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Impact of prediabetes awareness education among the first-degree relatives of diabetes patients

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Abstract

Background: Despite the clinical importance of prediabetes, little is known about the level of prediabetes awareness amongst the first-degree relatives of diabetes in India.

Methods: This was a prospective open label questionnaire study conducted among 553 first-degree relatives of diabetes patients recruited from selected colleges of Nilgiris district of TamilNadu. First degree-relatives awareness on prediabetes was assessed using a prediabetes awareness questionnaire. An education session using a prediabetes information pamphlet were provided. After a washout period of 10 days the questionnaire were readministered to study the impact of education provided. The chi square analysis was used to measure the level of association between the dependent & the independent variables. A paired samples T test was carried out to determine if the mean of pre & post education scores was statistically significant.

Results: A paired samples t-test showed that the participant's level of prediabetes knowledge increased from prediabetes awareness program, pre-program (M = 3.6, SD = 1.18) to post-program (M = 6.7, SD = 1.544; $t = -47.01$, $p < 0.05$, $df = 552$).

Conclusion: Planning and implementing programs to motivate students to be responsible for their own health are of paramount importance.

Key words: First-degree relatives, Hereditary diseases, Prediabetes awareness, Prediabetes questionnaire, Diabetes prevention programs.

Introduction

The lifetime risk of developing type 2 diabetes mellitus is 40% for those having one parent with Type 2 Diabetes mellitus and 70% if both parents have the same¹. First-degree relatives are about 3 times more at risk to develop disease than others². As per literatures, risk is even higher if mother is having the disease than father³. India is always among the top five countries with prediabetes since years, but the number of interventional studies among the high-risk groups were found to be low⁴. This study was carried out to assess the impact of prediabetes awareness education among the young first-degree relatives through a questionnaire survey conducted pre and post the counselling sessions.

Materials and method

Study design and subject recruitment:

A community based prospective open label interventional study was carried out among the first-degree relatives of diabetes patients screened from selected colleges of Nilgiris district in Tamil Nadu of south India. The Institutional Review Board of JSS College of Pharmacy, Ooty, India approved this study (**Approval number: JSSCP/IRB/ (8) /2022–2023**) during the period of October 2022 to March 2023. Male and female FDRs aged between 18 to 35 years who were not yet diagnosed with diabetes were included in the study. Incomplete questionnaires and those who have cognitive impairments and other understanding difficulties were excluded. Those unwilling to participate or unable to understand the questionnaire were also excluded. The sample size required was calculated using G-power software (95% confidence interval, $\alpha=0.05$, power of 80%) considering 10% drop outs. The sample size, hence acquired, was 553.

Instrument used:

A Prediabetes Awareness Questionnaire for Diabetes FDRs was used for conducting this survey. The questionnaire was used after approval from two related questionnaires. The initial section included one question on identification of prediabetes risk factors and 9 questions on perceptions of first-degree relatives about prevention of type 2 diabetes. This part had six-point Likert scale from

strongly disagree to strongly agree. This section was adapted after approval from FDR's questionnaire by **Professor Dr. David L Whitford *et al***, Department of Family Medicine, Royal College of Surgeons in Ireland⁵. This part of questionnaire was validated among Indian population with expert opinions and a small pilot study among doctors, pharmacists, nurses, and students in the community settings of ooty.

The second section included KAP – PAQ knowledge questions which was developed and validated by the author in the year 2021 for newly diagnosed prediabetes patients⁶. So, the plan was to reuse the prediabetes knowledge questions among another risky population like FDRs. This section assesses the knowledge on prediabetes, its diagnosis, and the management. It comprised 10 multiple choice questions with one correct option which carries 1 mark.

The final questionnaire included 20 questions – first question on risk factors and other 9 questions on perceptions and 10 questions on prediabetes knowledge.

