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The effect of interactive online learning on knowledge, attitude, and practice related to diabetes mellitus of productive-age population

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ABSTRACT

Background: Diabetes mellitus still becomes a significant population health problem. In achieving sufficient awareness, face-to-face public education methods may serve as an effective measure. However, in the amid of pandemic, their implementation is restricted, which leads to the use of virtual platforms for learning activities. In addition, the applicability of the online learning method has yet to be explored.
Objective: To evaluate its impact on the knowledge, attitude, and lifestyle practices of the productive-age population related to diabetes.
Methods: A pre-test and post-test quasi-experimental study involving a single group was conducted among the productive-age population (aged 15 to 64 years) selected using consecutive sampling in two sub-districts in Surabaya, Indonesia. Baseline and endline levels of participants' knowledge, attitude, and practice regarding diabetes assessed using a self-developed questionnaire were compared after receiving an educational intervention.
Results: A total of 19 participants meeting the eligibility criteria were selected as the study subjects. A statistically significant increase in the participants' knowledge score from pre- to post-test (p=0.038) was observed. There was no significant change between the pre-test and post-test scores of attitude (p=0.938) and practice (p=0.087) after the intervention.
Conclusion: Online learning method improved the population's knowledge regarding diabetes mellitus. However, it appears to have a limited role in providing better modification for attitude and practice. Further research comparing online and traditional face-to-face education methods are required to establish this approach as an alternative.

Latar belakang: *Diabetes mellitus masih menjadi masalah kesehatan masyarakat yang bermakna. Metode edukasi secara tatap muka dapat menjadi langkah yang efektif dalam meningkatkan kesadaran masyarakat. Namun, keadaan pandemi menyebabkan penerapannya lebih dibatasi. Hal ini mengarahkan masyarakat kepada penggunaan aplikasi berbasis daring untuk melaksanakan kegiatan pembelajaran. Penerapan edukasi dengan metode daring masih memerlukan eksplorasi lebih lanjut.*
Tujuan: *Penelitian ini bertujuan untuk mengevaluasi pengaruh edukasi secara daring terhadap pengetahuan, sikap, dan praktik gaya hidup yang terkait diabetes pada populasi usia produktif.*
Metode: *Studi ini merupakan studi eksperimen semu tanpa kontrol dengan pre-test dan post-test yang*

melibatkan populasi usia produktif (15 hingga 64 tahun). Sampel dipilih secara konsekutif dari dua kecamatan di Surabaya, Indonesia. Tingkat pengetahuan, sikap, dan praktik dari partisipan mengenai diabetes sebelum dan sesudah intervensi dinilai menggunakan kuesioner yang dirancang secara mandiri. Kedua nilai tersebut kemudian dibandingkan untuk menentukan pengaruh intervensi.

Hasil: *Subjek dari penelitian ini berjumlah sebanyak 19 partisipan yang memenuhi kriteria inklusi dan eksklusi. Hasil penelitian menunjukkan adanya peningkatan skor pengetahuan partisipan yang signifikan (p=0,038) dari pre-test ke post-test. Tidak ada perubahan yang signifikan antara skor pre-test dan post-test aspek sikap (p=0,938) dan praktik (p=0,087) setelah pemberian intervensi.*

Kesimpulan: *Metode edukasi daring meningkatkan pengetahuan masyarakat tentang diabetes mellitus. Namun, metode ini tampaknya memiliki peran yang terbatas dalam memberikan perubahan yang positif untuk aspek sikap dan praktik. Penelitian lebih lanjut yang membandingkan metode edukasi daring dengan tatap muka masih diperlukan untuk menentukan penerapannya sebagai metode alternatif.*

INTRODUCTION

Diabetes mellitus (DM) is a part of the metabolic diseases group characterized by a hyperglycemia state due to abnormal insulin secretion, abnormal insulin action, or both. The most common is type 2 diabetes. Diabetes mellitus is one of the leading causes of death in the world. Based on WHO data, 422 million people worldwide have diabetes, with 1.6 million diabetes-related deaths each year. The majority of diabetes cases are in the low- and middle-income countries.[1] In 2019, Indonesia occupied the 7th position as the country with the highest number of diabetes cases globally, reaching 10.7 million people.[2] The International Diabetes Federation (IDF) predicts the number of diabetic patients in Indonesia will increase to 16.6 million by 2045.[3]

