RESEARCH ARTICLE

PREDICTORS OF HEALTH BEHAVIOURS AMONG PEOPLE WITH RECENTLY DIAGNOSED TYPE 2 DIABETES

Rajesh Nair
Indian Institute of Public Health Delhi, Gurgaon, India

Correspondence to: Rajesh Nair (rnair@iiphd.org)

DOI: 10.5455/ijmsph.2013.2.378-389 Received Date: 05.01.2013 Accepted Date: 28.01.2013

ABSTRACT

Background: Behavioural interventions shown to be an effective strategy (in terms of changing behaviour among those at risk) for targeting multiple high risk behaviours in relation Type 2 diabetes. Physical activity plays an important role in the management of Type 2 diabetes.

Aims & Objective: The overall aim of study was to identify demographic and psychosocial predictors of change in self-reported physical activity and to identify targets for future interventions.

Material and Methods: Participants (N = 478) of this study were all randomized into the ADDITION Plus trial and were recruited from 36 practices in East Anglia region, in U.K. 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 present study is an observational cohort study. For the current study self-reported data regarding physical activity measured at baseline and one year were used and all demographic (age, sex, ethnic group, age finished full time education, current working status, socioeconomic status) and psychosocial (perceived behaviour control, intention) predictors were assessed at baseline. Linear univariate and multivariable linear regression analysis was used to quantify the associations between demographic and psychosocial correlates.

Results: Adjusting for baseline physical activity, only 'current working status' and 'physical activity at baseline' independently predicted physical activity at one year. No significant associations were found for any other correlates.

Conclusion: Present study found very few predictors of physical activity over the year. It is critical to further investigate the change in physical activity by including other correlates related to demography, psycho-social, environmental influences such as family support, physical environment etc. Present findings outline that being employed predicted physical activity over 12 months, accordingly it may be suggested that future interventions should be planned for retired, not working and employed people.

KEY-WORDS: Type 2 Diabetes; Physical Activity; Behaviour; Behavioural Control; Intention

Introduction

Worldwide diabetes is a major and growing health problem. The number of people with Type 2 diabetes is continuing to rise due to increasing incidence, rising numbers of elderly people (increased overtime), and better care and survival of people with clinically diagnosed diabetes, especially in developed countries.[1] In 2009 the number of people living with diabetes worldwide is estimated to be around 220 million (the estimated prevalence of diabetes for all age groups worldwide was 2.8% in year 2000 and 4.4% in 2030) out of which about 90% of cases concern Type 2 diabetes.[2] It is estimated that 20% of the current global diabetic population resides in the WHO South-East Asia Region alone and the number of diabetic population in the countries of the region is likely to triple by the year 2025.[3] In 2005 an estimated 1.1 million people died because of diabetes, out of which 80% diabetes-related deaths have occurred in less and medium industrialized countries.[2]

Behavioural interventions shown to be an effective strategy (in terms of changing behaviour among those at risk) for targeting multiple high risk behaviours in relation Type 2 diabetes.[6-12] The key aim of these interventions are to address high risk behaviour and delay the onset of diabetes or to manage complications among those diagnosed with disease.[4-6,12] The behavioural interventions which are focused on people living with Type 2 diabetes can lead to improved health outcomes.[7] However the results of trials suggests that effect of physical activity promotion interventions among people at high risk of diabetes remains invariably different may be

because of the fact that people at higher risk bring lesser amount of desired behaviour change in terms of overcoming their sedentary life style, smoking habit, change in dietary intake.[8-11,13]

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, e.g. walking, jogging, swimming etc.; (b) Frequency e.g. 3 times a week; (c) Duration e.g. 1 hour and (d) intensity e.g. 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."[14]

Objectives of the Study

1. To identify possible determinants of change in physical activity to increase our understanding of the causal processes and to inform which variables should be targeted in future interventions;
2. To identify predictors of change in self-reported physical activity in addition plus cohort, this may help to define target groups for future interventions.