Methods:

Each respondent was informed in detail about the aim of the research, objectives and the methods used. All the participants were given informed consent form prior to the administration of questionnaire. A translated version of Tamil informed consent, which is the regional language spoken in Nilgiris was used in subjects who were unable to understand the English version fully. Initially, demographics including lifestyle was collected using data collection form. Baseline Knowledge scores were gathered with KAP-PAQ, done through conversational interviews to aid those unfamiliar with the medical terms. Baseline perceptions on type 2 diabetes were also collected using FDRs questionnaire. A standardized interviewing technique ensured respondents comprehended the questions. Prior to starting any awareness program, it is good to collect the existing awareness level of the target population under study. An education session (Prediabetes Education Program) using a Prediabetes Information Pamphlet were provided. Pamphlet content was on prediabetes, its risk factors, signs and symptoms, diagnosis, lifestyle modifications to prevent the prediabetes. Pharmacist awareness session in regional language were carried out for 20-25 minutes as pictograms and PowerPoint presentations. After a washout period of 10 days, this structured questionnaire was readministered to the respondents to assess the impact of education provided. Before and after the PEP program, the difference in their perceptions, the way they interpret and understand about prediabetes, based on their individual experiences, biases, and

beliefs were clearly noted and compared. Pre and post identification of 9 prediabetes risk factors were noted and compared as well. The overall score for knowledge questions was calculated, and the maximum attainable score was 10 points. For each participant, the total score was calculated pre and post separately.

Statistical analysis

Data were coded and entered to an excel software (Microsoft office excel 2010) database which were imported to Statistical Package for Social Sciences, IBM SPSS Version 25. We performed a descriptive analysis. Qualitative variables were summarized in absolute and relative frequencies. A chi square analysis was used to measure the level of association between the dependent and the independent variables. A paired T test was carried out to determine if the mean of pre-post education scores is statistically significant. Statistical significance was assessed at P value ≤ 0.05 .

Results

This was a prospective colleges-based questionnaire pre-post study on prediabetes and the impact of awareness education on it. A total of 575 FDRs were obtained from 7 colleges in Ooty, 3 colleges in Kotagiri and 1 college of Coonoor of Nilgiris district in Tamilnadu state of India among which 553 completed the study (**Figure 1**). The demographic data showed that 340 (61.5%) were males and 213 (38.5%) were females. Among the total participants, most, that is, 486 (88%) were between the age group of 18–25 years. **Table 1** shows the frequency that among (n= 553) 17% were diploma students, 73% were degree students, 8% were post-graduation students and 2% PhD scholars. Along with the demographic data collection, anthropometric measurements taken shown that 52% (n= 290) had normal BMI, 26% (n= 143) was overweight, 10% (n=56) was obese and 12% (n=64) was underweight. During waist to hip analysis, we could find that 68% (n=376) had low waist to hip ratio, 15% (n=81) had moderate and 17% (n=96%) with high ratios.

While analysing the potential possible risk factors among the first-degree relatives, we could figure out that 42% (n=234) used to have outside food 1-2 days per week, 23% (n= 129) 3-4 days/week, 4% (n=19) 5-6 days/week and 5% (n= 29) daily. Among the respondents who completed the study, 96% (n=532) were non-vegetarians and 4% (n=21) only were pure vegetarians. The frequency of eating high fat foods (fried chicken and snacks, pizzas, pastries, and burgers) 49% (n=270) used to have 1-2 days per week, 21% (n= 118) 3-4 days/week, 4% (n=22) 5-6 days/week and 3% (n=19) on daily basis. **Table 2** represents the knowledge of FDRs on risk factors of diabetes. Respondents were

