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Psychosocial covariates of physical activity in recently diagnosed Type 2 diabetes patients

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ABSTRACT

Background **Regular physical activity can be effective not only in preventing diabetes and managing its complications but also be effective in minimizing the risk of developing other chronic diseases among diabetics. The overall aim of study was to determine probable causes of change in physical activity so as to generate evidences for future interventions and to identify psychosocial covariates of self reported physical activity in recently diagnosed Type 2 diabetes cases.**

Methods **Participants n=478 (239 intervention arm and 239 control arm) of an observational cohort were randomized into the ADDITION Plus trial and were recruited from 36 practices in East Anglia region. Participants were people recently diagnosed with diabetes (screen detected and clinically diagnosed within the preceding 3 years were individually randomized) and were between the age group of 40-69 years, (mean age 59.2 years). The self reported data regarding physical activity was measured at baseline and one year were used. Demographic and psychosocial (treatment control, consequences, anxiety) covariates were assessed at the baseline. Linear univariate and multivariable linear regression analysis was used to quantify the associations between demographic and psychosocial correlates. Results: With regard to the psychosocial correlates(except for participants' perceptions about the consequences of diabetes), no significant associations with physical activity were found. Treatment control and anxiety failed to predict physical activity.**

Conclusion **The result suggests to further investigate the change in physical activity by including other variables related to demography, other psycho-social and environment influences. Based on the available literature, it is suggested that other factors were found consistently associated with physical activity such as self efficacy, attitude, sensation seeking, family-friend social support, goal orientation, motivation could be studied.**

Keywords: Physical Activity, Type 2 diabetes, Treatment control, Consequences, Anxiety

INTRODUCTION

Diabetes Mellitus is characterised by a state of chronic hyperglycemia resulting from a diversity of etiologies. Both environment and genetic factors play a role in disease manifestation. Out of the different types of Diabetes Mellitus, Non-insulin dependent diabetes mellitus (NIIDM or Type 2 diabetes) is most common (90-95% of all cases) and is generally discovered by chance as compared to Insulin dependent diabetes mellitus (IDDM, Type 1 diabetes) (5-10%)[1]. Greater central adiposity, low level of physical activity, poor eating habits and medium to high socio-economic status associated with economic development are key risk factors for the development of Type 2 diabetes. [2, 3] Type 2 diabetes is typically gradual at the onset and occurs mainly in the middle aged and elderly, however an increasing number of younger people are being diagnosed with the disease.[1,2]Although increases in both the prevalence and incidence of Type 2 diabetes have occurred globally dramatically in economic

transition societies found in newly industrialized countries.[2, 3]

Behavioural interventions which are focused on people living with Type 2 diabetes can lead to improved health outcomes.[4,5,6] These behavioural interventions focus on bringing about changes in lifestyle by giving participants targets, such as an increase in physical activity, change in sedentary lifestyle, improved dietary intake. These behavioural targets are set by the intervention team and the aim is for the participants to achieve these targets at the follow-up. [5, 6]

Behavioural intervention-based studies focus on the direct relation between diabetes and high risk behaviors such as sedentary lifestyle. Health education and self management training are key strategies in such behavioural interventions.[5,6] However, the outcome of numerous trials suggests that effect of physical activity promotion interventions among people at high risk of diabetes remains invariably ineffective. It could be concluded that people at higher risk are less likely to participating in behavior change in terms of overcoming their sedentary life style, smoking habit, change in dietary intake. [7, 8, 9, 10] Health interventions focusing on behaviour change reported desired results (related to physical activity) when these interventions transition from instructing to empowering people at high risk of Type 2 diabetes about behaviour change .[11, 12] Major limitations of such studies to date is the inability to isolate the effects of behavioural interventions from other aspects of intensified management including prescribing of medication and better organisation of services. [11, 12] This applies to both the effect of the intervention on behavioural outcomes and the subsequent effect of behaviour change on clinical outcomes, such as cardiovascular risk.

