



Impact of prediabetes education program on Knowledge, attitude and practice among prediabetic population of south India

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ARTICLE INFO

Keywords:

Prediabetes education program
Questionnaire
Knowledge
Attitude
Practice
India

ABSTRACT

Education plays a vital role not only in the management of diabetes but also for the effective prevention of diabetes and its complications. Prediabetes awareness and knowledge is grossly inadequate in India and massive prediabetic screening and management programs are urgently needed. This study was an initiative to conduct education program among the prediabetic subjects after assessment of their knowledge attitude and practice using a newly developed and validated prediabetes questionnaire. A total of 308 prediabetic participants were recruited through prediabetes screening camps conducted in the selected districts of Kerala and Tamilnadu. A newly developed and validated KAP-PAQ Questionnaire was used to analyze the Knowledge Attitude and Practice among the prediabetic population. The impact of Prediabetes Education Program was assessed by administration of questionnaire before and after PEP with an interval period of 30 days. Baseline assessment of knowledge among prediabetics shown that 90% had poor knowledge but after PEP program 43% had average knowledge and 44% could score good knowledge. Baseline assessment of attitude exhibited 30% with negative attitude but after counseling 68% shown positive attitude. Regarding practice assessment 35% had very poor and 52% shown poor practice but after PEP 71% shown good practice and 15% shown very good practice. Baseline KAP survey shows the need for health literacy among the newly diagnosed prediabetics. Prediabetes education program could bring significant improvement in knowledge attitude and practice and KAP-PAQ was found to be an efficient tool to conduct survey among the newly diagnosed prediabetics of south India.

1. Introduction

According to IDF Diabetes atlas 2019, India stands among the top ten countries with 77 million diabetes, 43.9 million undiagnosed diabetes and 25.2 million impaired glucose tolerance cases (International Diabetes Federation, 2019). Awareness and knowledge about diabetes is inadequate in India mostly over the rural areas (Deepa et al., 2014). Life style education is proven to be an effective strategy if we prior assess the characteristic of the population mainly knowledge, their attitude and practices about diabetes (Shah et al., 2009). Questionnaires are one of the vital tools of survey research for gathering information on individual perspectives in a large cohort (Jones et al., 2013). The objectives of diabetes education not only include developing knowledge and awareness but also increasing psychological resilience and motivation, changing their behaviour, and improving their quality of life and self

management skills (Świątoniowska et al., 2019). A recent population-based study in urban India found 20% of people with newly diagnosed diabetes had co-occurring depression which urges the need for early assessment of psychological factors influencing risky population like prediabetics (Poongothai et al., 2010). A large percentage of people in India around 35% are insufficiently active, with fewer than 10% engaging in recreational physical activity (Anjana et al., 2014). The purpose of this study was to compare the knowledge, attitude and practice levels pre and post education program among the prediabetics of south India. Interventions on prediabetes can make health care more affordable prevent a preventable disease and control the diabetes epidemic (Tuso, 2014). Moreover, elements of KAP are interconnected and interdependent where one element goes high the other two factors get affected positively (Fatema et al., 2017). Till date there are no national prevalence and interventional study on diabetes and prediabetes

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<https://doi.org/10.1016/j.pmedr.2021.101395>

Received 22 December 2020; Received in revised form 10 April 2021; Accepted 7 May 2021

Available online 10 May 2021

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which truly represent India as a whole (Anjana et al., 2011). This study is an initiative to conduct education program among the prediabetics after assessment of their knowledge attitude and practice using a newly developed and validated prediabetes questionnaire.

2. Methods

2.1. Research design

This study was part of a community based prospective open label interventional study carried out in 30 places over selected districts of Kerala (Wayanad, Calicut, Malappuram) and Tamilnadu (Nilgiris) of south India. Blood glucose testing was carried out at Vrindavan Lab and diagnostic Centre, Wayanad under certified Biochemists. This study was funded by Department of Science and Technology, New Delhi (SR/WOS-B/746/2016). The Institutional Review Board of JSS College of Pharmacy, Ooty, India approved this study (Approval number: JSSCP/DPP/IRB/06/2015–16). We carried out the search to identify a validated questionnaire suitable and easy to use in Indian setting among prediabetic population and we could find a gap in its existence. Knowledge Attitude Practice-Prediabetes Assessment Questionnaire (KAP-PAQ), a newly developed and validated questionnaire was used to obtain prediabetes awareness, knowledge, traditional beliefs and practices among the target population. The questionnaire development in a period of 15 months passed through several steps like conceptualization, questionnaire design, literature review, experts review, pre test, pilot test and also validation procedures like face validity, factor analysis and Cronbach's alpha. Under the supervision of doctors from Aster Wayanad Speciality Hospital, Kerala KAP-PAQ Questionnaire was administered through conversational interview technique by clinical pharmacist. All the participants were given written informed consent prior to the administration of questionnaire and translated version of Malayalam and Tamil were used in subjects who were unable to understand the English version fully. The baseline assessment of Knowledge Attitude and Practice among the study subjects using KAP-PAQ questionnaire is already being published by the investigators (Mohsina et al., 2020). This paper focuses on the comparison of baseline and follow up scores and the impact of prediabetes education program among the prediabetics of south India.