asked which of a list of factors increased a person's risk of type 2 diabetes; 39% identified 1 risk factor, 17% identified 2 risk factors, 16% identified 3 risk factors, 15% identified 4 risk factors, 9% identified 5 risk factors, 3% identified 6 risk factors and 1% identified 7 risk factors before the awareness education. But after the education sessions, 25% (n=136) identified all risk factors, 27% (n=149) identified 8 risk factors and 33% (n=180) identified 6 to 7 risk factors after the completion of washout period. **Figure 2** represents the worry of first-degree relatives on onset of diabetes, baseline data shown that among 553 respondents, 445 did not had any worry regarding the occurrence of diabetes in their lifetime. During the follow-up data analysis, we could understand that respondents started thinking about the consequences of such life style diseases and 83% (n=460) responded accordingly. **Table 3** represents the baseline perceptions of first-degree relatives before Prediabetes Awareness Education, in which majority believed that their current domestic situation had no influence on early development of diabetes among them. **Table 4** constitutes perceptions of first-degree relatives after Prediabetes Awareness Program, in which majority (76%) marked that they can probably avoid developing diabetes by getting the right medical advice indicates the change to positive attitude towards prediabetes management. **Table 5** shows the FDRs response on 10 prediabetes knowledge questions from KAP-PAQ (Knowledge Attitude Practice – Prediabetes Awareness Questionnaire) pre and post the awareness sessions. A paired samples t-test showed that the participant's level of prediabetes knowledge increased from prediabetes awareness program, pre-program (M = 3.6, SD = 1.18) to post program (M = 6.7, SD = 1.544).

A chi-square test was run between the different categorical variables in our study, and we could find an association between gender and post knowledge values. A major finding was females performed better after the prediabetes awareness program than males with a statistical significance value less than 0.05. Before prediabetes awareness education, only 10% (n=32) females had good knowledge which was changed post session to 49% (n= 104) females acquired good knowledge scores. Past research has shown gender variations in cognitive patterns of attention, men are generally more vigilant about spotting certain signals while women have better inhibitory control, an ability to override a natural urge to respond. Another finding was an association between courses and post knowledge values. We found that pharmacy and life sciences students performed better after the prediabetes awareness program than arts and engineering students with a statistical significance value less than 0.05. Among 553 respondents from life sciences, engineering, arts, nursing, and

pharmacy 65% good knowledge was shown by pharmacy students post sessions, 25% by nursing, 41% by life sciences, 10% by arts compared to engineering students.

DISCUSSION

The present study was conducted among (n = 553) first-degree relatives of diabetes patients recruited from selected colleges of Nilgiris district of Tamilnadu which includes Ooty, Kotagiri, Coonoor. It is the first study done on prediabetes awareness among the youth who are first degree relatives of diabetes patients in south India. In our study, majority of study participants family history was from father (53%) compared to mother (34%). As per literature, risk of T2D is higher in the off-spring if the mother rather than the father has T2D⁷. During the analysis of sleep data, among the first - degree relatives around 47% of the respondents had poor sleep. From four decades ago, several studies showed that sleep has a major role in the regulation of endocrine functions and glucose metabolism⁸. Sleep fragmentation leads to an increase in sympathetic nervous system activity that inhibits insulin secretion and promotes insulin resistance⁹. We could also find that 90% of our respondents never did any diabetes related blood check-up in their lifetime. As per epidemiology, 77 million individuals have diabetes in India and which is expected to rise to over 134 million by 2045. Approximately 57% of these individuals remain undiagnosed¹⁰. Evaluating the hours screen time, we could find that 43% of FDRs had a screen time more than 6 hours a day. Increased screen time has been prospectively associated with adiposity and T2D risk in adults¹¹.

During data analysis, we could analyse that 84% of FDRs never had the habit of doing exercise. Physical activity and exercise in youth can reduce stress and anxiety, increase muscle and bone strength, and helps in preventing obesity, diabetes, and other cardiovascular diseases¹². During diet analysis, we could find that consumption of sugar sweetened beverages was high (64%) among the participated first-degree relatives. Evidence suggests that the consumption of sugar-sweetened beverages (SSBs) has increased in parallel to overweight and obesity trends. Currently, Sugar sweetened beverages contribute between 10% and 15% of youth's caloric intake and are the primary source of added sugar in the diet of children and adolescents¹³. Among our study participants 40% had the social habit of taking alcohol and 52% used to smoke. Tobacco smoking, especially among university students, remains a significant issue worldwide¹⁴. The frequency of

eating outside among FDRs was found to be 74% which also included foods rich in high fats like fried foods, burgers, pizzas, and pastries.