The measurement of the behaviours themselves is a challenge (to understand the effect of interventions on behaviour), with the majority of studies relying on self report, which is imprecise and susceptible to recall bias.[11] This has limited the ability to identify active ingredients of interventions aimed at facilitating behaviour change and to replicate effective interventions in clinical settings.[5, 6,11] Regular physical activity can be effective not only in preventing Diabetes and managing its complications. It is also effective in minimizing the risk of developing chronic diseases such as cardiovascular disease among people living with diabetes.[13] Physical activity also strengthens other adaptive behaviors such as improving dietary intake, less smoking etc.[14] Despite known benefits of physical activity among people living with diabetes a high percentage of them do not engage in sufficient levels of physical activity. [14,15]

Definition of physical activity

"Physical activity is a bodily movement due to skeletal muscle that results in expenditure of energy. Exercise is subset of physical activity that is planned and structured. Sport is further subset of physical activity involving competitive situations and use of rules. The dimensions of physical activity include: a) type of activity, eg. walking, jogging, swimming etc.; b) frequency eg. 3 times a week; c) duration eg. 1 hour and d) intensity eg. Metabolic Energy Equivalents (METs). Moderate physical activity (MPA) is often described as activity between three and six METs and vigorous physical activity as over six METs. 1 MET is approximately equal to 1 kcal/kg/hr." [16]

Key objectives of the study

1. To determine probable causes of behavioural change in physical activity to enhance our understanding of the causal processes and to generate evidences for future interventions

2. To identify psychosocial covariates of self reported physical activity in recently diagnosed Type 2 diabetes cases.

3. Numerous factors may affect individual's participation for physical activity as suggested by Meta-analysis and systematic reviews. These demographic and biological characteristics factors that positively impact physical activity are: psychological, emotional, social, cultural and environmental factors.[17,18,19,20,21,22] Being male (sex), higher level of education, being Caucasians (ethinicity), higher levels of education, higher socio-economic status, physical activity preference (such as liking exercise), stronger intention to be active, self efficacy, positive attitude towards physical activity, previous high physical activity, healthy diet, obesity, BMI, sensation seeking, good

family-friend-social support, and goal orientation/ high motivation are found to be positively associated with physical activity. Negatively associated factors with physical activityare: older age, low socioeconomic status, drinking, smoking, depression.[17,23] In case of recently diagnosed Type 2 diabetes patients such covariates of physical activity need to be further verified. [17,23]

There are a limited number of studies which measure anxiety and psychosocial factors as correlate of physical activity among patients recently diagnosed with type II diabetes. Most of these studies presented no clear association between anxiety and physical activity. However, a study among Taiwanese adults with anxiety disorder found state anxiety was significantly and negatively associated with physical activity. [24] Self reported anxiety may not be causally related to behaviour change, but may form part of pragmatic strategy to identify those who might benefit from changing their physical activity behavior.[25] In the present study the association of anxiety with physical activity is being considered based on a theoretical premise in the absence of sufficient data related to anxiety among people living with diabetes. Also key dimensions of theory based framework such as Common Sense Model (CSM) was used to inform the choice of psychological covariates of physical activity among people living with Type-2 diabetes. These theory based psychosocial correlates of change in physical activity could be helpful in identifying the significant independent covariates of physical activity.

The Common Sense Model (CSM) is also known as the illness perception model, illness representation model, or Leventhal's model.[25] The common sense model suggests five dimensions to illness beliefs: cause, consequences, treatment control, identity, and timeline.[26,27,28,29] The Common Sense Model outlines the key constructs related to lay beliefs about illness or idea of illness representations. The illness representations integrate with existing schemata (the normative guidelines which people hold). This helps people to understand any health-related symptoms and help them in coping with it. [25,30] The Common Sense Model of illness places the illness representation into the centre of those cognitive and emotional processes that are responsible for evaluating health and illness.[31,32,33] The theory suggests that patients who consider their greater control over the illness or find their illness controllable would also view their illness as being less chronic with fewer serious consequences (cognitive re-appraisal). This facilitates patients suffering from illness to organize their lay beliefs about their illness. Patient's cognition regarding illness develops associations between illness outcomes such as psychological and physical adjustment and illness representations. The illness representation would cause coping responses and would influence health outcomes such as physical activity. The central point of common sense model is that people with illness tend to use common sense in developing their representations based on their knowledge and experiences. Based on the findings from previous researches and the objectives of present study, following hypotheses have been generated.