The potential contribution of present study would be the identification of significant predictors of change in physical activity among people recently diagnosed with Type 2 diabetes. Meta-analysis and systematic reviews have suggested that numerous factors may affect the individual's participation for physical activity, including demographic, biological, psychological, emotional, social, cultural and environmental factor.[16,17,18,21,24,25] These studies have shown that the following factors are positively associated with physical activity - sex (being male), higher levels of education, ethnicity (Caucasians), 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. Older age, low socioeconomic status, drinking, smoking, depression, and perceived barriers were found to be negatively associated with physical activity. The demographic variables such as age, sex socio economic status and education have already shown to be the predictive of physical activity and but need to be further verified especially in case of people recently diagnosed with Type 2 diabetes.[15,16]

Few theory based programs (inclusive of correlates related physical activity) have played a pivotal role in diabetes management.[17] Theory-based interventions have found to be more effective in comparison to the non-theory-based intervention strategies.[29] However, it is critical to empirically assess the effectiveness of any theory-based approach prior to implementation at the field level. In the present study key dimensions of one theoretical frameworks- Theory of Planned Behaviour (TPB) was used to inform the choice of psychological predictors of physical activity among people living with Type-2 diabetes.[17-23] These theory based psychosocial correlates of change in physical activity could be helpful in identifying the significant independent predictors of physical activity. Meta-analytic evidence has shown that behavioural determinants such as-perceived behaviour control, intention, subjective norm based on the Theory of Planned Behaviour have the ability to predict behaviour.[13,18-21] As per these meta-analytic studies intention and perceived behaviour control are positive proximal cognitive predictors of physical activity.[13] The Theory of Planned Behaviour is an extension of the Theory of Reasoned Action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) and was designed to address the original model's limitations in predicting behaviours over which people have incomplete volitional control (partial control over the behaviour).[21] The Theory of Planned Behaviour is a social cognitive theory which has been widely examined to predict physical activity behaviour in different settings.[22] The theory proposes that behaviour is predicted by intention and also by perceived behavioural control to the extent that this matches actual control.[19] Intentions are indications of individual's willingness and effort to plan and perform the

behaviour. The performance of any behaviour is largely dependent on the degree of intention to engage in the behaviour. A stronger intention facilitates the performance of the behaviour. Intentions and perceived behavioural control account for considerable variance of actual behaviour.[13]

Hypotheses

1. There is a positive association between socio-demographic characteristics viz. age, sex, ethnic group and physical activity.
2. High social status, current work status and age finished full-time education is positive predictor of physical activity.
3. Intention and Perceived Behaviour Control are positive predictors of physical activity.

Materials and Methods

Design and Setting

The present study is an observational cohort study. The ADDITION Plus trail was comprised of practices nested within the intensive treatment arm of ADDITION- Cambridge study in the United Kingdom with screen detected Type 2 diabetes patients and clinically diagnosed patients within three years period from the ADDITION-Cambridge and non-ADDITION Practices. Additional practice sites (n=8) were added to increase the recruitment of recently diagnosed patients. The participants were recruited from 36 general practices in urban, suburban and rural Cambridgeshire, East Hertfordshire, West Suffolk and North Essex areas of England. 239 study participants out of 425 eligible screen detected patients from the ADDITION Cambridge study and similarly 239 study participants out of 684 patients clinically diagnosed within the previous 3 years were individually randomized to receive intensive treatment alone or in conjunction with a facilitator led individually tailored behaviour change intervention. Total 478 participants 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 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 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.[27] EPAQ2 was earlier validated using total energy expenditure and tested for repeatability twice with 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 has 88 items and the response scale with regard 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 time they had spent walking in different sections of their life at and at home, to work at work and walking for leisure. In the present study total physical activity MET hrs/week scores measured at baseline and 12 months have been used. For the measurement of selected psychosocial correlates of physical activity (perceived behavioural control and intention), a questionnaire was developed based on the Theory of Planned Behaviour.[19,20] Each construct was assessed with two items, measured on a 5-point Likert scale ranging from 'strongly disagree' to 'strongly agree'. The items for perceived behaviour control were: 'I am confident that I could be more physically active in the next 12 months, if I wanted to' and 'It would be difficult for me to be more physically active in the next 12 months even if I wanted to'. The items for measuring intention were: 'I intend to be more physically active in the next 12 months' and 'It is likely that I will be more physically active in the next 12 months'.

