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Impact of android app educational interventions on depression, anxiety and stress of recently detected type II diabetes patients

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ABSTRACT

Background: Persons with chronic disorders also suffer from undiagnosed mental health issues. Diabetes and stress are related to each other, people with diabetes mellitus have stress and stress in diabetes in turn affects their health. This study was conducted to assess the impact of android app educational interventions on depression, anxiety and stress among recently detected Type II diabetes patients.

Materials and methods: The study was a randomized controlled trial. Total, 66 subjects were recruited, 33 in both control and intervention group. The study group got interventions by using mobile application based software and control group got web-based intervention. All were counselled with lifestyle education by using printed educational materials. Depression, Anxiety and Stress Scale (DASS-21) was used in the study.

Results: Among the participants, 40.91% reported that they had at least one co-morbid condition. Only two participants had mental health issues. At baseline, 15.2% had depression, 43.9% had anxiety and 15.2% had stress, which were not different between control and intervention group. During follow up, the proportion of depression, anxiety and stress was decreased both in intervention and control group. In control group depression was decreased from 18.2% to 0%, anxiety was decreased from 45.5% to 4.5% and stress was also decreased from 18.2% to 4.5%. In intervention group, depression was decreased from 12.1% to 0%, anxiety was decreased from 42.4% to 0% and stress was also decreased from 12.1% to 0%.

Conclusion: Technology mediated educational interventions and involvement of clinicians may have a greater impact to improve the mental health in diabetes patients.

Introduction

Diabetes is a chronic incurable disorder of carbohydrate metabolism and Type II diabetes is the most common form of diabetes, accounting for 90 to 95% of all diagnosed cases of diabetes.[1] Type II diabetes is a progressive condition in which an individual's pancreas is not able to produce enough insulin, or body doesn't respond properly to insulin, called insulin resistance. It is a combination of ineffective insulin and lack of insulin. According to World Health Organization (WHO) fact sheet on diabetes, "an estimated 3.4 million deaths are caused due to high blood sugar".[2] Globally, the

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number of people with Type II diabetes is estimated to 387 million and is predicted to increase 592 million by 2035.[3] India is now severely affected by the global diabetes epidemic.[4] Diabetes is a disorder with multifactorial causes including both genetics and changes in lifestyle like diet, exercise and stress.[3,5]

Many individuals with chronic disorders also suffer from undiagnosed mental health issues.[6] Persistent stress may be the cause of serious illness. Stimulation in secretion of other hormones during stress raises glucose levels in blood. Diabetes and stress are much related to each other. Due to diabetes, patients take stress and such condition in diabetes also affects their health. Anxiety is the feeling of discomfort, worry, fearful thinking, apprehension of something with an undefined result; and stress is a state of psychological condition stemming from an unfavourable situation.[7] If the anxiety and stress are not properly managed, then depression develops in diabetic patients. According to the International Federation of Diabetes, it is important to implement psychological care for the management of diabetes.[8] Many studies have reported that depression enhances the risks of diabetes and anxiety and stress reported to have worsen the metabolic processes and escalate the complications in diabetes patients.[9-11] Proper assessment of mental health condition, counselling the patients and giving educational interventions are needed for diabetes management.[12] If self-care management of diabetes patients will be linked to technology, then they must be able to strengthen their physiological as well as psychological health. Some people face difficulties to use any app or website due to poor technical knowledge and low awareness regarding apps as a healthcare instrument, their own perceptions related to disease severity and other practical constraints like rural connectivity are the challenges for these type of studies. But now, some easy and simple android applications have been developed for boosting up patients' mental health by improving their awareness on diabetes.[13]

There are limited studies on mobile application for improvement of mental health among diabetic patients. So, a study was planned for the technical utilization of android applications by monitoring and guiding the diabetic patients for the management of diabetes and then reducing their stress. It was a hospital-based study, conducted to assess the effect of a mobile-based-application for the prevention of complications like stress, anxiety and depression among diabetes patients.