2.2. Data collection

Prediabetes screening was carried out among the local community by distribution of flyers prior the week of screening through Accredited Social Health Activists and social workers of each area. Males and females aged between 25 and 55 years participated for screening. Blood tests like FBS, HbA1c, Fasting lipid profile, blood pressure, HOMA IR were performed along with collection of past medical and medication history to screen out newly diagnosed prediabetics. The diagnosis of prediabetes was based on fasting plasma glucose between 100 and 125 mg/dl and HbA1C between 5.6% and 6.4%. Subjects who were not willing to participate in the study and not capable of understanding the questionnaire were excluded from the study. Baseline scores of KAP were collected using conversational interview technique which provided assistance to complete the questionnaire to people who are not familiar with medical terminologies. Standardized interviewing technique was carried out during the validation procedure of the questionnaire to confirm this mode of administration. It was made sure that answers were given by the respondents in order to ensure that they understood the questions completely. KAP-PAQ is a 30 item questionnaire with 10 questions each on Knowledge Attitude and Practice on prediabetes. Once the baseline scores were collected and analyzed, they were enrolled to Prediabetes Education Program on the next day of screening. After an interval period of 30 days follow up scores were collected by administration of questionnaire again on the respondents.

We determined that 315 prediabetes respondents would be

satisfactory sample size after adding 5% non response rate. The sample size required was calculated using power analysis (95% confidence interval, $\alpha = 0.05$, power of 80%). The data were entered in Ms excel and analyzed using the SPSS version 21 statistical software. Paired *t* test were used to determine whether the mean difference between pre and post intervention values were zero and Pearson's correlation was used to check the linear relationship between KAP variables either positive or negative.

2.3. Prediabetes education program (PEP)

This program was conducted for increasing the life style disease awareness and for changing unhealthy life style practices through group and individual prediabetes counseling among the participants. Here prediabetes was mainly taught about basics of healthy eating and proper exercise along with importance of weight loss, adequate sleep and stress free environment to lead a healthy life style. Prediabetes counseling was done with the aid of Prediabetes Information Pamphlet (PIP) along with pictograms. A 24 h dietary capture was done to assess their usual dietary intake per day. They were well taught about the consequences of ignoring prediabetes condition and the importance of regular blood checkups once diagnosed with prediabetes. After group counseling

Table 1
Baseline Characteristics of participants.

Baseline characteristic	Total (308)
Men : Women	158:150
Age (Years)	n (%)
25–30	11 (3.6)
31–35	17 (5.5)
36–40	50 (16.2)
41–45	63 (20.5)
46–50	79 (25.6)
51–55	88 (28.6)
District (State)	
Wayanad (Kerala)	72 (23.4)
Calicut (Kerala)	86 (27.9)
Malappuram (Kerala)	34 (11)
Nilgiris (Tamilnadu)	116 (37.7)
Education	
High school	167 (54.2)
Higher secondary	80 (26)
Graduation & above	61 (19.8)
Occupation	
Unskilled/skilled labourers	125 (40.6)
Executive/business class	51 (16.6)
House hold jobs	132 (42.9)
Diet	
Vegetarians	68 (22.1)
Non vegetarians	240 (77.9)
Smoking	
Yes	98 (31.8)
No	199 (64.6)
Currently stopped	11 (3.6)
Alcohol	
Yes	91 (29.5)
No	211 (68.5)
Currently stopped	6 (1.9)
BMI	
Normal	68 (22.1)
Over weight	163 (52.9)
Obese	75 (24.4)
Underweight	2 (0.6)
Waist to hip ratio	
High	157 (51)
Moderate	132 (42.9)
Low	19 (6.2)

BMI- Body Mass Index.