Statistical Analysis

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 also 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, perceived behaviour control, intention and physical activity. Cronbach's alpha reliability was assessed for the two items related to perceived control behaviour. Spearmen's correlation was used due to the distribution of variables. Spearmen's correlation was used to assess the relation between the continuously measured correlates of physical activity and physical activity. Linear regression models were used to identify the predictors 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

The dataset comprised of demographic and psycho-social correlates of behaviour 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, perceived behaviour control, intention 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 ADDITION Plus cohort are presented in Table 1.

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.

Table-1: Demographic Characteristics of the ADDITION Plus Cohort (Total Respondents=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

Table-2: Descriptive Analysis of Psychosocial Correlates of Physical Activity in the ADDITION Plus Cohort (n=478)

Predictors	Mean	SD	Range (approx.)
Perceived Behavioural Control	3.68	1.01	4
Intention	3.74	0.8	4
Physical Activity (Baseline)	78.83	72.00	489
Physical Activity (12 months follow-up)	76.93	64.46	404

Table-3: Descriptive Characteristics of the ADDITION Plus Trial Cohort (n=478), Stratified by Sex

Predictors	Men (n=298)				Women (n=180)			
	Mean	SD	Range	Missing Value	Mean	SD	Range	Missing Value
Age group (40-69)	58.9	7.5	30	0	59.6	7.4	30	0
Perceived Behavioural Control	3.7	1.0	4	8	3.5	1.0	4	5
Intention	3.8	0.8	4	9	3.7	0.8	4	6
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

Table-4: Spearman Correlations between Demographic, Psychosocial Variables and Physical Activity in the ADDITION Plus Cohort

Predictors	1	2	3	4	5	6
1. Age at baseline	-					
2. Age at finished full time education	-0.273**	-				
3. Perceived behavioural control (PBC)	-0.173**	0.188*	-			
4. Intention	-0.173**	0.109*	0.538**	-		
5. Total physical activity METhrs/week (Baseline)	-0.385**	0.136*	0.216**	0.214**	-	
6. Total physical activity METhrs/week (12 month follow-up)	-0.408**	0.109*	0.166**	0.198**	0.741**	-

The correlations were computed using list-wise category;
* Correlation is significant at the 0.05 level (2-tailed);
** Correlation is significant at the 0.01 level (2-tailed)

Table-5: Associations between Baseline Demographic, Psychosocial Correlates and Physical Activity over 12 Months in the ADDITION Plus Cohort using Linear Univariate Regressions

Predictors		Complete Cohort			
		b-coefficient	Std. Error	95% CI	p-value
Demographic	Age group (40-69) n = 478	-1.185	0.352	-1.877 to -0.493	<0.001
	Sex n = 478	4.602	5.399	-0.015 to 15.219	0.395
	Education n = 470	-1.007	4.537	-9.929 to 7.914	0.824
	Retired n = 461	-40.489	5.887	-52.065 to -28.913	<0.001
	Not working n = 461	-39.885	9.059	-57.699 to -22.071	<0.001
	House Ownership n = 470	4.454	6.907	-9.129 to 18.037	0.519
Psycho-Social	Perceived Behavioural Control n = 465	-0.525	2.486	-5.414 to 4.363	0.833
	Intention n = 463	3.971	3.251	-2.423 to 10.364	0.223

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

Level of Physical Activity and its Hypothesized Psychosocial Correlates

Mean (SD), range values of psychosocial correlates of physical activity (in terms of f 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. At baseline, participants had moderately strong perceived behavioural control (3.68 ± 1.01) regarding physical activity. Similarly, participants expressed a moderately strong intention to become more physically active (3.74 ± 0.8) within the next 12 months. 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).

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 shows the descriptive characteristics of ADDITION Plus cohort stratified by sex to see if there were any gender based significant differences among men (n=298) and women (n=180) in physical activity.