Hypotheses

1. There is a positive association between socio-demographic characteristics such as age, sex, ethnic group and physical activity.
2. Consequences and Treatment Control related to diabetes are positively associated with physical activity.
3. Anxiety is a negative covariate of physical activity.

METHODS

Design and setting

For present observational cohort study, the dataset comprising of n = 478 participants was obtained from the parent study- ADDITION Plus Trial for a MPH course dissertation work. The ADDITION Plus trial was a primary care based study and comprised of: (i) practices nested within the intensive treatment arm of ADDITION-Cambridge study with screen detected Type 2 diabetes patients (ii) also clinically diagnosed patients within three years period from the ADDITION- Cambridge (iii) and patients from non-ADDITION Practices. . The aim of ADDITION-Plus trial was to assess whether a behaviour change intervention delivered by trained and quality assured lifestyle facilitators was a cost-effective addition to intensive treatment. The trial could achieve and maintain these changes in important health related behaviors (physical activity, smoking

cessation, taking medication and dietary change) in people with screen detected diabetes (already receiving intensive general practice based care). Total n=478 participants (239 intervention arm and 239 control arm) were individually randomized in the intervention and control arm of the study.

Eligibility criteria

The eligibility criteria included age group of 40-69 yrs. with Type 2 diabetes following screening in the ADDITION programme or a clinical diagnosis during the previous three years in participating GP surgeries. The exclusion criteria for the study included women who were pregnant or lactating or anybody who had a psychotic illness with a likely prognosis of less than one year.

Procedure

In the parent ADDITION Plus study the baseline measurements included the completion of questionnaires, physiological and anthropometric measures and venesection. Similar measurements were conducted at one year and five years after randomization. The patients were individually randomized from a central site by a statistician blind to patient characteristics. For the current observational cohort study only self reported physical activity measured at baseline and one year were used. Further in this study the correlates of physical activity studied at baseline were used as per the hypotheses for the present study. The measurements were undertaken at outpatient clinical research facilities by trained staff following standard operational procedures and unaware of participants study group allocation. Double data entry of all measures was undertaken by an independent agency, blind to study group (Wyman Dillon Research and Data Management, Bristol, UK and Document Technologies and Imaging Solutions Ltd. Chalgrove, Oxford). The ethical approval for ADDITION Plus was obtained from the Eastern Multi Centre Research Ethics Committee vide reference No. 02/5/54. The participants were informed regarding the details of the study and written informed was obtained. ISRCTN-9975498.

Measures

Physical activity was assessed using validated the EPAQ2.[34] EPAQ2 was earlier validated using total energy expenditure and was tested for repeatability twice within a three month interval. Physical activity was reported by the participants in three major domains: at home, at work and during recreation over the past 12 months. EPAQ2 had 88 items and the response scale to each activity is -"none in last one month", "less than once a month", "once per month", " two three times a month", "once a week", " two to three times per week", " four to five times a week", and " six or more times a week". Participant's energy expenditure was assessed from the frequency, intensity and duration per episode of self reported physical activity in these domains. In the questionnaire the patients were asked to recall the times they had spent walking in different aspects of their life: at home, to work, at work and/ or for leisure. In the present study, total physical activity were measured at baseline and 12 months intervals with MET hrs./week scores .

For the measurement of selected psychosocial correlates of physical activity (consequences and treatment control), an Illness Perception Questionnaire-Revised (IPQ-R) was used. The consequences and treatment control subscales of Illness Perception Questionnaire-Revised (IPQ-R) [35,36] were comprised of 12 items. The consequences scale assessed seriousness of diabetes and the impact of diabetes on various aspects of life. The examples of items regarding the consequences construct were 'My diabetes is a serious condition' and 'My diabetes has major consequences on my life'. Similarly items for the Treatment control construct were: 'My treatment can control my diabetes' and 'My treatment will be effective in curing my diabetes'. Both scales were measured on 5-point Likert scales ranging from 'strongly disagree' to 'strongly agree'. To measure state anxiety, the short form of the scale of Spiegelberger State- Trait Anxiety Inventory (STAI) was used. [37] The short form of STAI consists of six items that evaluates how person feel 'right now, at this moment'. The response are given in four point scale ' not at all' to 'very much'.