Materials and methods

Study design

In this experimental study, pre-designed, pre-tested and semi structured questionnaire was used which included DASS 21 scale to measure depression, anxiety and stress. Both qualitative and quantitative components were included in the questionnaire and the study was conducted from October 2016 to October 2018.

Study setting

This Randomized Controlled Trial was conducted in the Endocrinology and Community Medicine department of a tertiary care hospital.

Study population

Adult T2DM patients within 3 months of diagnosis, aged between 18 to 60 years, who visited endocrinology OPD during study period were included. Those who were assuming less techno-friendly and patients with cognitive impairment, any severe chronic diseases were not included in the study.

Sample size

The sample size was 54 patients for this two-treatment parallel-design study. With a dropout rate of 20% at the maximum during follow up over time, an additional number of 11 patients were added up and the total required sample size was 65 or roughly 33 for each arm.

Methods

After obtaining written consent, patients were randomized to control and intervention group. The sample size of 66 was divided into 11 blocks and 6 in each block. The 6 subjects within each block were assigned to website/ mobile group by random sequence generation 3 to control and 3 to intervention group. Sequentially numbered, sealed, opaque envelopes (SNOSE) were used to secure adequate allocation concealment.[14] Total 11 envelopes were prepared for 11 blocks and randomly generated sequence of control and intervention (eg. ABABBA) labelled papers were kept in that envelope. The investigators counselled all participants regarding lifestyle education by using printed educational materials. Intervention group participants were allowed to use android app and control group were told to use website named tunediabetes.com. The mobile based application included general personal data, diabetes related data, laboratory test data, online chat option and reminder for medication and exercise. The general personal data included socio-demographic profile, history of other chronic conditions, diet, sleep, exercise and anthropometry like BMI, waist circumference and diabetes related data included blood sugar, HbA1C etc.

There was also provision of all information related to complications of diabetes and its prevention. The control group was provided with an online platform in the website which included options for recording data similar to that of the mobile application except for the provisions like reminders.

The intervention group participants were contacted every 3 weeks for 3 months over telephone by principal investigator and were enquired about lifestyle change and counselled if required. Home visit was provided to the intervention group by the research team before first follow up and second visit was also done for missing cases. Baseline data collected and at every 3 months interval in one year (4 times), follow up conducted. Details of participant recruitment and follow up was mentioned in Figure 1.

Data collection tools and measurements

The study tool consisted of socio-demographic data, risk factors, co-morbidities, complications and family history of diabetes mellitus. For the assessment of depression, anxiety and stress, a validated DASS-21 questionnaire in local Odia Language was used. The DASS-21 questionnaire has 21 items,