The Chinese government announced the discovery of an unknown case of pneumonia in the city of Wuhan, China In December 2019.[4] The cause of pneumonia was found to be SARS-CoV-2, which the World Health Organization (WHO) named the disease later as Coronavirus Disease 2019 (COVID-19).[5] WHO characterized the COVID-19 as a pandemic on 11 March 2020.[6] The COVID-19 pandemic has greatly affected social, economic, and health system activities. Examples in the field of health, there are still many diseases considered neglected. Among others is the DM.

In order to improve the community's knowledge and concern of the community in dealing with DM, efforts are required that aim to raise public awareness regarding the disease, for instance, by using face-to-face education methods.[7] Nevertheless, the COVID-19 pandemic circumstance requires countries to carry out control and precautionary measures, including quarantine, lockdown, and social distancing, to decrease the disease's transmission.[8,9] Consequently, direct counseling and educational activities are affected and have become limited in their practice. To overcome this issue in the field of education, online learning using various available platforms has become more commonly implemented.[10]

Online learning is considered an ideal alternative for the traditional face-to-face method if appropriately designed.[11,12] Several studies have addressed the practicality of online learning. Based on Tuna, *et al*. research, online learning was considered an effective method in delivering information in the area of health.[13] Furthermore, another study has demonstrated that online education through videos and leaflets is an effective method to increase public knowledge.[14] Contrarily, another study by Dewantara and Nurgiansah argued that online learning during the COVID-19 pandemic is continuing to be more ineffective.[15] Therefore, in this study, we will attempt to investigate the effect of online learning on the knowledge, attitude, and lifestyle practices of the productive-age population related to DM in Surabaya, East Java, Indonesia.

METHODS

This study is a part of a bigger project ("Impact of interactive virtual education on knowledge, attitude, and practice regarding

metabolic syndrome of productive age population in Surabaya") conducted by the RADIALIS Research Group. The study protocol has been approved by the Health Research Ethics Committee, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia (48/EC/KEPK/FKUA/2021). All methods were performed in conformity with the relevant guidelines and standard recommendations.

Study design, site, sampling, and participants

This study used a quasi-experimental design involving pre-tests and post-tests for a single group conducted from 20 March to 3 April 2021. For the purpose of this study, two locations include Ketabang and Pacar Keling sub-districts in Surabaya, Indonesia, were selected. Participants were recruited using a consecutive sampling method. The inclusion criteria were subjects aged 15 to 64 years who agreed to participate by giving their consent and has access to the Zoom Cloud Meetings platform. We further excluded participants who did not attend this study or complete the educational intervention, pre-test, and post-test.

Measurement tool and data collection process

A self-reported pre-test and post-test questionnaire consisting of socio-demographic variables (age, gender, and educational level) and three domains, including knowledge, attitude, lifestyle practice related to DM, was developed using Google Forms (docs.google.com/forms). The questionnaire was originally drafted in the vernacular language (Bahasa Indonesia). Prior to the data collection, all participants were provided with a brief guidebook containing the complete description of the current study methods and procedures. Pre-test data and consent to participate was obtained one day before starting an educational intervention by contacting the study participants. We conducted an online education consisting of two sessions on 21 March 2021, via the Zoom Cloud Meetings (Zoom Video Communications, Inc., San Jose, CA, USA). The participants were educated regarding knowledge, attitude, and lifestyle practice related to DM in the first 40-minutes session using the conventional one-way teaching method and assisted by audio-visual media. Subsequently, the participants were given an open 15-minutes of question-and-answer session to discuss the provided education. These sessions were delivered virtually online by an expert in the corresponding field. The intervention was then followed by a post-test conducted using the same questionnaire in a period of up to 3 April 2021.