Statistical analysis for study

Data were analyzed using the Statistical Package for Social Sciences 17.0 (SPSS, In. Chicago, IL, USA). Descriptive statistics were performed for mean scores or proportions for all demographic and psychosocial correlations of physical activity. Descriptive summary statistics were calculated separately for men and women participants including mean, standard deviation (SD), range,

and missing values at baseline and follow-up. To examine any possible differences in baseline and 12 months follow-up levels of physical activity, a T-test was used. To verify any significant difference between responders and non-responders at 12 months follow-up, T-tests were employed for the following variables- age, sex, consequence treatment control and physical activity. Spearmen's correlation was used due to the distribution of variables and to assess the relation between the continuously measured correlates of physical activity. Linear regression models were used to identify the covariates of physical activity at one year in the whole cohort and separately in the intervention and control arm. Baseline scores for physical activity were adjusted for in all models to explain change in this variable over time. The residuals of all linear regression models were checked to ensure they were normally distributed. The Type I error was set at 0.05 level for all tests. Multivariable regression analysis was conducted at intervention and control arm separately. No major difference was found which justified pooling data. Multivariable regression analysis was run to examine the predictors of change in physical activity over the year, mutually adjusting for all significant variables and baseline PA ($p < 0.05$), to establish which variables were independently associated with the outcome.

RESULTS

Participants Characteristics

The dataset comprised of demographic and psycho-social correlates of behavior change related to physical activity for 478 study participants (239 intervention arm and 239 control arm) at baseline and at 12 months follow-up. To verify any significant difference between responders and non-responders at 12 months follow-up, T-tests were employed for the following variables- age, sex, consequence treatment control and physical activity. No significant differences were noticed between responders and non responders. Multivariable regression analysis was conducted at intervention and control arm separately. No major difference was found which justified pooling data. The demographic characteristics of cohort are presented in **Table 1**.

Table 1 Demographic characteristics of the study participants (n=478)

Predictors		Frequency (%)
Age at baseline	Mean (SD)	59.2 (7.5)
Sex N= 478	Male	298 (62.3)
	Female	180 (37.7)
Ethnic group N = 478	Caucasians	466 (97.5)
	Black	3(.60)
	Asian	9 (1.9)
Marital status N = 470	Married	355 (74.3)
	Unmarried	33(6.9)
	Divorced/separated	54(11.30)
	Widow/widower	28(5.9)
Education (age finished full time education) N= 470	Mean (SD)	17.1 (4.2)
	< 16 years	300(62.8)
	17 to 22	151(31.6)
	23 above	19(4.0)
Current work status N= 461	Working	256(53.6)
	Retired	175(36.6)
	Not working	30(6.3)
Household cars or vans N= 460	Yes	441 (92.3)
	No	29(6.1)
Home ownership N = 470	Rent	70(14.6)
	Own	390(81.6)

N=Number of participants with data for respective variable

Two-thirds were men and the mean age of participants was 59 ± 7 years. 97.5% of participants were Caucasians. The majority of participants were married and the mean age at which the participants had finished fulltime education, which was used as an indicator of educational level, was 17 ± 4 years. Nearly half of the study participants were working either full time or part time, almost one-third were retired and about one-tenth were not working (which included participants waiting to start a new job, unemployed participants, temporary or permanently sick participants). Most of the participants owned a house and merely 14.6% reported to live in rented house. Similarly, the majority of participants owned at least one car or van.

Levels of physical activity and its hypothesized psychosocial correlates in the cohort

Mean (SD), range values of psychosocial correlates of physical activity (in terms of home, work and recreational dimensions) in ADDITION Plus cohort are presented in **Table 2**. The missing values for each variable during the baseline and 12 months follow-up are also reported in the Table. The missing values regarding physical activity at base line and over 12 months are 37 (7.7 %) and75 (15.7 %) respectively of total sample size- n = 478. The possible reason for maximum missing values regarding physical activity as compared to other variables may be the self reported responses by the participants based on last 12 months recall period. The participants neither agreed nor disagreed (2.89 ± 0.64) that diabetes would have an impact on their daily lives (the consequences related to the seriousness of diabetes). On the contrary, the participants were moderately positive about the control of diabetes through treatment as they had moderately strong belief on 'Treatment control' scale (3.77 ± 0.5).