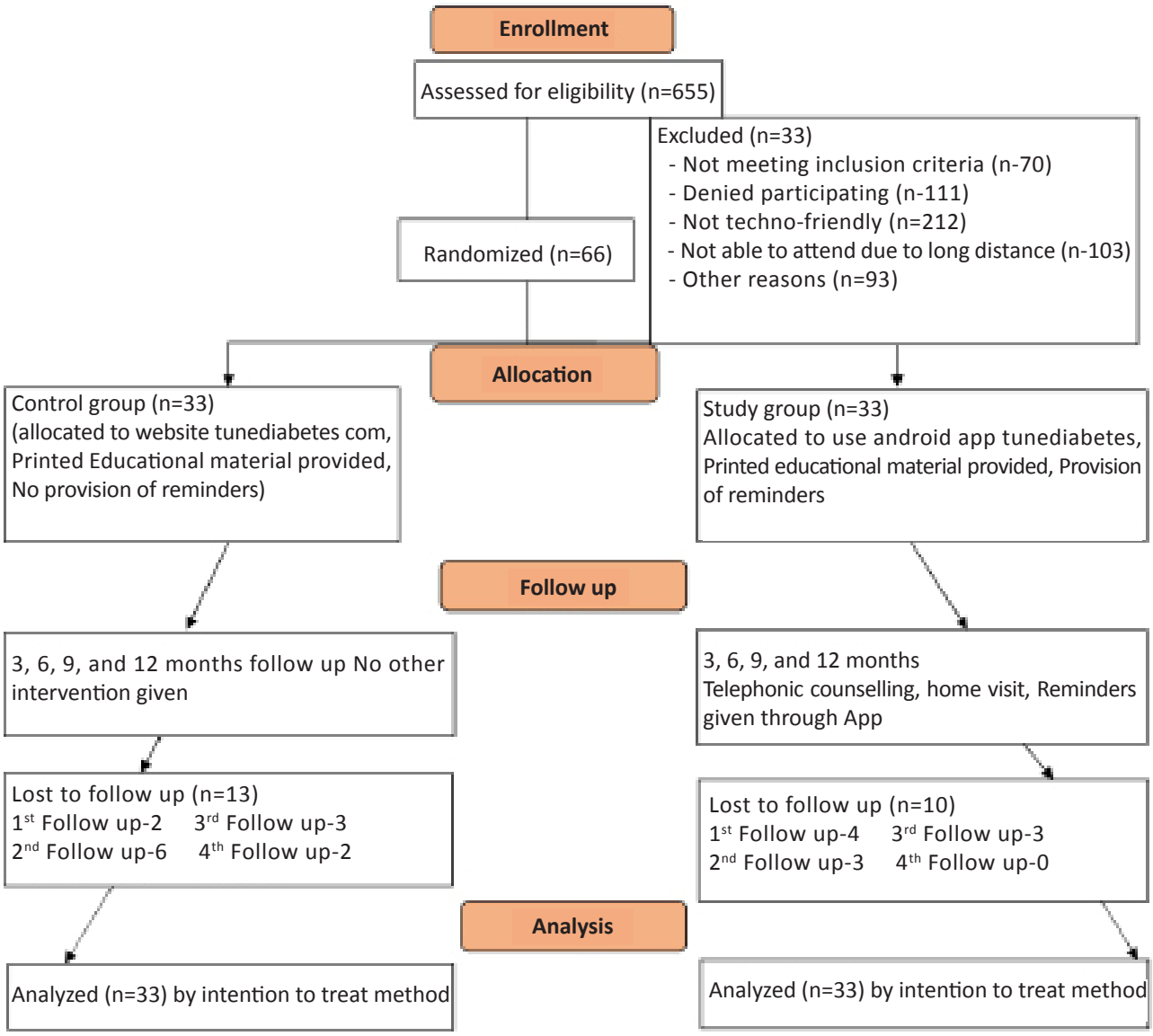

Figure 1. *Details of participant recruitment and follow up.*

assessing the symptoms of depression, anxiety and stress respectively. The participants rated their experience on every symptom on a 4-point severity scale ranging from '0' (does not apply to me), to '3' (applie s to me most of the time). Scores of each scale were summed up then and categorized as normal, mild, moderate, severe and extremely severe according to the DASS manual.[15]

Ethical approval

This randomized controlled trial was approved by the "Institutional ethics committee" as well as registered in "Clinical Trial Registry of India". The ethics committee code and the clinical trial registration number were DMR/IMS/-SH/SOA/16006, CTRI/2017/02/007911 respectively.

Data analysis

Data were analysed by SPSS v 20 licensed to our university. Descriptive analysis, repeated measures ANOVA test were applied to analyse continuous data and for categorical data proportions and Cochrane Q test was used.

Results

Total 66 subjects were recruited in the study, of which 33 were enrolled into control and 33 into intervention group.

Out of 66 study subjects, 65.2% were male and the mean age of the study subjects was 42.29±9.5. More than 95% were Hindus. Around 89.4% of the study subjects belonged to general caste; and 57.6% lived in joint family. Majority (89.4%) patients were married. Only 63.7% were educated up to graduation or master degree level and the mean per capita income was 11,545 Rupees (Table 1). There was no difference found between control and intervention groups in socio-demographic characteristics.

Table 1 Socio-demographic characteristics of participants.