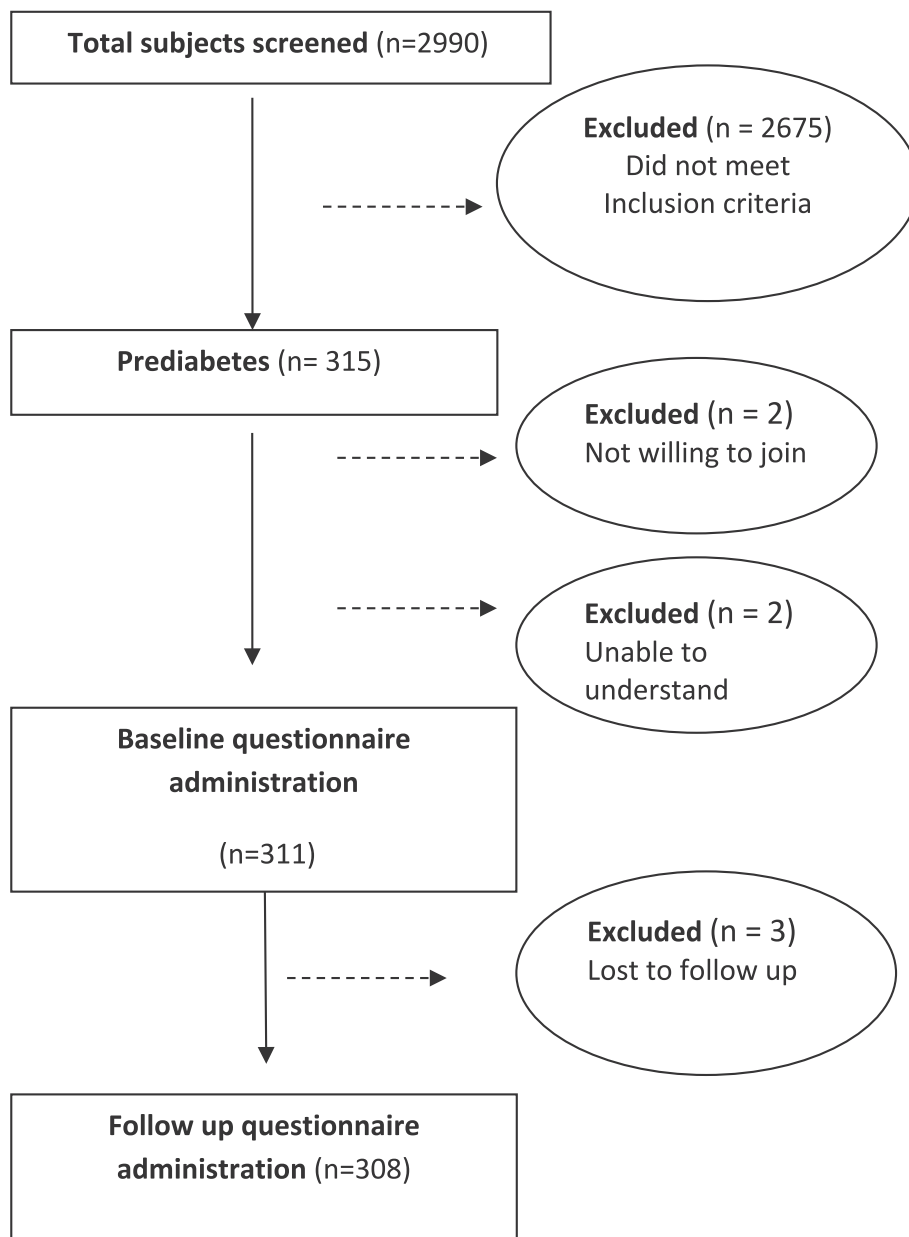


Fig. 1. Flow diagram for the KAP-PAQ Questionnaire study.

sessions, tailor made recommendations was given for each individual after analyzing their baseline answers to questionnaire.

2.4. KAP-PAQ scaling and scoring

Knowledge among prediabetics was assessed using KAP-PAQ Questionnaire comprised of 10 multiple choice questions on areas like etiology, detection, consequences as well as recommendations on prediabetes. Among the four answer options, only one correct answer has to be opted out. Points were given only to the correct answer and zero points to incorrect answer. As per the scoring of the questionnaire out of 17 marks, below 10 were considered as poor knowledge, 10 to 13 marks as average knowledge and 14 to 17 marks as good Knowledge. For questions 1, 2, 7, 8, 9, 10 correct answers can score 1 mark while correct answer for question 3 for 3 marks, question 4 and 5 for 2 marks and question 6 could score 4 marks.

Attitude among prediabetics assessed using KAP-PAQ comprised of 10 questions with 3 point likert type scale options strongly disagree;

neither agree nor disagree and strongly agree. Each positive attitude can score 1, each negative attitude (-1) and neutral attitude can score 0 marks. Out of total 10 marks, less than 0 were considered strongly negative attitude, 0 to 2 as negative attitude, 3 to 6 as neutral attitude and 7 and 8 as positive attitude while 9 and 10 as strongly positive attitude. Items on attitude section focused on attitudes of prediabetes towards life style modification and to find their feelings and beliefs that they had towards prediabetes. Thus KAP-PAQ had both evaluative component and cognitive component to assess their psychological state with end labeled bipolar response options. The scores were added and higher scores in the attitude section indicate more positive attitude on diabetes prevention.

Practice among prediabetics assessed using KAP-PAQ comprised of 10 multiple choice questions on daily practices regarding dietary intake, physical activity, sleep pattern, meal frequency as well as blood tests. Zero points were given for the lowest frequencies in the scale, 1 point for acceptable practice and 2 to 4 marks for the highest frequency in the scale. Points were summed up and a higher score in this section

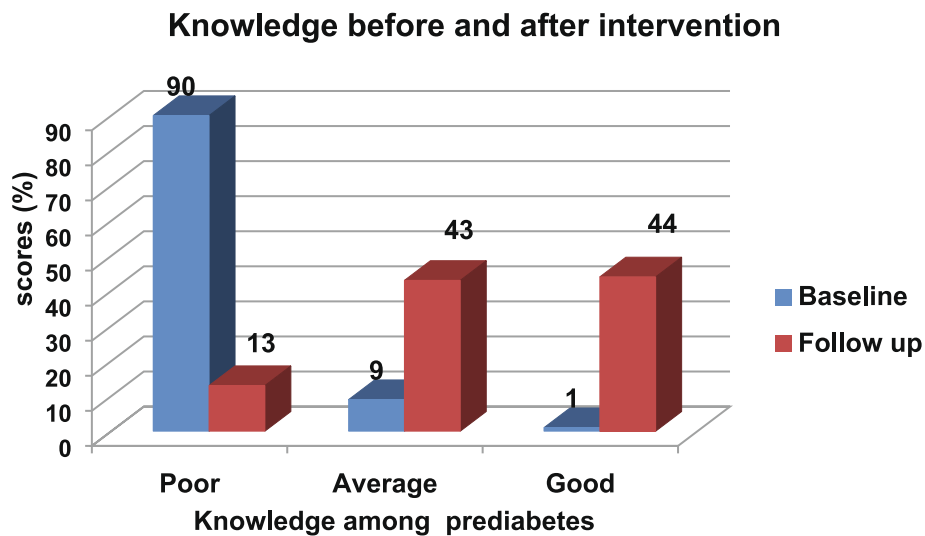


Fig. 2. Knowledge among prediabetes baseline and follow up after PEP.

Table 2
Prediabetes response on Knowledge.