Determination of participants' level of knowledge, attitude, and practice

To assess the level of knowledge about DM, the participants were asked ten questions with a particular topic on each item. A correct answer for each question was scored 10 points, and an incorrect answer was scored 0 points (maximum score: 100 points). The attitude and practice were evaluated using a four-point Likert scale, ranging from "strongly disagree" to "strongly agree" and "never or rarely" to "always", with a total of 10 items for each domain. Positive attitude and practice items were scored 1 to 4 points, whereas negative statements were scored in the opposite order, 4 to 1 point (maximum score: 40 points). The participants' knowledge, attitude, and practice levels were further rated based on their total scores. For the knowledge domain, a total score of >70 was considered as "good", 50–70 as "moderate", and <50 as "poor", while the total score of the attitude and practice domains were considered as "good" if ≥30, "moderate" if 20–29, and "poor" if <20.

Data management and statistical analysis

Submitted responses were extracted from Google Forms to the Microsoft Excel ver. 2019 (Microsoft Corporation, Redmond, WA, USA) for further data processing and coding. Dichotomous data were presented as frequencies and proportions, whereas continuous data were presented based on data normality in mean ± standard deviation (SD) or median (interquartile range/IQR). The comparison between pre-

test and post-test scores for the knowledge, attitude, and practice domain was analyzed using Wilcoxon signed-rank test due to the data's normality. All normalities were tested following the principle of the Shapiro-Wilk test. Simple logistic regression analyses were performed to determine demographic covariates associated with the increase in post-test scores for each domain. A two-tailed p-value of less than 0.05 was considered statistically significant. All statistical analyses were performed using SPSS software (SPSS Inc., Chicago, IL, USA).

RESULTS

Characteristics of study participants

A total of 19 participants who successfully met the eligibility criteria were included in this study. The median age was 45.0 years (IQR: 31.5–51.0), with female gender (68.4%) and educational level of a college degree (52.6%) as the majority. The detailed characteristics of the study participants are provided in Table 1.

Comparison of pre-test and post-test scores

The Wilcoxon signed-rank test was used for all domains. The comparison analysis between pre-test and post-test scores of the knowledge domain showed a significant difference (p=0.038). However, no significant differences were observed in the attitude (p=0.938) and practice (p=0.087) domains. The scores and

Table 1. Characteristics of the study participants

		Participants (*N* = 19)
	Age (years)	45.0 (31.5–51.0)
Gender	Male	6 (31.6)
	Female	13 (68.4)
Educational Level	College Degree	10 (52.6)
	Primary or High School	9 (47.4)

Data are presented as median (interquartile range [IQR]) or Σ (%).

Table 2. Comparison of the knowledge, attitude, and practice pre-test and post-test scores

Domain		**Pre-test (N = 19)**	**Post-test (N = 19)**	**p-value**
Knowledge	Mean	58.95	63.68	0.038*
	Median	60	60	
	Good	5 (26.3)	7 (36.8)	
	Moderate	6 (31.6)	4 (21.1)	
	Poor	8 (42.1)	8 (42.1)	
Attitude	Mean	32.11	32.26	0.938
	Median	31	32	
	Good	13 (68.4)	15 (78.9)	
	Moderate	6 (31.6)	4 (21.1)	
	Poor	0	0	
Practice	Mean	25.37	26.00	0.087
	Median	26	26	
	Good	2 (10.5)	3 (15.8)	
	Moderate	16 (84.2)	15 (78.9)	
	Poor	1 (5.3)	1 (5.3)	

Data are presented as N (%), * $p < 0.05$

comparison results between pre-test and post-test are summarized in Table 2. The score details of each item in the knowledge, attitude, and practice domains are provided in Table 3, Table 4, and Table 5, respectively.