Variables		Overall (n=66) n (%)	Control (n=33) n (%)	Intervention (n=33) n (%)	Significance
Age in years (Mean±SD)		42.29±9.5	42.88±9.5	41.70±9.6	0.617
Gender	Male	44 (66.66)	23 (69.7)	21 (63.6)	0.601
	Female	22 (33.33)	10 (30.3)	12 (36.4)	
Religion	Hindu	63 (95.5)	31 (93.9)	32 (97)	0.500
	Others	3 (4.5)	2 (6)	1 (3)	
Caste	General	59 (89.4)	29 (87.9)	30 (90.9)	0.509
	SC	3 (4.5)	1 (3)	2 (6.1)	
	Others	4 (6.1)	2 (6)	1 (3)	
Family Type	Joint	38 (57.6)	22 (66.7)	15 (45.5)	0.083
	Nuclear	28 (42.4)	11 (33.3)	18 (54.5)	
Marital status	Single	7 (10.6)	5 (15.20)	2 (6.1)	0.230
	Married	59 (89.4)	28 (84.8)	29 (87.9)	
Education level	Secondary and higher secondary	24 (36.4)	15 (45.5)	9 (27.3)	0.125
	Graduate and above	42 (63.6)	18 (54.5)	24 (72.7)	
Socio-economic status	Upper	34 (51.5)	14 (42.4)	20 (60.6)	0.294
	Middle	23 (34.8)	14 (42.4)	9 (27.3)	
	Lower	9 (13.6)	5 (15.2)	4 (12.1)	

Out of all subjects, 40.91% reported that, they had at least one co-morbid condition like hypertension, hypothyroidism, cardio-vascular disease, obesity, urological problems, osteoarthritis, neurological disorder without cognitive impairments, etc. Two participants were having depression and were under treatment. While interviewing about the family history of diseases, 60.61% reported that their family members were having one or more health problems. Majority family members (45.45%) of the participants had diabetes and 18.18% having cardio-vascular disorders.

Sleep was adequate among 74.2% participants and no difference was found between control and intervention groups. Tobacco addiction was found in 28.79% participants and 25.76% participants were alcohol addicted in baseline and no difference was observed between control and intervention group. Based on DASS-21, 15.2% had depression, 43.9% had anxiety and 15.2% had stress and these were not different in control and intervention groups (Table 2).

In the present study, 28.78% participants were found to use tobacco in any form, 6.06% were using both smoke and smokeless tobacco products. 25.8% were current alcoholics and 3.03% were heavy drinkers. Among the participants, 16.66% smoked tobacco products daily, 18.2% were using smokeless tobacco products daily. Alcohol was consumed by 34.84% participants in their lifetime on any occasion, 25.8% and 15.2% patients were consuming alcohol in past 12 months and 30 days respectively. Alcohol was quitted by six participants (9.1%) due to health related factors.

Table 2 Sleep, addiction, and mental health of participants at baseline.

Sleep per day	Total (N=66) n (%)	Control (N=33) n (%)	Intervention (N=33) n (%)	Significance
Adequate sleep	49 (74.2)	26 (78.8)	23 (69.7)	0.398
Less sleep	17 (25.8)	7 (21.2)	10 (30.3)	
Addiction				
Tobacco -Yes	19 (28.79)	10 (30.30)	9 (27.27)	0.786
No	47 (71.21)	23 (69.7)	24 (12.12)	
Alcohol - Yes	17 (25.76)	7 (21.2)	10 (30.3)	0.398
No	49 (74.24)	26 (78.8)	23 (69.7)	
Mental health				
Depression	10 (15.2)	6 (18.2)	4 (12.1)	0.492
Anxiety	29 (43.9)	15 (45.5)	14 (42.4)	0.804
Stress	10 (15.2)	6 (18.2)	4 (12.1)	0.492

In our study, dropout rate was high; control group (33→20), intervention group (33→23) which may be due to repeated follow ups, rigorous daily diary maintenance and their personal issues. This might be addressed by counselling and motivating the patients by the health care providers. It was found that, proportion of participants with adequate sleep increased in both the groups after intervention. Participants with adequate sleep were increased from 78.8% to 85% in control group and 69.7% to 78.3% in intervention group. Tobacco and alcohol use in last 3 months among participants was enquired during each follow up and the proportion of tobacco and alcohol use was decreasing in both the groups. In control group, proportion of participants addicted to tobacco was decreased from 30.3% to 10% and proportion of participants addicted to alcohol was decreased from 21.2% to 0%. In intervention group, proportion of participants addicted to tobacco was decreased from 27.27% to 0% and participants addicted to alcohol was decreased from 30.3% to 0%.