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. Similarly the scores for men and women regarding perceived control behaviour were 3.7 ± 0.9 and 3.5 ± 7.4 respectively. In the same way the mean scores for Intention for men and women was 3.8 ± 0.8 and 3.7 ± 0.8 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 = - 0.408; <0.01) with physical activity at baseline and 12 months. The age when participants finished full-time education (ρ = 0.109; <0.05), perceived behavioural control (ρ = 0.166; <0.01), intention (ρ = 0.198; <0.01), and Consequences (related to disease condition) (ρ = 0.126; <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 = 0.741; <0.01) with physical activity at 12 months.

Predictors of Physical Activity

To examine the main purpose of this study, univariate regressions were conducted in which physical activity at 12 months was regressed onto the hypothesized correlates, adjusting for baseline physical activity. Table 5 depicts the associations between the hypothesised demographic and psycho-social correlates related to physical activity over 12 months.

Demographic Predictors

Age was a significant negative predictor of physical activity over year. An increase in age was associated with a reduction in the Physical Activity over the year as the results of complete cohort depicts that one year increase in age would

lead to reduction in physical activity by 1.19 units (<0.001; 95% CI -1.88 to -0.49). As far as sex variable is concerned it was coded as 1 for male and 0 for female. The increase in this variable did not show any significant association with Physical activity over 12 months follow up. Hence the first hypothesis stating that there is a positive association between socio-demographic characteristics viz. age, sex, ethnic group and physical activity was not confirmed. Current working status was re-coded in three categories as working, retired and not working. The working category was used as reference category, thus, the 'retired' and 'not working' variables were included as dummy variables. Both dummy variables were significant negative predictor of physical activity. The second demographic variable of interest was educational level. The age at which participants finished full-time education failed to predict physical activity over the year. Third, house ownership was used as an indicator of high social economic status of the participants. However, in case of this variable too, there was no significant association with physical activity over the year. Therefore the second hypothesis that high social status, current work status and age finished full-time education is positive predictor of physical activity was partially confirmed.

Psychosocial Correlates

Perceived behavioural control and Intention did not emerge as significant predictors of physical activity. Therefore, the third hypothesis stating that Intention and Perceived Behaviour Control are positive predictors of physical activity was not confirmed.

Each model explained 42 % to 45% of the variance in 12 months Physical Activity. The Physical Activity at baseline accounted most of the variance in each model. After adjusting for all significant correlates in a multivariable regression model (Baseline physical activity METhrs./week, Age at baseline, retired, not working), baseline physical activity (β=0.47; 95% CI 0.390 to 0.564), being retired (β=-34.24; 95% CI -47.85 to -20.64) and not working (β=-37.36; 95% CI -55.35 to -19 38) remained as independent predictors of Physical Activity METhrs./week in this model. The variance explained by this model was 51 %.

Results Summary

As discussed above, to verify any significant difference between responders and non-responders at 12 months follow-up, T-tests were used for the following variables- age, sex, perceived behaviour control, intention and physical activity. No significant differences were noticed between responders and non-responders. No significant difference was observed in physical activity levels of the entire cohort of participants between baseline and 12 months follow-up period.

A significant difference was found between the two sexes on physical activity at both baseline and 12 months follow-up, with males being more physically active than females. No significant change was observed in the physical activity of males from baseline to 12 months follow-up. However, a significant positive change in physical activity could be noticed at the two intervals i.e. baseline and 12 months follow-up for females. Age was negatively correlated with physical activity. Age finished full time education, perceived behaviour control and intention show significant positive association with physical activity. Age and physical activity were negatively correlated. Age when participants finished full time education, Perceived Behavioural Control and Intention were positively correlated with physical activity at 12 months follow-up.

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. Both the dummy variables i.e. 'retired' and 'not working' in the current work status category were significant negative predictor of physical activity The age at which participants finished full-time education and house ownership used as an indicator of high social economic status of the participants failed to predict physical activity over the year. Therefore the second hypothesis that high social status, current work status and age finished full-time education is positive predictor of physical activity was partially confirmed.

With regard the psychosocial correlates no significant associations with physical activity were found (Perceived Behaviour control, Intention). Hence, third hypothesis stating that Intention and Perceived Behaviour Control are positive predictors of physical activity was not confirmed. In the final multivariable regression model the significant predictors 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 identify possible determinants of change in physical activity to increase our understanding of the causal processes and to inform which variables should be targeted in future interventions and (ii) To identify predictors of change in self-reported physical activity, which may help to define target groups for future interventions. Findings related to demographic and psychosocial correlates of change in physical activity are considered below.