Table2 Descriptive analysis of psychosocial correlates of physical activity (n=478)

Predictors	Mean	Standard Deviation	Range (approx.)	Missing values
Treatment control	3.77	0.5	4	**27**
Consequences (diabetes related condition)	2.89	0.64	4	**24**
Anxiety	32.45	11.28	56	**10**
Physical Activity (Baseline)	78.83	72.00	489	**37**
Physical Activity (12 months follow-up)	**76.93**	**64.46**	**404**	**75**

Participants were somewhat anxious (32.45 ± 11.28) regarding their condition. The scores for Physical Activity (METhrs/Week) baseline and over 12 months were 78.83 ± 72.00 and 76.93 ± 64.46 respectively. No significant differences were

found between baseline and 12 month follow-up (t-statistic-0.363; 95% CI -2.9 to 7.9).

Gender based descriptive characteristics

Table 3 showed the descriptive characteristics stratified by gender to see if there were any gender based significant differences among men (n=298) and women (n=180) in physical activity.

Table 3: Gender based descriptive characteristics (n=478), stratified by sex

Predictors	Men (n=298)				Women (n=180)			
	Mean	SD	Range (approx.)	Missing Value	Mean	SD	Range (approx.)	Missing Value
Age group (40-69)	58.9	7.5	30	0	59.6	7.4	30	0
Consequences (diabetes related condition)	2.9	0.7	4	11	2.9	0.6	3	13
Treatment control	3.8	0.5	4	16	3.8	0.4	3	11
Anxiety	31.6	11.1	57	7	33.9	11.4	53	3
Physical Activity (Baseline)	96.8	78.4	489	24	49.3	46.9	319	13
Physical Activity (12 months follow-up)	90.8	65.5	392	53	55.5	56.7	404	22

It is clear from Table 3 that the mean (SD) scores regarding age for men and women were 58.9 ± 7.5 and 59.6 ± 7.4 respectively. Scores for men and women regarding consequence variable (belief regarding diabetes related condition) it was 2.9 ± 0.7 for men and 2.9 ± 0.6 for women. The scores for Treatment control for men and women were 3.8 ± 0.5 and 3.8 ± 0.4 respectively. Similarly the mean (SD) scores for men and women were 31.6 ± 11.1 and 33.9 ± 11.4 respectively. Hence, no significant differences were noticed among men and women scores on psycho-social correlates of physical activity. The only remarkable difference that could be observed between the two sexes was on physical activity at baseline as well as 12 months follow-up as suggested by results of T tests. Physical activity score for men at baseline was 96.8 ± 78.4(p<0.001; 95% CI 34.39 to 60.73) and for women it was 49.3 ± 46.9 (p <0.001; 95% CI 35.82 to 59.29). Likewise the scores for physical activity over 12 months follow-up for men and women were 90.8 ± 68.4(p<0.001; 95% CI 22.79 to 47.74) and 55.5 ± 56.6 (<0.001; 95% CI 23.16 to 47.37) respectively. The decrease in physical activity among men over the year (96.8 ± 78.4 to 90.8 ± 65.5) was not statistically significant (t-statistic= .681; 95% CI -8.56 to 5.59). For women, a small but significant increase was seen for physical activity over 12 months, from 49.3 ± 46.9 to 55.5 ± 56.7 (p<0.01; 95% CI -16.92 to -2.70).

Relationships between demographic, psychosocial correlates and physical activity

Table 4 shows Spearman correlations between the continuous demographic and psycho-social correlates related to physical activity at baseline and 12 months. Participants' age had a moderate negative correlation (ρ = -. 408; <0.01) with physical activity at baseline and 12 months. The age when participants finished full-time education (ρ = .109; <0.05), consequences (related to disease

condition) (ρ = .126; <0.05), showed a small significant positive association with physical activity at baseline and at over 12 months. Physical activity at baseline showed a strong significant positive association (ρ = .741; <0.01) with physical activity at 12 months.

Table 4 Spearman correlations between demographic, psychosocial variables and physical activity (n=478)

Predictors	1	2	3	4	5	6	7
Age at baseline	-						
Age at finished full time education	-.273**	-					
Consequences	-.232**	.054	-				
Treatment control	.059	.066	.029	-			
Anxiety	-.088	.044	.154**	-.122*	-		
Total physical activity METhrs/week (Baseline)	-.385**	.136*	.078	.111*	-.007	-	
Total physical activity METhrs/week (12 month follow-up)	-.408**	.109*	.126*	.068	-.026	.741**	-
** Correlation is significant at the 0.01 level (2-tailed).							
* Correlation is significant at the 0.05 level (2-tailed).							
The correlations were computed using list-wise category							

Table 5 depicts the associations between psycho-social correlates related to physical activity over 12 months.