Questions on Prediabetes knowledge	Baseline (%)	Follow up (%)
1. Prediabetes condition can lead to		
A. Type 2 diabetes mellitus*	79 (25.6)*	288 (93.5)*
B. Type 1 diabetes mellitus	96 (31.2)	5 (1.6)
C. Both	87 (28.2)	15 (4.9)
D. None	46 (14.9)	0 (0)
2. What is the chance of one getting prediabetes if both their parents have type 2 Diabetes?		
A. 25–40 Percentage	106 (34.4)	28 (9.1)
B. More than 50 percentage	71 (23.1)*	267 (86.7)*
C. 10–15 percentage	58 (18.8)	13 (4.2)
D. 0 percentage	73 (23.7)	0 (0)
3. Which is the best method for detecting prediabetes conditions?		
A. Blood testing	97 (31.5)*	193 (62.7)*
B. Urine testing	53 (17.2)	24 (7.8)
C. Both	120 (39)	91 (29.5)
D. None of the above	38 (12.3)	0 (0)
4. What is the fasting blood glucose level (after an overnight fast of 10 h) in prediabetes?		
A. 140–199 mg/dl	87 (28.2)	49 (15.9)
B. <100 mg/dl	91 (29.5)	40 (13)
C. 100–125 mg/dl	92 (29.9)*	209 (67.9)*
D. <200 mg/dl	38 (12.3)	10 (3.2)
5. Average blood glucose for the past 3 months is given by the blood test		
A. HbA1c Test	84 (27.3)*	242 (78.6)*
B. Fructosamine Test	75(24.4)	28 (9.1)
C. Fasting Blood Glucose Test	82 (26.6)	23 (7.5)
D. Oral Glucose Tolerance Test	67 (21.8)	15 (4.9)
6. What is the importance of testing insulin levels along with glucose levels in prediabetes?		
A. To identify insulin tolerance	140 (45.5)	51 (16.6)
B. To identify insulin overdose	62 (20.1)	61 (19.8)
C. To identify insulin resistance	41 (13.3)*	190 (61.7)*
D. None of the above	65 (21.1)	6 (1.9)
7. Preferred recommendation for prediabetes		
A. Diet control and exercise	153 (49.7)*	306 (99.4) *
B. Insulin Injections	88 (28.6)	0 (0)
C. Dental check up	26 (8.4)	1 (0.3)
D. None of the above	41 (13.3)	1 (0.3)
8. The Prediabetes should take regularly		
A. Foods that are high in fat	72 (23.4)	2 (0.6)
B. Soft drinks and energy drinks	46 (14.9)	2 (0.6)
C. High fiber foods	134 (43.5)*	291 (94.5) *
D. Foods rich in carbohydrate	56 (18.2)	13 (4.2)
9. How often prediabetes should do exercise?		
A. Once a week for atleast 30 mins	66 (21.4)	5 (1.6)
B. Most days of the week for atleast 30 mins	163 (52.9)*	300 (97.4)*
C. Once a month for atleast one hour	44 (14.3)	2 (0.6)
D. None of the above	35 (11.4)	1 (0.3)
10. How far weight reduction help prediabetes condition in obese patient?		
A. Will Not help	75 (24.4)	3 (1)
B. Greatly help	56(18.2)*	287 (93.2) *
C. Slightly help	111 (36)	17 (5.5)
D. Unsure	66 (21.4)	1 (0.3)

* Correct answer given by respondent.

Attitude before and after intervention

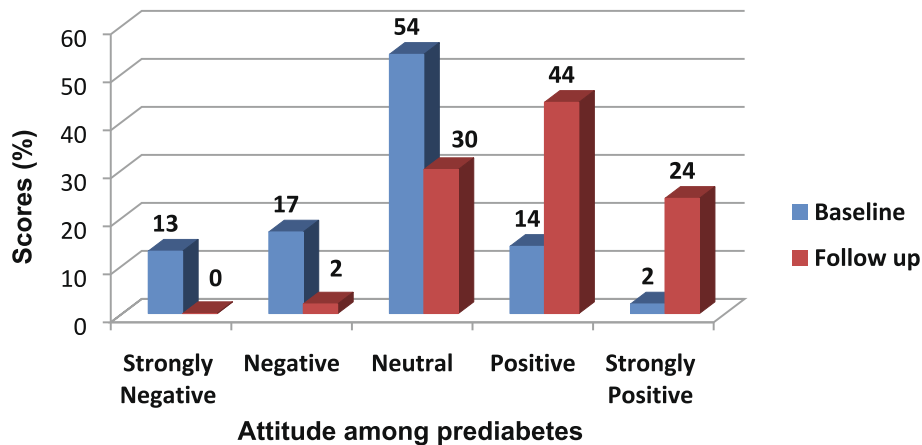


Fig. 3. Attitude among prediabetes baseline and follow up after PEP.

indicated a healthier life style practiced. The possible maximum score was 26 marks in that Very poor (Below 6), Poor (7–13), Good (14 to 20) and Very Good (Above 20) was categorized.

3. Results

After screening 2990 subjects through 30 prediabetes screening camps in districts of Kerala and Tamilnadu 315 newly diagnosed

Table 3
Prediabetes response on Attitude.