Table 3. Comparison of knowledge pre-test and post-test scores

Items#	Scores	Pre-test (N = 19)	Post-test (N = 19)
1. Recommended daily sugar consumption	Correct answer	7 (36.8)	9 (47.4)
	Mean	3.68	4.74
	Median	0	0
2. Incorrect statement about diabetes mellitus	Correct answer	11 (57.9)	12 (63.2)
	Mean	5.79	6.32
	Median	10	10
3. People with risk of diabetes mellitus	Correct answer	18 (94.7)	18 (94.7)
	Mean	9.47	9.47
	Median	10	10
4. Tests for diabetes mellitus	Correct answer	16 (84.2)	16 (84.2)
	Mean	8.42	8.42
	Median	10	10
5. Diagnosis of diabetes mellitus using fasting blood glucose	Correct answer	11 (57.9)	7 (36.8)
	Mean	5.79	3.68
	Median	10	0
6. Diagnosis of diabetes mellitus using two-hour postprandial glucose	Correct answer	7 (36.8)	7 (36.8)
	Mean	3.68	3.68
	Median	0	0
7. Symptoms of diabetes mellitus	Correct answer	16 (84.2)	15 (78.9)
	Mean	8.42	7.89
	Median	10	10
8. Complications in diabetes mellitus	Correct answer	5 (26.3)	12 (63.2)
	Mean	2.63	6.32
	Median	0	10
9. Management to control diabetes mellitus	Correct answer	16 (84.2)	19 (100.0)
	Mean	8.42	10.00
	Median	10	10
10. Insulin resistance	Correct answer	5 (26.3)	6 (31.6)
	Mean	2.63	3.16
	Median	0	0

Data are presented as Σ (%).

Table 4. Comparison of attitude pre-test and post-test scores

Question	Scores	Pre-test (N = 19)	Post-test (N = 19)
1. Exercise should be done regularly	Total	69	70
	Mean	3.63	3.68
	Median	4	4
2. Food intake must be controlled properly for maintaining the health	Total	70	68
	Mean	3.68	3.58
	Median	4	4
3. Consumption of fruits and vegetables should be done regularly	Total	66	68
	Mean	3.47	3.58
	Median	3	4
4. Excess sugar consumption has a positive effect on the body	Total	60	57
	Mean	3.16	3.00
	Median	3	3
5. By reducing carbohydrate consumption, blood sugar levels will be well controlled	Total	56	58
	Mean	2.95	3.05
	Median	3	3
6. Consuming foods or drinks with artificial sweeteners are good for the body	Total	68	65
	Mean	3.58	3.42
	Median	4	4
7. Not taking medication properly will negatively affect diabetic patients	Total	59	58
	Mean	3.11	3.05
	Median	3	3
8. Good exercises are just heavy-intensity exercises	Total	60	62
	Mean	3.16	3.26
	Median	3	3
9. Diabetic patients no longer need to take medication if blood sugar levels have reached normal	Total	50	51
	Mean	2.63	2.68
	Median	2	3
10. Any kinds of herbal remedy are effective for controlling blood sugar levels	Total	52	56
	Mean	2.74	2.95
	Median	3	3

Association between demographic variables and the increase in post-test scores

The differences across age, gender (male vs. female), and education level (college degree vs. high school) were not associated with the increase in post-test scores in all domains ($p>0.05$).

Table 5. Comparison of practice pre-test and post-test scores

Question	Scores	Pre-test (N = 19)	Post-test (N = 19)
1. I routinely check my blood sugar at least every three months	Total	32	34
	Mean	1.68	1.79
	Median	2	2
2. I set a meal schedule and control the nutritional content of the food I eat	Total	47	49
	Mean	2.47	2.58
	Median	2	2
3. I like to have snacks in addition to my main meals	Total	52	55
	Mean	2.74	2.89
	Median	3	3
4. I consume more than two tablespoons of sugar per day	Total	52	56
	Mean	2.74	2.95
	Median	3	3
5. I check the sugar levels listed on food and beverage packages to limit my sugar consumption per day	Total	41	39
	Mean	2.16	2.05
	Median	2	2
6. I reduce food and drinks consumption that contains high sugar levels (e.g., sweets, cakes, and soft drinks)	Total	49	51
	Mean	2.58	2.68
	Median	2	3
7. I regularly eat fruits and vegetables daily	Total	56	52
	Mean	2.95	2.74
	Median	3	3
8. I often watch TV or play gadgets rather than doing physical activities	Total	49	54
	Mean	2.58	2.84
	Median	3	3
9. I try to maintain an ideal body weight	Total	48	50
	Mean	2.53	2.63
	Median	2	3
10. I suggest my family to avoid consuming excessive sugar	Total	56	54
	Mean	2.95	2.84
	Median	3	3