During follow up the proportion of depression, anxiety and stress was decreased both in intervention and control group. During last two follow ups, in the intervention group, no one had mental health issues, but in control group, one had anxiety and one had stress. In control group, proportion of participants with depression was decreased from 18.2% to 0%, anxiety from 45.5 to 4.5% and stress from 18.2 to 4.5. In intervention group, proportion of participants with depression was decreased from 12.1% to 0%, anxiety from 42.4 to 0% and stress from 12.1 to 0. (Table 3)

Table 3 Sleep, addiction and mental health of participants at follow up.

Sleep per day	Control n (%)					Intervention n (%)				
	Baseline	1st Follow up n=31	2nd Follow up n=25	3rd Follow up n=22	4th Follow up n=20	Baseline	1st Follow up n=29	2nd Follow up n=26	3rd Follow up n=23	4th Follow up n=23
Adequate sleep	26 (78.8)	26 (83.9)	25 (100)	22 (100)	17 (85)	23 (69.7)	26 (89.7)	23 (88.5)	20 (87.0)	18 (78.3)
Less sleep	7 (21.2)	5 (16.1)	0 (0)	0 (0)	3 (15)	10 (30.3)	3 (10.3)	3 (11.5)	3 (13)	5 (21.7)
Addiction										
Tobacco -Yes	10 (30.30)	4 (12.9)	2 (8)	2 (9.1)	2 (10)	9 (27.27)	3 10.35)	2 (7.7)	1 (4.3)	0 (0)
No	23 (69.7)	27 (87.1)	23 (92)	20 (90.9)	18 (90)	24 (12.12)	26 (89.65)	24 (92.3)	22 (95.7)	23
Alcohol - Yes	7 (21.2)	5 (16.12)	3 (12)	2 (9.1)	0 (0)	10 (30.3)	3 (10.35)	3 (11.5)	1 (4.3)	0 (0)
No	26 (78.8)	26 (83.87)	22 (88)	20 (90.9)	20 (100)	(69.7)	26 (89.65)	23 (88.5)	22 (95.7)	23 (100)
Mental health										
Depression	6 (18.2)	2 (6.3)	0	0	0	4 (12.1)	1 (3.6)	0	0	0
Anxiety	15 (45.5)	5 (15.6)	1 (3.0)	1 (4.5)	1(4.5)	14 (42.4)	8 (28.6)	1 (3.0)	0	0
Stress	6 (18.2)	2 (6.3)	2 (6.1)	1 (4.5)	1(4.5)	4 (12.1)	4 (14.3)	1 (3.0)	0	0

When the recruited patients were asked about any other health problems they faced in last three months, majority of them told that they had not suffered from any health problems (Table 4).

Table 4 Participants suffered from health problems in last 3 months.

Suffered from health problems in last 3 months	Control n (%)				Intervention n (%)			
	1st Follow up n=31	2nd Follow up n=25	3rd Follow up n=22	4th Follow up n=20	1st Follow up n=29	2nd Follow up n=26	3rd Follow up n=23	4th Follow up n=23
Yes	6 (19.4)	5 (20)	4 (18.2)	3 (15)	9 (31)	4 (15.4)	6 (26.1)	7 (30.4)
No	25 (80.6)	20 (80)	18 (81.8)	17 (85)	20 (69)	22 (84.6)	17 (73.9)	16 (69.6)