Questions on Prediabetes Attitude	Baseline (%)	Follow up (%)
11. I can do a lot for my prediabetes		
A. Strongly Disagree	45 (14.6)	2 (0.6)
B. Neither Agree nor Disagree	82 (26.6)	38 (12.3)
C. Strongly Agree*	181 (58.8)*	268 (87)*
12. Prediabetes should keep their blood sugar close to normal		
A. Strongly Disagree	35 (11.4)	3 (1)
B. Neither Agree nor Disagree	82 (26.6)	42 (13.6)
C. Strongly Agree	191 (62)*	263 (85.4)*
13. Control of blood sugar is difficult in prediabetes		
A. Strongly Disagree	77 (25)*	190 (61.7)*
B. Neither Agree nor Disagree	112 (36.4)	106 (34.4)
C. Strongly Agree	119 (38.6)	12 (3.9)
14. There is not much use in blood sugar control in prediabetes because type 2 diabetes mellitus will happen anyway		
A. Strongly Disagree	103 (33.4)*	175 (56.8)*
B. Neither Agree nor Disagree	97 (31.5)	119 (38.6)
C. Strongly Agree	108 (35.1)	14 (4.5)
15. Prediabetes happens only to a cursed person		
A. Strongly disagree	133 (43.2)*	161 (52.3)*
E. Neither Agree nor Disagree	111 (36)	133 (43.2)
F. Strongly Agree	64 (20.8)	14 (4.5)
16. People with prediabetes should be taught about diabetes mellitus		
A. Strongly Disagree	23 (7.5)	2 (0.6)
B. Neither Agree nor Disagree	51 (16.6)	27 (8.8)
C. Strongly Agree	234 (76)*	279 (90.6)*
17. Prediabetes condition is ignored much by the society		
A. Strongly Disagree	34 (11)	6 (1.9)
B. Neither Agree nor Disagree	86 (27.9)	57 (18.5)
C. Strongly Agree	188 (61)*	245 (79.5) *
18. Support from family is important in dealing with prediabetes		
A. Strongly Disagree	47 (15.3)	7 (2.3)
B. Neither Agree nor Disagree	90 (29.2)	85 (27.6)
C. Strongly Agree	171 (55.5)*	216 (70.1) *
19. Prediabetes should be taught about life style modifications		
A. Strongly Disagree	28 (9.1)	3 (1)
B. Neither Agree nor Disagree	77 (25)	45 (14.6)
C. Strongly Agree	203 (65.9)*	260 (84.4) *
20. I can lead a normal life in spite of prediabetes		
A. Strongly Disagree	67 (21.8)	5 (1.6)
B. Neither Agree nor Disagree	80 (26)	40 (13)
C. Strongly Agree	161 (52.3)*	263 (85.4) *

* Correct answer given by respondent.

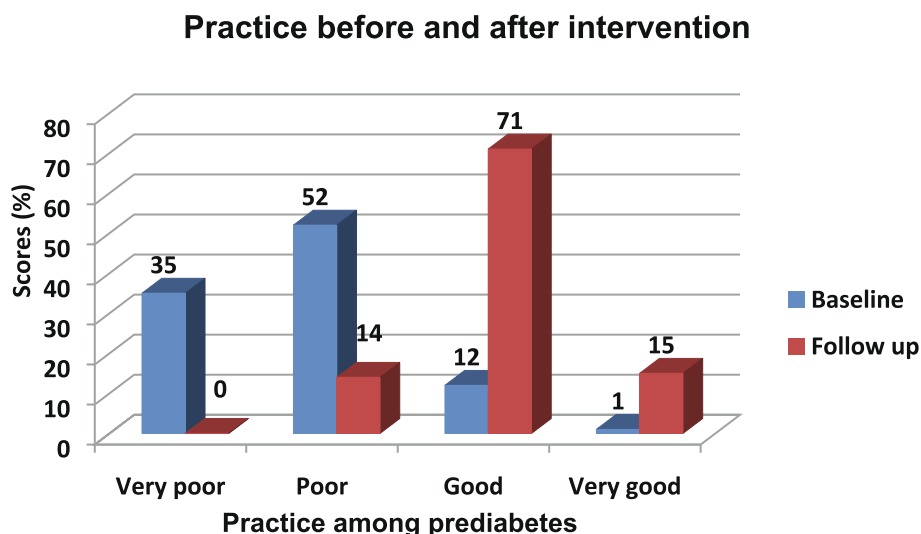


Fig. 4. Practice among prediabetics Baseline and follow up after PEP.

prediabetes were identified. A prediabetes prevalence of 10.5% was detected in districts of Kerala and Tamilnadu. 7 Subjects were excluded from the study due to reasons of lost to follow up as well as unwillingness to fill the questionnaire. Table 1 represents the demographic data among the study participants. Fig. 1 represents the flow chart for KAP-PAQ Questionnaire study.

3.1. Knowledge pre and post education program

Fig. 2 represents the knowledge among prediabetics (%) baseline and after prediabetes education program among the study population. Table 2 show the prediabetes response options on knowledge baseline and follow up after 30 days interval. As per paired T test, the mean baseline knowledge score was 4.7 and mean follow up knowledge score was 12.9. Paired samples correlations shown a significant P value (less than 0.05) with a correlation coefficient variable of 0.495. Among the newly diagnosed prediabetes of the study with almost equal proportion of males and females among which 80% of the respondents had below graduation level education and only 17% were from executive/ business class. Baseline assessment of knowledge among prediabetics shown that 277 out of 308 (90%) had poor knowledge which was lowered to 40 out of 308 (13%) after the prediabetes education program with an interval follow up period of 30 days. We analyzed that 28 subjects (9%) had average knowledge and only 3 (1%) had good knowledge in baseline assessment. After the counseling sessions 133 (43%) attained average knowledge and 135 (44%) scored good knowledge among the study population. 43 prediabetics (14%) scored zero marks in the knowledge section in baseline while no one scored zero after the PEP program. Among the 10 multiple choice questions, there were 3 least correct answered questions which included, the importance of identifying insulin resistance in prediabetes where only 41 (13%) given the correct answer which was raised to 190 (62%) correct answers in the follow up. Another major knowledge gap was detected in the question of importance of weight reduction in prediabetes reversal where only 56 out of 308 (18%) correctly responded in baseline which was improved in follow up by 287 (93%). Deficiency of knowledge was also spotted in the question on role of family history in early development of prediabetes where only 71 (23%) opted correct which was turned to 267 (87%) correct responses after PEP Program. During the evaluation of knowledge part in our study, it was found that 75% of the respondents found difficulty in distinguishing type 1 and type 2 diabetes in baseline assessment.