DISCUSSION

This study found that educational learning using an online method had a significant effect on the level of knowledge but not on the attitude and practice perception regarding DM. Providing education through online platforms could serve as an alternative in health promotion during a pandemic, although the effect of providing online education is still not fully clear. Several previous studies reported that online education had a significant impact, while others reported the opposite.[16-19] Yet, it is agreed that education about DM urgently requires an improvement.[20,21]

Knowledge plays a critical role and is closely

related to attitude and behavior.[22,23] A low level of knowledge about DM has been shown to increase the risk of complications due to diabetes.[24] Hence, using health promotion as an effort to promote DM in the community is highly recommended by various studies.[25–27] Our study showed an increase in participants' knowledge significantly after health promotion, which could depict that level of knowledge was low prior to the intervention. These findings are also consistent with other reports which showed a low level of knowledge in the suburban population.[28,29] Information about DM is still rarely known in the suburban areas since the provision of health intervention and education is scarcely available.

If comparison analyses were performed on each knowledge' item (Table 3), the results showed a significant increase in the knowledge about complications of diabetes (Item #8) after health promotion. However, surprisingly, there was a significant decrease in the knowledge regarding the diagnosis of diabetes (Item #5). These findings could obscure the overall effect of providing online diabetes education. Nevertheless, they could be explained since the topic about diabetes complications is considered very compelling for the audience. People tend to be more aware of the hazard and further negative outcomes caused by diabetes.[30] This awareness could make them focus on the lesson of diabetes complications. At the same time, since the topic on the diagnosis of diabetes requires more attention and accuracy in answering the questions, online education may not be suitable in increasing the knowledge on this particular topic.

Changes in attitude and practice are also crucial since a healthy lifestyle is considered the most effective way to prevent and reduce the risk of developing DM. Adopting a healthy behavior is expected to reduce the burden of diabetes and is the key to achieve good health as the fourth goal of Sustainable Development Goals (SDGs).[31,32] An improved healthy behavior has also been shown to reduce the health expenditure required for managing DM.[33] Unfortunately, our results showed no significant change in attitude and practice after the subjects received an online education. This finding might be explained since a short-term intervention is insufficient to provide changes in the attitude and practice aspects. Longer duration and higher frequency of the intervention are needed to improve someone's attitude and practice.[17] Several studies also revealed that more apparent changes could be achieved by giving continuous exposure to the participants.[23,31] Additionally, it is stated that attitude change takes time, since people have to consider regarding the issue and their commitment to generate reasons and favorable attitudes.[34] Some behaviors may also require more time to change.[35] The rather short interval between the pre-test and post-test in this study might not have allowed sufficient time for the participant's attitudes and behaviors to change.[34] A study by Murray, *et al*. suggested several key factors influencing the maintenance of lifestyle behavior change, including social support, 'education and knowledge', and also 'beliefs and emotions'.[36] Our study only targeted the educational factors of participants, which might not be adequate to encourage thorough changes and maintenance of behaviors. Future studies investigating similar topic should further consider these influencing factors, the length of intervention, and follow-up period to provide the best possible quality of intervention for attitude and behavioral change. The use of online platforms for providing education is one of the most determining factors in this study. Intervention approaches that are not adapted to the local context may become barriers in achieving successful public health interventions.[37] Most residents in the suburban area are still unfamiliar with the use of online media. This is indicated by the low satisfaction in the application of the online system as an educational tool.[38] In addition, poor internet connection and the low quality of the technology used by the participants could also become other factors that reduce their focus and concentration, which could further lead to confusion throughout the learning sessions. A previous study by Bao and Yu argued that a hybrid method by

combining online and offline teaching might enhance the quality of intervention and provide better benefits rather than using only an online intervention.[39] Another important factor that we speculate affects the success in providing education in this study is the participants' level of health literacy. Low health literacy prevents easy delivery of health care information and education. The level of health literacy itself is influenced by several demographic factors, including level of education, age, race, ethnic, gender, and socioeconomic status.[40] A cross-sectional study by Herath *et al*. found that level of education was associated with knowledge on DM.[31] Conversely, they found no association between gender and age with the knowledge of DM. In terms of the attitude and practice on DM, educational level was found to be significantly associated.[41] However, after the participants were given intervention in our study, we found that the increase in the post-test scores in all domains was not associated with age, gender, and educational level.