Demographic Correlates of Physical Activity over the Year

The first hypothesis stating that, 'There is a positive association between socio-demographic characteristics viz. age, sex, ethnic group and physical activity' was not confirmed. None of the above hypothesized demographic correlates of change in physical activity 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 yrs), 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.[13]

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 associated with the physical activity.[13,16] However, the present study do not support Shanghai Women Health Study, a large population based cohort study that investigated associations between different types of physical activity (daily living, occupational, leisure-time, and commuting to work) in relation to risk of type 2 diabetes in middle-aged women.[36] Though in this regard it can be stated that this may be due to the cultural and ethnicity related differences. There was a notable difference 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.[29-32] Another study that examined approximately 167,000 African- American and white males and females between the ages of 18 and 75 in California reported a higher percentage of sedentary behavior in African-American women (67%) compared with men.[33]

Going further, there was no significant change found in the physical activity of men over the period of one year, but women showed a significant increase in their physical activity. These results are not in line with other studies which have reported that men were more likely than women to increase their physical activity and male sex was independently associated with significant increase in physical activity.[13,16,28] However, some studies have reported that overall no improvement noticed in the cohort regarding physical activity over follow-up period, may be due to ineffective intervention program.[6,34,35] This contention needs to be studied further using other variables as significant change in physical activity in case of women cannot be unnoticed. Considering that behaviour change is rooted in complex factors stabilized by relatively difficult to

change forces like ethnicity, this variable was included in the present study. However, the analysis revealed that the vast majority of participants were of Caucasian origin as compared to a marginal representation of Asians and Blacks, and hence there was no variability in the independent variable. Therefore, ethnicity could not be tested as a correlate of physical activity in the present study. Hence, nothing conclusive can be said about this variable as a correlate of physical change.

The second hypothesis stating, 'High social status, current work status and age finished full-time education are positive predictors of physical activity' was partially confirmed, as current working status independently predicted physical activity over the period of 12 months. The results show that being retired from work and not working was inversely related to physical activity. It can be inferred that people in employment either full time or part time were more likely to report high physical activity. These results are in line with the existing studies which suggests current working status is associated with physical activity.[15,16,35] The physical activity in case of working people occurs while moving from house to work place and within work place due to routine and unscheduled activities. One possible explanation may be that house ownership is not an appropriate single indicator of high social economic status. Other key variables such as annual income and social class also need to be assessed to better understand the association between socio-economic status and change in physical activity.

Psychosocial Correlates of Physical Activity over the Year

The third hypothesis stating that, 'Intention and Perceived Behaviour Control are positive predictors of physical activity', was not confirmed. The findings suggest that feeling confident to become more physically active may not actually translate into action. The present findings are supported by studies which have also suggested that perceived control about becoming more physical active over next year did not predict change in physical activity.[13,34] Furthermore, intention was not associated with change in physical activity. This suggests that strong intentions may not necessarily translate into action. This finding is consistent with studies which have also found that stronger intentions did not result in behaviour change to be more physically active.[13,34] These findings indicate that motivation for being physically active is not critical for execution and did not predict change in physical activity. However, with regard to the above mentioned two psychosocial variables namely Perceived behavior control and Intention, there are also studies which have found these to be important predictors of physical activity.[37,38] The differences in the results of present study and other studies in this area may also be because of longer than usual follow –up period. 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 predictor of future physical activity is past physical activity. This result is supported by existing studies.[13,34]

Conclusion

Present study found very few predictors of physical activity over the year. Adjusting for baseline physical activity, only 'current working status' and 'physical activity at baseline' independently predicted physical activity at one year. No significant associations were found for any other correlates. 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, previous physical activity, current fitness level, diet, BMI, sensation seeking, family-friend social support, goal orientation, motivation etc. can be studied. Hence, further research is required to identify predictors of behaviour change related to physical activity. Present findings outline that being employed predicted physical activity over 12 months, accordingly it may be suggested that future interventions should be planned for retired, not working and employed people.