Discussion

The present study had a concept of giving intervention by using the mobile app technology for improving the mental health patients with type II diabetes. The participants were newly diagnosed (within 3 months) diabetes mellitus patients and the feeling of anxiety and stress related to the disease were common among them. If the anxiety and stress are not managed properly then it may worsen the mental health condition. In our study, educational interventions were given to the participants by mobile app and website

to enrich the mental health in study and control group respectively. Health care professionals, patients and families should be prepared with adequate information to reduce risk factors, make every day necessary adjustments in daily dietary habits, physical exercises, proper medications, and manage complications of diabetes for good physical and mental health.[16]

Many studies revealed that psychological health problems like anxiety, stress, and depression are very common in diabetic patients than the normal population.[17-22] Early recognition and treatment of depression, anxiety and stress in type II diabetes patients are very essential because of its relationship with hyperglycaemia, diabetic complications and poor quality of life.[23-26] In our study, 40.91% reported having at least one co-morbidity like hypertension, thyroid disorders, cardio-vascular disease, obesity, urological problems, osteoarthritis, neurological disorder, and only two participants were having mental health issues. In our study, co-morbidity in patients of recently diagnosed type II diabetes was similar or higher than other studies.[23-26] About 60% reported that their family members had one or more health problems. Majority (45.45%) family members of the participants had diabetes and 18.18% had cardio-vascular disorders. Yang Q et al, reported that, collecting family history of diabetes could provide significant improvements in detecting undiagnosed diabetes with proper validation.[27] In the present study based on score ranges from the DASS manual, 15.2% had depression, 43.9% had anxiety and 15.2% had stress and were not different in control and intervention groups at baseline. The proportion of depression, anxiety and stress was decreased both in intervention and control groups. In control group depression was decreased from 18.2% to 0%, anxiety was decreased from 45.5% to 4.5% and stress from 18.2% to 4.5%. In intervention group, depression was decreased from 12.1% to 0%, anxiety was decreased from 42.4% to 0% and stress from 12.1% to 0%. Similar findings were shown by the study done by Bahety et al, in which depression, anxiety and stress were 26.6%, 40% and 19.4% respectively.[28] Our findings were similar with other studies, that anxiety was common in type II diabetes supporting the association between psychiatric illness and type II diabetes.[29,30] Similarly, stress percentage for female was 21.74% while for males it was 6.98%. This result showed that depression, anxiety and stress is a common health problem in type II diabetes which corroborates with findings of a study by Bahety P et al.[28] In a critical review the author explained that females have a higher prevalence and risk of depression compares to males and there are many factors have been connected for this gender difference including socio-cultural and biological factors.[31]

In control group, proportion of participants addicted to tobacco was decreased from 30.3% to 10% and proportion of participants addicted to alcohol was decreased from 21.2% to 0%. In intervention group, proportion of participants addicted to tobacco was decreased from 27.27% to 0% and proportion of participants addicted to alcohol was decreased from 30.3% to 0%. The favourable results may be attributed to awareness regarding consequences of alcohol and tobacco by mobile application and web based platform. A study reported that in terms of alcohol consumption, to some extent current drinking was an independent risk factor for depression. A study showed that a bi-directional relationship between alcohol use and stress and alcohol use was used as means of coping with life's stresses.[32,33] Diabetes self-care management like checking blood glucose level, doing regular physical activity, taking general and specific diet have been improved among diabetes apps users. A study revealed that, use of diabetes apps may be a useful approach to enhance awareness on diabetes and its complications which may ultimately improve self-care practice.[34] In our study, app users got regular information regarding their diabetes medications, check-ups, diet, physical activity through the app by the health care professionals to reduce the disease severity and make them psychologically stable. Findings of a study concluded that, mobile applications related to diabetes mellitus had the potential to enhance diabetes self-care management to maintain a healthier lifestyle.[35]

Conclusion

Mobile app intervention decreased the proportion of depression, anxiety and stress in both control and intervention groups. In today's era of mobile and internet, education through mobile will be a great help for decreasing the mental health related problems. Clinicians may counsel and convince the patients to use the health related applications for their problems. Future mobile application based interventional research is needed for different health issues.

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Conflicts of interest

No conflicts of interest.

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