Consequence (related to diabetes condition) The psychological correlate 'consequences' related to the participants' beliefs about seriousness and impact of diabetes on various aspects of their life was a significant positive predictor of Physical Activity METhrs./week over 1 year . The results shows that one unit increase in the belief about the consequences related to diabetes would increase physical activity by 8.98 units.

Treatment control was not found associated with physical activity at 12 months follow-up but small significant association was found with physical activity at baseline. Anxiety was not associated with both physical activity at baseline and 12 months follow-up. Treatment Control failed to predict physical activity. Hence, the hypothesis stating that consequences and Treatment Control related to diabetes are positively associated with physical activity was partially confirmed.

Anxiety did not predict physical activity. Hence the third hypothesis that anxiety is a negative predictor of physical activity was not confirmed.

Table 5 Associations between demographic, psychosocial correlates and physical activity over 12 months using linear univariate regressions (n=478)

Sr. No.	Predictors	Complete cohort			
		b-coefficient	Std. Error	95% CI	p-value
Demographic					
1.	**Age group (40-69) n = 478**	-1.185	0.352	-1.877 to -.493	**<0.001**
2.	**Sex n = 478**	4.602	5.399	-.015 to 15.219	**.395**
3.	**Education n = 470**	-1.007	4.537	-9.929 to 7.914	**.824**
4.	**Retired n = 461**	-40.489	5.887	-52.065 to -28.913	**<0.001**
5.	**Not working n = 461**	-39.885	9.059	-57.699 to -22.071	**<0.001**
6.	**House Ownership n = 470**	4.454	6.907	-9.129 to 18.037	**.519**
Related to diabetes					
9.	**Consequence n = 454**	8.988	3.933	1.253 to 16.723	**.023**
10.	**Treatment control n = 451**	-1.323	5.197	-11.545 to 8.898	**.799**
11.	**Anxiety n = 468**	**-.069**	**.228**	**-.517 to .379**	**.762**

**Physical Activity METhrs./week at baseline was adjusted for each model*
**N in the first column refer to the number of participants included in each Linear univariate regression model*
Each model explained 42 % to 45% of the variance in 12 months Physical Activity. The variance explained by this model was 51 %.

Predictors of Physical Activity at 12 months follow up

Among demographic variables, Age was a significant negative predictor of physical activity over year. Sex did not show any significant association with Physical activity over 12 months follow up. First hypothesis stating that there is a positive association between socio-demographic characteristics viz. age, sex, ethnic group and physical activity was not confirmed. With regard the psychosocial correlates, except for participants' perceptions about the consequences of diabetes, no significant associations with physical activity were found (Treatment control & Anxiety). Hence, second hypothesis stating that consequences and treatment control related to diabetes are positively associated with physical activity was partially confirmed. The third hypothesis stating that hypothesis that anxiety is a negative predictor of physical activity was also not confirmed by present findings. In the final multivariable regression model the significant covariate of physical activity over the year were

physical activity at baseline and current working status- retired and not working among demographic variables.

DISCUSSION

The key objective of the present study were (i) To determine probable causes of change in physical activity to enhance our understanding of the causal processes and to generate evidences for future interventions; (ii) To identify psychosocial covariates of self reported physical activity in recently diagnosed Type 2 diabetes cases. The subsequent paragraphs deal with the detailed discussion of results in relation to the hypotheses.