With a rapidly rising middleclass community and a changing lifestyle, India is gifted with one of the world's fastest growing fast-food marketplaces. People have begun to experiment with various culinary styles and eating habits¹⁵. Prediabetes knowledge among first degree relatives was evaluated using an adapted and validated prediabetes questionnaire in our study. We found that, 46% had poor knowledge, 54% with average knowledge and 0% had good knowledge before education. While only 3% shown poor knowledge, 73% with average knowledge and 25% acquired good knowledge after awareness education. 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 India⁶.

Perception towards prediabetes and its management was assessed among the first-degree relatives in our study. We could analyse that 81% of respondents did not show any worry about diabetes development in their life time, 69% were unaware about their domestic situation and even 41% still believed that diabetes develops due to bad luck in their baseline responses. In a study examining FDR's understanding of family medical history of cancer, only 54% of the 309 in Faculty of Medicine and Health at University of Leeds knew the type of information required to compile a family medical history¹⁶. Most of them did not had belief that right medical advice can help in avoiding diabetes. When asked about the barriers, majority of the FDRs reported that they do not have adequate time for any exercise or cook any healthy food before education. From the questionnaire survey conducted among FDR's we were also surprised that only 2% were motivated themselves to do exercise for prevention of life style diseases. Increased use of social media, computers, televisions, cell phones, and virtual games may be some of the major contributing elements to this youth trend. This result is also influenced by decreased participation in outdoor activities and an increase in the usage of motor vehicles for transportation¹⁷. Youth are using social media for one-third of their waking hours, interfering with their everyday activities, and leaving them lethargic, unenthusiastic, and unproductive¹⁸. But after prediabetes awareness education, a significant improvement in their perception towards prediabetes prevention was seen. A person forms a range of good and bad habits during their youth that they will carry with them throughout their lives¹⁹. Since college students are going through a transitional stage in their lives, there are possibilities for them to create healthy habits²⁰. Limitation of the study is that results cannot be

generalized to all regions of India and the study period too was short. Identifying the high-risk population with prediabetes, an asymptomatic condition as well as attempting to modify lifestyle choices for individuals with diverse cultural and genetic backgrounds present significant challenges²¹.

CONCLUSION

Our study highlights important gaps in knowledge of prediabetes and prevention of diabetes among the young first-degree relatives of diabetes patients who are at higher risk. These results are of concern since the ‘diabesity’ epidemic (obesity and type 2 diabetes) is likely to be the biggest epidemic in human history. Our findings suggest that there is an urgent need to focus on the youth especially first-degree relatives of diabetes patients on the prevention of lifestyle diseases through structured education programs. College is a critical time where students are more prone to engage in risky health behaviours known to negatively affect wellbeing such as physical inactivity, stress, poor dietary habits, and usage of habit-forming substances. The college-age years, which are often identified as “emerging adulthood,” are a time of transition from youth to the responsibilities of adulthood. The use of electronic media (television, computers, cell phones and smartphones, etc.) or screen time has been cited as one of the main factors associated with sedentary lifestyles among college going youth. Planning and implementing programs to motivate students to be responsible for their own health, to engage more in physical activity, to practice healthy eating habits and avoiding bad habits are of paramount importance. Our study also aims to include family members in educational interventions, so they may provide support to patients with diabetes, help to develop healthy family behaviours, and promote diabetes self-management.

Author contributions:

All authors equally contributed to the concept/design of this study, data collection, analysis, and interpretation, drafting of the article, as well as critical revision and approval of the article.