3.2. Attitude pre and post education program

Fig. 3 represent the attitude among prediabetics (%) baseline and follow up after prediabetes education program. Table 3 show the prediabetes response options on attitude baseline and follow up after 30 days interval. As per paired T test, the mean baseline attitude score was 3.4 and mean follow up attitude score was 7.3. Paired samples correlations shown a significant P value (less than 0.05) with a correlation coefficient variable of 0.692. Baseline assessment of attitude among prediabetics shown that only 6 (2%) had strongly positive attitude, 43 (14%) had positive attitude, 165 (54%) had neutral attitude while 53 (17%) had negative attitude and 41 (13%) had strongly negative attitude. After the PEP program, 75 (24%) shown strongly positive attitude, 135 (44%) shown positive attitude, 91 (30%) responded neutral while only 7 (2%) shown negative attitude and none shown strongly negative attitude in the follow up administration. During baseline survey, only 77 (25%) of prediabetes disagreed to the negative statement that control of blood sugar is difficult in prediabetes while after PEP, 190 (62%) disagreed to it. Similarly before counseling, only 103 (33%) disagreed to the negative statement that there is not much use in blood sugar control in prediabetes because type 2 diabetes will happen anyway while after PEP 175 (57%) disagreed to it. Surprisingly during baseline survey 133 (43%) only disagreed the statement that prediabetes happens only to a cursed person. While after PEP, 161 (52%) disagreed to this myth but others was still stuck on this belief even in this modern era.

3.3. Practice pre and post education program

Fig. 4 represent the practice among prediabetics (%) baseline and follow up after prediabetes education program. Table 4 shows the prediabetes response on Practice baseline and follow up after 30 days interval. As per paired T test, the mean baseline practice score was 8.6 and mean follow up practice score was 17.0. Paired samples correlations shown a significant P value (less than 0.05) with a correlation coefficient variable of 0.568. Table 5 shows a positive Pearson correlation between knowledge attitude and practice among prediabetes population. Regarding healthy life style practices 109 (35%) had very poor practice while half of the population 161 (52%) shown poor practice only 37 (12%) shown good practice and 1 (0.3%) had very good practice in baseline assessment. After the PEP Program none of the respondents shown very poor practice, 42 (14%) shown poor practice, 219 (71%) shown good practice and 47 (15%) shown very good practice. During

Table 4
Prediabetes response on Practice.

Questions on Prediabetes Practice	Baseline (%)	Follow up (%)
21. How many hours per week do you perform exercises like cycling, walking, yoga etc?		
A. 3 to 6 h a week*	12 (3.9)*	191 (62)*
B. 1 to 2 h a week	82 (26.6)	94 (30.5)
C. Less than 1 h a week	77 (25)	2 (0.6)
D. None	137 (44.5)	21 (6.8)
22. How often you consume sugar sweetened beverages (soda, carbonated beverages and non carbonated fruit drinks)?		
A. 5 or more times a week	49 (15.9)	5 (1.6)
B. 3 or 4 times a week	53 (17.2)	6 (1.9)
C. 1–2 times a week	84 (27.3)	117 (38)
D. Almost Never	122 (39.6)*	180 (58.4)*
23. How frequently you substitute fibre rich foods like oats, whole grains, fruits or vegetable salads over normal meals?		
A. 5 or more times a week	79 (25.6)*	181 (58.8)*
B. 3 or 4 times a week	64 (20.8)	90 (29.2)
C. 1–2 times a week	84 (27.3)	18 (5.8)
D. Almost never	81 (26.3)	19 (6.2)
24. How often you sleep less than six hours/night?		
A. 5 or more times a week	42 (13.6)	9 (2.9)
B. 3 or 4 times a week	40 (13.0)	7 (2.3)
C. 1–2 times a week	94 (30.5)	95 (30.8)
D. Almost Never	132 (42.9)*	197 (64)*
25. How often you skip meals?		
A. 5 or more times a week	19 (6.2)	4 (1.3)
B. 3 or 4 times a week	29 (9.4)	5 (1.6)
C. 1–2 times a week	94 (30.5)	84 (27.3)
D. Almost Never	166 (53.9)*	215 (69.8)*
26. How often you consume high fat foods (like fried snacks and meat, fast foods, chocolates)?		
A. 5 or more times a week	101 (32.8)	23 (7.5)
B. 3 or 4 times a week	60 (19.5)	28 (9.1)
C. 1–2 times a week	91 (29.5)	73 (23.7)
D. Almost Never	56 (18.2)*	184 (59.7)*
27. How often you eat food while watching TV/ using mobile phone/ reading books (Distracted eating)?		
A. Every time	107 (34.7)	46 (14.9)
B. Twice a day	44 (14.3)	20 (6.5)
C. Once a day	85 (27.6)	69 (22.4)
D. Almost Never	72 (23.4)*	173 (56.2)*
28. How long you spend in front of computer/TV in a day?		
A. More than 6 h a day	62 (20.1)	56 (18.2)
B. 4–6 h a day	66 (21.4)	62 (20.1)
C. 1–3 h a day	125 (40.6)	89 (28.9)
D. Almost Never	55 (17.9)*	131 (42.8)*
29. How often you check blood sugar at home/lab?		
A. Once in 6 months or yearly	81 (26.3)	16 (5.2)
B. Once in 2 or 3 months	35 (11.4)	113 (36.7)
C. Weekly or monthly once	9 (2.9)*	153 (49.7)*
D. Never	183 (59.4)	26 (8.4)
30. How often you check cholesterol profile at lab?		
A. Once in 10 years	31 (10.1)	16 (5.2)
B. Once in 5 years	13 (4.2)	61 (19.8)
C. One or more times in 2 years	63 (20.5)*	131 (42.5)*
D. Never	201 (65.3)	100 (32.5)

* Correct answer given by respondent.

the baseline survey, important findings among newly diagnosed prediabetics was only 12 (4%) had the practice of 3 to 6 h a week of performing exercises like cycling, walking, yoga etc but after the counseling program 191 (62%) started daily half an hour of exercise while 94 (31%) started exercise for weekly 4 to 5 days. Another important finding was

Table 5
Correlations between knowledge, attitude and practice among prediabetes (N = 308).