Strengths of Study

The data used for present study is from high quality RCT. As the available literature suggests that 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 current available studies have looked into change in physical activity for shorter period of follow-up (e.g. 6 months), but the present study has corroborated results for over 12 months follow-up. The present study in one of the largest to look into the predictors of physical activity over one year. Hence, the estimates regarding the association between predictors and physical activity become more precise because of the large sample size. 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. Apart from collecting self-reported information from participants, advice to improve physical activity was also provided to the participants. Physical activity at baseline was controlled to avoid confounding.

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 and may not be not generalized. The objective measures related to physical activity may have also been analyzed along with self-reported measures. In spite of the fact that physical activity at baseline was adjusted in the linear Univariate and multivariable regression models, however there are still chances that unknown factors may have confounded the results and such residual confounders are difficult to control for. It is also possible that the unmeasured variables may also have confounded the results. Three principal forms of bias- recall bias, response bias or social desirability bias may have affected present study. The 'Perceived Behavioural Control' and 'Intention' two psychological constructs based on the Theory of Planned Behaviour (TPB) were essentially two-item construct.

Implications of Study

Present findings outline that being employed predicted physical activity over 12 months, accordingly it may be suggested that future interventions should be planned among retired, not working and employed people. The identified predictors would facilitate in developing effective intervention strategies to promote physical activity, and this would improve the case management of people living with diabetes in primary care and community settings. Appropriate psychological counselling can be arranged for the people recently diagnosed with diabetes based on the findings of present study.

Recommendations for Future Research and Public Health Intervention

1. The other possible predictors of physical activity related to demography, psycho-social and environment influences such physical environment, family support, annual income may be studied in future studies.
2. Interventions for improving physical activity for retired and not working people should be planned in the light of findings of present study (with caution).
3. Further systematic research is required to see more predictors such as self-efficacy, attitude, previous physical activity, current fitness level, diet, BMI, sensation seeking, family-friend social support, goal orientation, motivation etc.

ACKNOWLEDGEMENTS

I would like to sincerely thank Dr. Wendy Hardeman, Prof. Simon Griffin, Dr. Nicholas J. Wareham, Prof. Ann Louise Kinmonth, Prof. Stephen Sutton and also the entire team of ADDITION Plus at University of Cambridge, U.K. for providing me this dataset to perform this study during MPH course. I also would like to

thank all study participants and colleagues who contributed to this study. The MPH course was supported by a Wellcome Trust Capacity Strengthening Strategic Award to the Public Health Foundation of India and a consortium of UK Universities. I thank the editor and reviewers for constructive criticisms of earlier versions of this article.