Several limitations exist in our study. First, our study did not provide a control group. The highest possible evaluation could not be ensured due to a lack of a control arm. Second, the diverse background of the participants might become cofounding factors. Level of education, gender, environment, and location could have an impact on the knowledge, attitude, and practice of the subjects.[26,42,43] However, these limitations were partly diminished by using pre-post intervention approaches. Finally, small sample sizes might be responsible for insignificant statistical tests. Nevertheless, we have applied statistical analyses that are appropriate with a small sample size. The Shapiro-Wilk test is recommended when the sample size is less than 50 as it has more power to detect the non-normality.[44] Additionally, standard non-parametric tests (e.g., Wilcoxon signed-rank test) have been used when the sample size is small.[45] Recruiting additional participants is difficult due to the rare and limited use of online platforms for education in Indonesian society. However, since only a few data are available regarding the knowledge, attitude, and practice after online education via virtual platforms in Indonesia, our results could be used as a reference for further research.

CONCLUSION

This study demonstrated an improvement in the knowledge of the productive-age population related to diabetes mellitus following online educational learning. However, the results did not show significant changes in the participants' attitude and lifestyle practice because this may require more intensive education and a longer follow-up time. Given the limitations in our study, further well-designed and larger-sized studies with a control group would be needed to confirm our findings.

CONFLICT OF INTEREST

The authors of this study report no relationships that could be considered as conflict of interest.

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REFERENCES

1. World Health Organization. Diabetes. https://www.who.int/health-topics/diabetes#tab=tab_1
2. Ministry of Health of the Republic of Indonesia. Diabetes Mellitus. Pusdatin. 2020. https://pusdatin.kemkes.go.id/download.php?file=download/pusdatin/infodatin/Infodatin-2020-Diabetes-Melitus.pdf
3. World Health Organization. Diabetes report 2010—2045. 2021. https://www.diabetesatlas.org/data/en/country/94/id.html
4. World Health Organization. COVID-19-China. 2020. https://www.who.int/emergencies/disease-outbreak-news/item/2020-DON229

