization group (t=2.28, p<0.001). Implication: Additionally, nurses can play a vital role in collaborating with the multidisciplinary team to create a health care services program tailored to people with DM's needs.

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