Correlation variables	Pearson correlation	P value
Baseline		
Knowledge and attitude scores	0.244**	0.00
Knowledge and Practice scores	0.200**	0.00
Attitude and Practice scores	0.161**	0.005
Follow up		
Knowledge and attitude	0.201**	0.00
Knowledge and practice	0.117**	0.04
Attitude and practice	0.117**	0.04

** Correlation is significant at the 0.05 level (2-tailed).

that only 9 (2.9%) had the frequent practice of checking blood sugar at home/lab while 183 (59%) never checked it in life time in baseline assessment. 128 (42%) of prediabetes screened had the habit of spending long hours in front of computer and television in a day. Baseline assessment of diet pattern with KAP-PAQ and 24 h diet capture, it was found that 186 (60%) have the habit of frequent intake of sugar sweetened beverages and 161 (52%) had the habit of frequent consumption of high fat foods which was far bettered after the PEP program.

4. Discussion

After the baseline KAP survey, major knowledge gap was identified in the areas of importance of insulin resistance knowledge in prediabetes, importance of weight reduction in prediabetes reversal and role of family history in prediabetes early development. Previous literatures have revealed that hyperinsulinemia and insulin resistance pave the way for impaired glucose tolerance followed by development of type 2 diabetes (DeFronzo and Tripathy, 2009). So the awareness of testing insulin levels has still not reached to the high risk population of the community like prediabetes in India. And also it is already proven that interventions that produce weight loss will improve insulin sensitivity, reduction of lipid oxidation and enhancement of glucose metabolism (Fischer et al., 2002). Another fact that the presence of Family history of diabetes in first degree relatives is associated with IFG, even in the absence of obesity (Rodríguez-Moran et al., 2010). Prediabetes education program could bring real difference in improving knowledge among prediabetics as per the analysis of 10 questions in follow up results.

According to published literatures about the attitude among prediabetics, the prevalence of depression is moderately increased in prediabetes and undiagnosed diabetes while markedly increased in the previously diagnosed diabetes compared to normal subjects (Chen et al., 2016). Depression and diabetes is propelled by shared underlying mechanisms like hypothalamic–pituitary–adrenal axis activation, inflammation, sleep disturbance, inactive lifestyle, poor dietary habits, and environmental and cultural risk factors (Holt et al., 2014). Diabetes education enhances the knowledge of subjects and changes their negative attitudes towards all aspects of the disease and it also helps them to improve diabetes self-care activities (Saleh et al., 2017).

Life style practice like long work hours contribute to the rising obesity related problems by reducing time for physical activity particularly for individuals working in sedentary occupations (Cook and Gazmararian, 2018). Nearly half of people with diabetes in India remain undetected, accounting for complications at the time of diagnosis (Joshi, 2015). Meta-analysis (10 studies) suggest there is a 112% greater relative risk associated with a large duration of sedentary behavior for development of type 2 diabetes (Hamilton et al., 2014). Dietary glycaemic load of Indian diets are also very high and are also low in fibre and mono unsaturated fatty acids adding to the risk of diabetes (Shobana et al., 2018). Strategies to enhance diabetes prevention among Indians are required and should encourage fibre rich healthy balanced diet low in saturated fats (Colles et al., 2013). The positive correlation (p =

<0.05) between prediabetes knowledge attitude and practice indicates that the more knowledgeable the participants, the more positive their attitude which can be observed through better life style practices. In this study we could see the impact of post education in their transition from negative attitude to positive attitude and poor practice to good practice. Prediabetes education is found to be an underutilized tool of diabetes prevention among Indian population.

5. Conclusion

Prediabetes education program could bring significant improvement in knowledge attitude and practice among the respondents shows it to be an effective strategy to prevent diabetes in high risk population like prediabetes. KAP-PAQ was found to be an efficient tool to conduct survey among prediabetes for future research. Baseline KAP survey shows the need for health literacy among the newly diagnosed prediabetics. A community based mass prediabetes screening and education program should be implemented all over India especially in the rural remote areas with limited access to health education and health care facilities. This should also be extended to primary health care clinics especially among the first degree relatives of diabetes patients who accompany them to clinics. Health literacy, proper individual counseling and group education programs need to be developed in the community setting. Identifying people with prediabetes which is an asymptomatic condition needs an extra effort. Future research need to be conducted to identify the felt needs of the prediabetics.

CRedit authorship contribution statement

K. Mohsina Hyder: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Project administration, Visualization, Writing - original draft, Funding acquisition. **Jithin Mohan:** Conceptualization, Investigation, Resources. **Visakh Varma:** Conceptualization, Investigation, Resources. **S. Ponnusankar:** Conceptualization, Methodology, Validation, Formal analysis, Resources, Data curation, Project administration, Writing - original draft, Funding acquisition, Supervision, Project administration. **D. Raja:** Conceptualization, Methodology, Software, Validation, Formal analysis, Data curation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Anjana, R.M., Ali, M.K., Pradeepa, R., et al., 2011. The need for obtaining accurate nationwide estimates of diabetes prevalence in India – Rationale for a national study on diabetes. *Indian. J. Med. Res.* 133 (4), 369–380.