5. Gorbalenya AE, Baker SC, Baric RS, de Groot RJ, Drosten C, Gulyaeva AA, et al. The species severe acute respiratory syndrome-related coronavirus: Classifying 2019-nCoV and naming it SARS-CoV-2. Nature Microbiology. 2020;5(4):536–44.
6. World Health Organization. Archived : WHO Timeline COVID-19. 2020. https://www.who.int/news/item/27-04-2020-who-timeline---covid-19
7. Maslakpak MH, Razmara S, Niazkhani Z. Effects of face-to-face and telephone-based family-oriented education on self-care behavior and patient outcomes in type 2 diabetes: A randomized controlled trial. Journal Diabetes Reseach. 2017;2017:8404328.
8. Ministry of Health of the Republic of Indonesia. 5 M di masa pandemi COVID-19 di Indonesia. 2021. http://www.padk.kemkes.go.id/article/read/2021/02/01/46/5-m-dimasa-pandemi-covid-19-di-indonesia.html
9. Wang C, Wang Z, Wang G, Lau JYN, Zhang K, Li W. COVID-19 in early 2021: Current status and looking forward. Signal Transduction and Targeted Therapy. 2021;6(1):114
10. Nasution AKP, Batubara MH, Nurmalima, Munandar I. High school students perceptions of online learning during the Covid-19 pandemic on The Aceh Mountains. 2021;4(2):83–91.
11. Muthuprasad T, Aiswarya S, Aditya KS, Jha GK. Students' perception and preference for online education in India during COVID -19 pandemic. Social Sciences & Humanities Open. 2021;3(1):100101.
12. Kusmaryono I, Jupriyanto J, Kusumaningsih W. A systematic literature review on the effectiveness of distance learning: Problems, opportunities, challenges, and predictions. International Journal of Educational Development. 2021;14(1):62–9.
13. Tuna A, Avdal EU, Yucel SC, Dal NA, Dicle A, Ozkan A, et al. Effectiveness of online education in teaching breast self-examination. Asian Pacific Journal of Cancer Prevention. 2014;15(7):3227–31.
14. Sabarudin, Mahmudah R, Ruslin, Aba L, Nggawu LO, Syahbudin, et al. Efektivitas pemberian edukasi secara online melalui media video dan leaflet terhadap tingkat pengetahuan pencegahan Covid-19 di Kota Baubau. Galenika J Pharmacy. 2020;6(2):309–18.
15. Dewantara JA, Nurgiansah TH. Efektivitas pembelajaran daring di masa pandemi COVID 19 bagi mahasiswa universitas PGRI Yogyakarta. Jurnal Basicedu. 2020;5(1):367–75.
16. Gabarron E, Bradway M, Fernandez-Luque L, Chomutare T, Hansen AH, Wynn R, et al. Social media for health promotion in diabetes: Study protocol for a participatory public health intervention design. BMC Health Service Research. 2018;18(1):1–5.
17. Goodarzi M, Ebrahimzadeh I, Rabi A, Saedipoor B, Jafarabadi MA. Impact of distance education via mobile phone text messaging on knowledge, attitude, practice and self efficacy of patients with type 2 diabetes mellitus in Iran. Journal of Diabetes Metabolic Disorders. 2012;11(1):1–8.
18. Noohi E, Khandan M, Mirzazadeh A. Effective of electronic education on knowledge attitude and self-care in patient's diabetic type 2 refer to diabetic center of Kerman University of medical science. Iranian Journal of Nursing Research. 2011;6(22):73–80.
19. Lipari M, Berlie H, Saleh Y, Hang P, Moser L. Understandability, actionability, and readability of online patient education materials about diabetes mellitus. American Journal of Health-System Pharmacy. 2019;76(3):182–6.
20. Lingam S, Rani PK, Sheeladevi S, Kotapati V, Das T. Knowledge, attitude and practices on diabetes, hypertension and diabetic retinopathy and the factors that motivate screening for diabetes and diabetic retinopathy in a pyramidal model of eye health care. Rural Remote Health. 2018;18(1):4304
21. Chatzistougianni P, Tsotridou E, Dimitriadou M, Christoforidis A. Level of knowledge and evaluation of perceptions regarding pediatric diabetes among Greek teachers. Diabetes Research and Clinical Practice. 2020;159:107952.