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Table 1: Demographic Characteristics of FDRs

Baseline Characteristic	Total (553)
Men: Women	340:213
Age (Years)	n (%)
18-20	350 (63.3)
21-25	136 (24.6)
26-30	37 (6.7)
31-35	30 (5.4)
Taluks (District)	Total (3/6)
Ooty (Nilgiris)	486 (87.9)
Kotagiri (Nilgiris)	50 (9.0)
Coonoor (Nilgiris)	17 (3.1)
Family History	n (%)
Father	297 (53.7)
Mother	185 (33.5)
Both	70 (12.7)
Siblings	1 (0.2)
Education	n (%)
Diploma	95 (17.2)
Degree	405 (73.2)
Post graduation	44 (8.0)
PhD	09 (1.6)
Sleep in hours	n (%)
Good sleep (8 hours & above)	61 (11)
Fair sleep (6-8 hours)	230 (41.6)
Poor sleep (4-6 hours)	258 (46.7)
Very poor sleep (less than 4 hours)	04 (0.7)
Hours screen time	n (%)
1-3 hours	87 (15.7)
4-6 hours	208 (37.6)
More than 6 hours	240 (43.4)
Almost never	18 (3.3)
Habit of blood checkup	n (%)
Monthly	4 (0.7)
3-6 months	19 (3.4)
Yearly	33 (6.0)
Never	497 (89.9)
Exercise	n (%)
Yes	89 (16.1)
No	464 (83.9)
Negative social habits	n (%)
Smoking	289 (52.2)
Alcohol consumption	219 (40)
Consumption of sugar sweetened beverages	n (%)
Not regular	142 (25.7)
1-2 days/week	234 (42.3)
3-4 days/week	129 (23.3)
5-6 days/week	19 (3.4)
7 days/week	29 (5.2)

Table 2: IDENTIFICATION OF PREDIABETES RISK FACTORS

Identification of prediabetes risk factors by the respondents (n= 553)	Baseline responses		Follow-up responses	
	Yes (✓)	No (X)	Yes (✓)	No (X)
Having a parent with type 2 diabetes	139 (25.1)	414 (74.8)	429 (77.57)	124(22.42)
Being overweight/obese	226 (40.86)	327(59.13)	476 (86.07)	77(13.92)
History of hypertension/ Dyslipidemia	141 (25.5)	412 (74.5)	409 (73.96)	144(26.03)
Taking little or no exercise	219 (39.60)	334(60.39)	414 (74.86)	139(25.13)
Being over 30 years of age	208 (37.61)	345(62.38)	311 (56.23)	242(43.76)
Having a brother or sister with type 2 diabetes	201(36.34)	352(63.65)	414 (74.86)	139(25.13)
History of CVD	195 (35.26)	358(64.73)	429 (77.57)	124(22.42)
History of PCOD	197 (35.62)	356(64.37)	475 (85.89)	78(14.10)
History of Acanthosis Nigerians	194 (35.08)	359(64.91)	414 (74.86)	139(25.13)
I do not know	61 (11.03)	492 (88.9)	0 (0)	553(100)

Attitude:	Baseline scores		
	Strongly disagree/ Moderately disagree	Strongly agree/ Moderately agree	Neutral
3. My work and/or domestic situation has a large influence on whether I develop diabetes.	382 (69%)	73 (13.2%)	98 (17.8%)
4. Developing diabetes is largely a matter of bad luck.	60 (10.8%)	228 (41.2%)	265 (48%)
5. I can probably avoid developing diabetes by getting the right medical advice.	141 (25.4)	103 (18.6%)	309 (56%)
Barriers			
6. I do not have time to exercise	39 (7%)	456 (82.5%)	58 (10.5%)
7. I do not like the taste of low-fat food.	85 (15%)	293 (53%)	175 (32%)
8. I do not have the time to prepare healthy low-fat food.	169 (30.6)	384 (69.4%)	0 (0%)
9. I would find it difficult to motivate myself to exercise.	9 (1.6%)	395 (71.4%)	149 (27 %)

Table 4: Perceptions of first-degree relatives on prediabetes after PAE

Attitude:	Follow-up scores		
	Strongly disagree/ Moderately disagree	Strongly agree/ Moderately agree	Neutral
3. My work and/or domestic situation has a large influence on whether I develop diabetes.	43 (8.0%)	482 (87%)	28 (5.0%)
4. Developing diabetes is largely a matter of bad luck.	440 (79.6%)	96 (17.3%)	17 (3.1%)
5. I can probably avoid developing diabetes by getting the right medical advice.	54 (9.8)	421 (76.1%)	78 (14.1%)
Barriers 6. I do not have time to exercise	300 (54.2%)	152 (27.5%)	101 (18.3%)
7. I do not like the taste of low-fat food.	85 (15%)	293 (53%)	175 (32%)
8. I do not have the time to prepare healthy low-fat food.	155 (28%)	301 (54%)	97 (18%)
9. I would find it difficult to motivate myself to exercise.	236 (42.6%)	102 (18.4%)	215 (39 %)