- Anjana, R.M., Pradeepa, R., Das, A.K., Deepa, M., Bhansali, A., Joshi, S.R., Joshi, P.P., Dhandhanian, V.K., Rao, P.V., Sudha, V., Subashini, R., Unnikrishnan, R., Madhu, S. V., Kaur, T., Mohan, V., Shukla, D.K., 2014. Physical activity and inactivity patterns in India – Results from the ICMR-INDIAB study (Phase-1) [ICMR-INDIAB-5]. *Int. J. Behav. Nutr. Phys. Act.* 11 (1), 26. <https://doi.org/10.1186/1479-5868-11-26>.
- Chen, S., Zhang, Q., Dai, G., Hu, J., Zhu, C., Su, L., Wu, X., 2016. Association of depression with pre-diabetes, undiagnosed diabetes, and previously diagnosed diabetes: a meta-analysis. *Endocrine.* 53 (1), 35–46.
- Colles, S.L., Singh, S., Kohli, C., Mithal, A., 2013. Dietary beliefs and eating patterns influence metabolic health in type 2 diabetes: A clinic-based study in urban North India. *Indian. J. Endocrinol. Metab.* 17 (6), 1066–1072.
- Cook, M.A., Gazmararian, J., 2018. The association between long work hours and leisure time physical activity and obesity. *Preventive. Medicine. Reports.* 10, 271–277.
- Deepa, M., Bhansali, A., Anjana, R.M., Pradeepa, R., et al., 2014. Knowledge and awareness of diabetes in Urban and Rural India: The Indian Council of Medical Research India Diabetes Study (Phase 1): Indian Council of Medical Research India Diabetes 4. *Indian. J. Endocrinol. Metab.* 18 (3), 379–385.
- DeFronzo, R.A., Tripathy, D., 2009. Skeletal muscle insulin resistance is the primary defect in type 2 diabetes. *Diabetes. Care.* 32 (suppl 2), S157–S163.
- Fatema, K., Hossain, S., Natasha, K., Chowdhury, H.A., Akter, J., Khan, T., Ali, L., 2017. Knowledge attitude and practice regarding diabetes mellitus among Non diabetic and diabetic study participants in Bangladesh. *BMC. Public. Health.* 17, 364.
- Fischer, S., Hanefeld, M., Haffner, S.M., Fusch, C., Schwanebeck, U., Köhler, C., Fucker, K., Julius, U., 2002. Insulin-resistant patients with type 2 diabetes mellitus have higher serum leptin levels independently of body fat mass. *Acta. Diabetol.* 39 (3), 105–110.
- Hamilton, M.T., Hamilton, D.G., Zderic, T.W., 2014. Sedentary behaviour as a mediator of type 2 diabetes. *Med. Sport. Sci.* 60, 11–26.
- Holt, R.I., Groot, M.D., Golden, S.H., 2014. Diabetes and depression. *Curr. Diab. Rep.* 14 (6), 491.
- International Diabetes Federation, 2019. IDF Diabetes Atlas, 9th edition. Belgium, Brussels. Available at: <https://www.diabetesatlas.org>.
- Jones, T.L., Baxter, MAJ, Khanduja, V., 2013. A quick guide to survey research. *Ann. R. Coll. Surg. Engl.* 95 (1), 5–7.
- Joshi, S.R., 2015. Diabetes care in India. *Ann. Glob. Health.* 81 (6), 830–838.
- Mohsina, H.K., Raja, D., Jithin, M., Ponnusankar, S., 2020. Assessing the Knowledge, Attitude and Practice (KAP) among the newly diagnosed Prediabetes screened in selected districts of South India. *Int. J. Res. Pharm. Sci.* 11 (3), 4836–4846.
- Poongothai, S., Anjana, R.M., Pradeepa, R., Ganesan, A., Umopathy, N., Mohan, V., 2010. Prevalence of depression in relation to glucose intolerance in urban south Indians—the Chennai Urban Rural Epidemiology Study (CURES-76). *Diabetes. Technol. Ther.* 12 (12), 989–994.
- Rodríguez-Moran, M., Guerrero-Romero, F., Aradillas-García, C., Violante, R., Simental-Mendia, L.E., Monreal-Escalante, E., Mendoza, E.L., 2010. Obesity and family history of diabetes as risk factors of impaired fasting glucose: implications for the early detection of prediabetes. *Pediatr. Diabetes.* 11 (5), 331–336.
- Saleh, F., Afnan, F., Ara, F., Mumu, S.J., Khan, A.A., 2017. Diabetes Education, Knowledge Improvement, Attitudes and self care activities among patients with type 2 diabetes in Bangladesh. *Jundishapur. J. Health. Sci.* 9 (1), e36058.
- Shah, V.N., Kamdar, P.K., Shah, N., 2009. Assessing the knowledge, attitudes and practice of type 2 diabetes among patients of Saurashtra region. *Gujarat. Int. J. Diabetes. Dev. Ctries.* 29 (3), 118–122.
- Shobana, S., Ramya, R.M., Sudha, V., Unnikrishnan, R., Pradeepa, R., Anjana, R.M., Mohan, V., 2018. Nutrition and its link with diabetes in Asian Indians: Challenges and solutions. *Proc. Indian. Natn. Sci. Acad.* 84 (4), 955–963.
- Świątoniowska, N., Sarzyńska, K., Szymańska-Chabowska, A., Jankowska-Polańska, B., 2019. The role of education in type 2 diabetes treatment. *Diabetes. Res. Clin. Pract.* 151, 237–246.
- Tuso, P., 2014. Prediabetes and life style modification: time to prevent a preventable disease. *Perm. J.* 18 (3), 88–93.