Demographic correlates of physical activity over the year

Based on the results of present study, the first framed hypothesis stating that, 'There is a positive association between socio-demographic characteristics viz. age, sex, ethnic group and physical activity' was not confirmed. Among all hypothesized demographic correlates of change in physical activity none were found to be significant predictors of physical activity over 12 months. The multivariable regression model suggested that age did not predict physical activity over 12 month's period. One possible explanation could be that the study participants were predominantly in the older age group. Therefore with the restricted age group of 40-69 years (mean age 59.2 years), no significant associations could be established with physical activity. Similar results have been reported by another study except male sex at baseline predicted increase in physical activity.[25] However, it is important to mention here that the univariate analysis suggested age to be a negative predictor of physical activity i.e. increasing age was associated with lower levels of physical activity. There have been studies which have reported younger age to be usually positively associated with the physical activity.[17,25] Notable differences were found in physical activity levels at both baseline and 12 months follow-up between males and females. Males were found to be more physically active as compared to females at both time intervals (baseline and one year follow-up). The results hence suggest that sex definitely appears to have influence on physical activity. The finding that lower physical activity levels are found among females in comparison to males is supported by various studies. Previous studies have demonstrated that middle-aged and older African American females are less active than both African- American and white males.[38, 39,40,41,42, 43]

The result suggests that physical activity was inversely related to being retired from work and not working. Considering these results it can be ascertained that people who are working fulltime or part-time end up doing more physical activities as compared to the persons who are not working. These results are also supported by other studies which have suggested that current working status is associated with physical activity.[17,23,39]

Psychosocial correlates of physical activity over the year

The second hypothesis stating that, 'Consequences and Treatment Control related to diabetes are positively associated with physical activity. Results of univariate regression analysis suggested that participants who reported that diabetes would have serious consequences were more likely to report higher physical activity over one year. These results are in line with a study [44], which found that participants who reported diabetes to be more serious or a greater risk to their health had better metabolic control at 3 – months follow-up. Based on the current results it can be ascertained the belief regarding the seriousness of disease condition has predicted physical activity over follow-up period. However, the same could not be established in the final multi- variate analysis model as consequence was not a significant predictor of physical activity over the year.

Moreover, in the present study the belief regarding treatment effectiveness (Treatment Control) in controlling the diabetes did not predict change in physical activity. However, this can be explained that longer than usual follow-up (12 months) may account for some differences found between the findings of this study and other studies. Maybe in comparatively shorter period the significant effectiveness of this psychological construct could be noticed. [30,44]

The third hypothesis stating that 'Anxiety is a negative predictor of physical activity' was not confirmed as no association was found between anxiety and change in physical activity. This result is in line with the studies which have found no clear

association between anxiety and physical activity.[12] So, it can be concluded that there may well be a relationship between anxiety and physical health but it was not found in the present study.

However, the findings of multivariable analyses reveal that physical activity measured at baseline was by far the strongest predictor of physical activity over 12 months. This suggests that the best covariate of future physical activity is past physical activity. This result is supported by existing studies.[12,45]

CONCLUSION

With regard to psychosocial correlates, except for participants' perceptions about the consequences of diabetes, no significant associations with physical activity were found Treatment control and Anxiety failed to predict physical activity. The result suggests that it is critical to further investigate the change in physical activity by including other variables related to demography, psycho-social and environment influences. Based on the available literature it is suggested that other factors which were found consistently associated with physical activity such as self efficacy, attitude, sensation seeking, family-friend social support, goal orientation, motivation should be studied. Hence, further research is required to identify more psychosocial covariates of behavior change related to physical activity.

Strengths of study

The data used for present study is from high quality RCT. There are limited studies regarding physical activity among people recently diagnosed with diabetes. The present study has provided opportunity to identify correlates related to physical activity among people recently diagnosed with diabetes. The identified predictors related to increase in physical activity will facilitate in targeting future interventions. The self reported measures used in the present studies are already tested for their validity and reliability. In the statistical analysis the difference due to responders and non responders were verified and no significant difference was noticed.

Limitations of study

The measures used in present study were self reported which may have caused measurement error and deliberation error and might have influenced the results. The study participants were predominantly Caucasian and therefore, the results should be interpreted with caution as they are not ethnically representative, hence may not be not generalized. Recall bias, response bias or social desirability bias may have affected present study. Selections bias may have creep in due participants volunteering for the present study. The measures used in present study were mainly self-reported and based on the capability of the study participants to understand respective items in different measures.

Recommendations for future research and public health intervention

The other possible covariates of physical activity related to demography, psycho-social and environment influences such physical environment, family-friend social support, annual income self efficacy, attitude, previous physical activity, current fitness level, diet, BMI, sensation seeking, goal orientation, motivation may be studied in future studies.

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