*PAE- Prediabetes Awareness Education

Table 5: FDRs response on Prediabetes Knowledge

FDRs response on Prediabetes Knowledge	Baseline (%)	Follow up (%)
1. Prediabetes condition can lead to A. Type 2 diabetes mellitus* B. Type 1 diabetes mellitus C. Both D. None	140 (25.31)* 252 (45.5) 109 (19.7) 52 (9.4)	500 (90.4)* 39 (7.0) 7 (1.2) 7 (1.2)
2. What is the chance of one getting prediabetes if both their parents have type 2 Diabetes? A. 25-40 Percentage B. More than 50 percentage C. 10-15 percentage D. 0 percentage	181 (32.7) 163 (29.4)* 181 (32.7) 28 (5.0)	64 (11) 452 (81)* 29 (5.2) 16 (2.8)
3. Which is the best method for detecting prediabetes conditions? A. Blood testing B. Urine testing C. Both D. None of the above	407 (73.5)* 53 (9.5) 77 (13.9) 16 (2.8)	465 (84)* 50 (9) 32 (5) 6 (1)
4. What is the fasting blood glucose level (after an overnight fast of 10 hours) in prediabetes? A. 140-199 mg/dl B. < 100 mg/dl C. 100-125 mg/dl D. >200 mg/dl	50 (9) 224 (40.5) 162 (29.2)* 117 (21.1)	22 (3.9) 144 (26) 364 (65.8)* 32 (4.1)
5. Average blood glucose for the past 3 months is given by the blood test A. HbA1c Test B. Fructosamine Test C. Fasting Blood Glucose Test D. Oral Glucose Tolerance Test	73 (13.2)* 318(57.5) 141 (25.4) 21 (3.7)	430 (77.7)* 54 (9.7) 65 (11.7) 4 (0.7)
6. What is the importance of testing insulin levels along with glucose levels in prediabetes? A. To identify insulin tolerance B. To identify insulin overdose C. To identify insulin resistance D. None of the above	58 (10.4) 280 (51) 162 (29.2)* 53 (10)	10 (1.8) 110 (19.3) 382 (69)* 51 (9.2)
7. Preferred recommendation for prediabetes A. Diet control and exercise B. Insulin Injections C. Dental check up D. None of the above	337 (60.9)* 58 (10.4) 137 (24.7) 21 (3.7)	489 (88.4)* 41 (7.4) 20 (3.6) 3 (0.5)
8. The Prediabetes should take regularly A. Foods that are high in fat B. Soft drinks and energy drinks C. High fiber foods D. Foods rich in carbohydrate	54 (9.7) 29 (5.2) 432 (78.1)* 38 (6.8)	44 (7.9) 9 (1.6) 467 (84.4)* 33 (5.9)
9. How often prediabetes should do exercise? A. Once a week for atleast 30 mins B. Most days of the week for atleast 30 mins C. Once a month for atleast one hour D. None of the above	205 (37.0) 198 (35.8)* 35 (6.3) 115 (20.7)	131 (23.6) 396 (71.6)* 17 (3) 9 (1.6)
10. How far weight reduction help prediabetes condition in obese patient? A. Will Not help B. Greatly help C. Slightly help D. Unsure	135 (24.4) 210(37.9)* 161 (29.1) 47 (8.4)	41 (7.4) 498 (90)* 6 (1) 8 (1.4)