22. Weitgasser R, Clodi M, Cvach S, Riedl M, Lechleitner M, Ludvik B. Diabetes education and counselling in adult patients with diabetes (Update 2019). Wiener klinische Wochenschrift. 2019;131:110–4.
23. Abougalambou SSI, AbaAlkhail H, Abougalambou AS. The knowledge, attitude and practice among diabetic patient in central region of Saudi Arabia. Diabetes and Metabolic Syndrome: Clinical Research and Reviews. 2019;13(5):2975–81.
24. Robles RB, Lidia G. Compeán Ortiz, Quirarte NHG, Berry DC, Pérez PA, Martínez SP. Knowledge and practices of diabetes foot care and risk of developing foot ulcers in México may have implications for patients of Méxican heritage living in the US. The Diabetes Educator. 2017;43(3):297–303.
25. Lee J, Smith JP. The effect of health promotion on diagnosis and management of diabetes. Journal of Epidemiology and Community Health. 2012;66(4):366–71.
26. Wolde M, Berhe N, Van Die I, Medhin G, Tsegaye A. Knowledge and practice on prevention of diabetes mellitus among diabetes mellitus family members, in suburban cities in Ethiopia. BMC Research Notes. 2017;10(1):1–6.
27. Ramirez-Perdomo C, Perdomo-Romero A, Rodríguez-Vélez M. Knowledge and practices for the prevention of the diabetic foot. Revista gaucha de enfermagem. 2019;40:e20180161.
28. Okonta HI, Ikombele JB, Ogunbanjo GA. Knowledge, attitude and practice regarding lifestyle modification in type 2 diabetic patients. African Journal of Primary Health & Family Medicine. 2014;6(1):2–7.
29. Pelullo CP, Rossiello R, Nappi R, Napolitano F, Di Giuseppe G. Diabetes prevention: Knowledge and perception of risk among Italian population. Biomed Research International. 2019;2019. Article ID 2753131. https://doi.org/10.1155/2019/2753131
30. Mujammami MH, Alodhayani AA, Aljabri MI, Alanazi AA, Alanazi SS, Alanazi AG, et al. Knowledge, awareness and perceptions of diabetes mellitus among the Saudi population. Journal of Comparative Effectiveness Research. 2020;9(6):413–22.
31. Herath HMM, Weerasinghe NP, Dias H, Weerarathna TP. Knowledge, attitude and practice related to diabetes mellitus among the general public in Galle district in Southern Sri Lanka: A pilot study. BMC Public Health. 2017;17(1):1–7.
32. Fortune K, Becerra-Posada F, Buss P, Galvão LAC, Contreras A, Murphy M, et al. Health promotion and the agenda for sustainable development, who region of the Americas. Bulletin of World Health Organ. 2018;96(9):621–6.
33. Janssen JAMJL. Health promotion and disease prevention can substantially reduce the total economic burden of diabetes in the Netherlands. Netherlands Journal of Medicine. 2017;75(7):263–4.
34. Lokhorst AM, Werner C, Staats H, van Dijk E, Gale JL. Commitment and behavior change: A meta-analysis and critical review of commitment-making strategies in environmental research. Environment and Behavior. 2013;45(1):3–34.
35. Behavior change fast and slow: Changing multiple key behaviors a long-term proposition?. Global Health, Science and Practice. 2015;3(4):521-4.
36. Murray J, Fenton G, Honey S, Bara AC, Hill KM, House A. A qualitative synthesis of factors influencing maintenance of lifestyle behaviour change in individuals with high cardiovascular risk. BMC Cardiovascular Disorders. 2013;13:48.
37. Milat AJ, Bauman A, Redman S. Narrative review of models and success factors for scaling up public health interventions. Implementation Science. 2015;10:113.
38. Dinh LP, Nguyen TT. Pandemic, social distancing, and social work education: Students' satisfaction with online education in Vietnam. Journal of Social Work Education. 2020;39(8):1074–83.
39. Bao L, Yu P. Evaluation method of online and offline hybrid teaching quality of physical education based on mobile edge computing. Mobile Networks and Applications. 2021;26:2188–2198.
40. Beagley L. Educating patients: Understand-

ing barriers, learning styles, and teaching techniques. Journal of Perianesthesia Nursing. 2011;26(5):331–7.
41. Kassahun CW, Mekonen AG. Knowledge, attitude, practices and their associated factors towards diabetes mellitus among non diabetes community members of Bale Zone administrative towns, South East Ethiopia. A cross-sectional study. PLoS One. 2017;12(2):1–18.
42. Belsti Y, Akalu Y, Animut Y. Attitude, practice and its associated factors towards Diabetes complications among type 2 diabetic patients at Addis Zemen District hospital, Northwest Ethiopia. BMC Public Health. 2020;20(1):1–11.
43. Abbasi YF, See OG, Ping NY, Balasubramanian GP, Hoon YC, Paruchuri S. Diabetes knowledge, attitude, and practice among type 2 diabetes mellitus patients in Kuala Muda District, Malaysia–A cross-sectional study. Diabetes and Metabolic Syndrome: Clinical Reseach and Reviews. 2018;12(6):1057–63.
44. Mishra P, Pandey CM, Singh U, Gupta A, Sahu C, Keshri A. Descriptive statistics and normality tests for statistical data. Annals of Cardiac Anaesthesia. 2019;22(1):67–72.
45. Dwivedi AK, Mallawaarachchi I, Alvarado LA. Analysis of small sample size studies using nonparametric bootstrap test with pooled resampling method. Statistics in Medicine. 2017;36(14):2187–205.