* Correct answer given by respondent

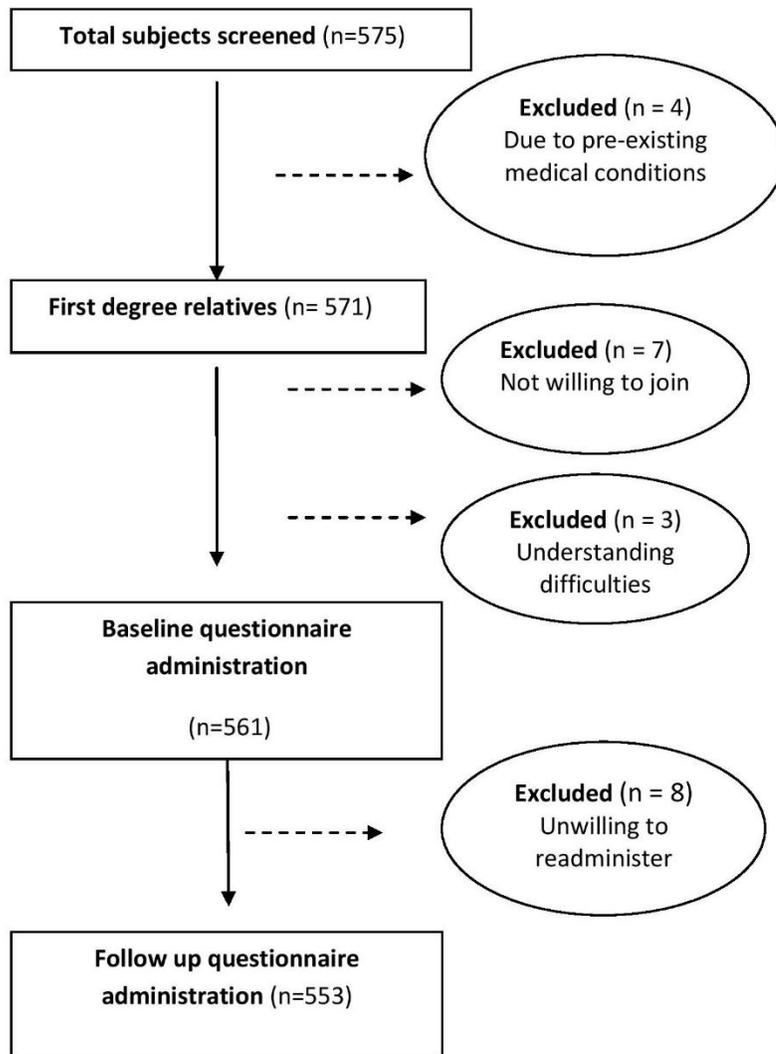


Figure 1: Flow diagram for the sampling and recruitment

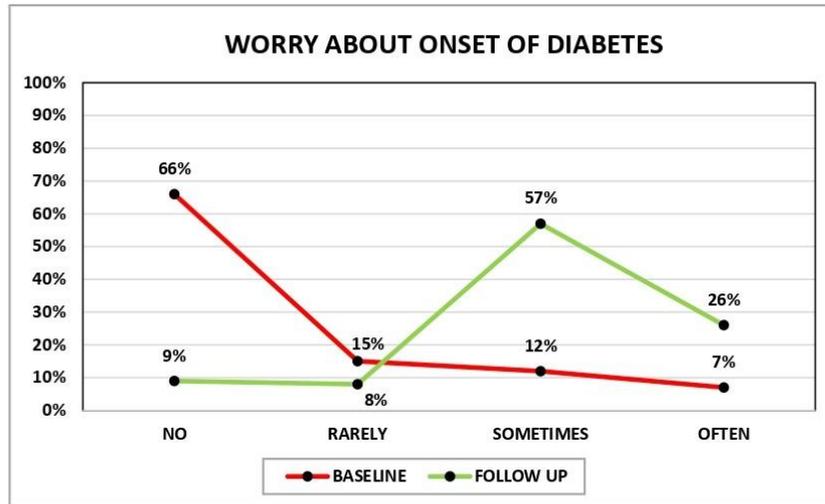


Figure 2: Represents the worry of respondents on onset of diabetes