References

1. Renders CM, Valk GD, Griffin S, Wagner EH, Eijk JT, Assendelft WJ.Interventions to improve the management of diabetes mellitus in primary care, outpatient and community settings. Cochrane Database Syst Rev 2001;(1):CD001481.
2. World Health Organization. Diabetes. WHO health topic on diabetes programs [Internet]. WHO. 2012. Available from: URL: http://www.who.int/mediacentre/factsheets/fs312/en/index.html
3. WHO. Health situation in the South-East Asia Region 1998-2000, SEARO, New Delhi. 2002.
4. Diabetes UK. Reports and statistics: Diabetes prevalence 2008. Available from: URL: http://www.diabetes.org.uk/Professionals/Publications-reports-and-resources/Reports-statistics-and-case-studies/Reports/Diabetes-prevalence-2008/
5. National Institute of Health. National diabetes statistics 2005. Available from: URL: www.diabetes.niddk.nih.gov/dm/pubs/statistics/index.htm
6. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM: Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. New England Journal Medicine. 2002; 346(6): 393-403.
7. Hardeman H, Johnston M, Johnston DW, Bonetti D, Wareham N J, Kinmonth A L. Application of the theory of planned behaviour change interventions: A systematic review. Psychology and Health. 2002; 17(2):123-158.
8. Taylor AH, Doust J, Webborn N. Randomised controlled trial to examine the effects of GP exercise referral programme in Hailsham, East Sussex, on modifiable coronary heart disease risk factors. Journal of Epidemiology Community Health. 1998;52(9):595-601.
9. Hillsdon M, Thorogood M, White I, Foster S. Advising people to take more exercise is ineffective: a randomised controlled trial of physical activity promotion in primary care. International Journal of Epidemiology. 2002;31(4):808-815.
10. Burton LC, Sharpio S, German PS. Determination of physical activity initiation and maintenance among community- dwelling old persons. Preventive Medicine. 1999;29(5):422-430.
11. King AC, Marcus B, Ahn D, Dunn AL, Rejeski WJ, Sallis JF, et al. Identifying subgroups that succeed or fail with three level of physical activity intervention: the activity counseling trial. Health Psychology. 2006;25(3):336-347.
12. Norris SL, Engelgau MM, Narayan KMV. Effective of Self Management Training in Type 2 Diabetes- A systematic review of randomized control trials. Diabetes Care. 2001;24(3):561-87.
13. Simmons RK, Sluijs E, Hardeman W, Sutton S, Griffing SJ. Who will increase their physical activity? Predictors of change in objectively measured physical activity over 12 months in the ProActive cohort. BMC Public Health. 2010;10:3-9.
14. Fox KR, Riddoch C. Charting the physical activity patterns of contemporary children and adolescents. Proceedings of the Nutrition Society. 2000;59(4):497-504.
15. Sallis JF, Owen N. Ecological models of health behaviour. In: health behaviour and health education: theory, research, and practice 3rd edi. Jossey-Bass. Dan Franscisco: CA. 2002. p. 462-484.
16. Trost SG, Owen N, Baumen AE, Sallis JF, Brown W. Correlates of adults participants in physical activity: review and update. Medicine & Science in Sports & Exercise. 2002;32(12):1996-2001.
17. Symons Downs D, Hausenblas HA. The theories of reasoned action and planned behaviour applied to exercise: A meta-analytic update. Journal of Physical Activity and Health. 2005;2(1):76-97.
18. Hagger MS, Chatzisarantis NLD, Biddle SJH. A meta-analytic review of the theories of reasoned action and planned behaviour in physical activity: Predictive validity and the contribution of additional variables. Journal of Sport & Exercise Psychology. 2002;15:151-161.
19. Ajzen I. The theory of planned behaviour. Organizational behaviour and human decision processes. 1991;50:179-211.
20. Armitage CJ, Conner M. Efficacy of theory of planned behaviour. Organizational behaviour and human decision Processes. 1991;50:471-499.
21. Symons Downs D, Hausenblas HA. Elicitation studies and the theory of planned behaviour: a systematic review of exercise beliefs. Psychology of sports and exercise. 2005;6(1):1-31.
22. Conner M, Sparks P. Theory of planned behaviour and health behaviour. In predicting health behaviour. Edited by Conner M, Norman P: Open University Press. 2005:171-222.
23. Dzewaltowski DA, Noble JM, Shaw JM. Physical Activity participation: Social cognitive theory versus the theories of reasoned action and planned behaviour. Journal of Sport & Exercise Psychology. 1990;12:388-405.
24. Plontikoff R, Lippke S, Courneya K, Birkett N, Sigal R . Factors associated with physical activity in Canadian adults with diabetes. Medicine & Science in Sports and Exercise. 2006;38(8):1526-1534.
25. Steed L, Debby C, Newman S. A systematic review of psychological outcomes following education, self-management, and psychological interventions in diabetes mellitus. Patient Education and Counselling. 2003;51:5-15.
26. Michie S, Abraham C. Identifying techniques that promote health behaviour change: Evidence based

or evidence inspired? Psychology & Health. 2004;19:29-49.
27. Olivarius NF, Beck-Nielsen H, Andreasen AH, Horder M, Pedersen PA. Randomised controlled trail of structured personal care of type 2 diabetes mellitus. British Medical Journal. 2001;323:970-975.
28. Ainsworth BE, Keenan NL, Strogatz DS, Garret JM, James SA. Physical activity and hypertension in black adults: the Pitt County study. American Journal of Public Health. 1991;81:1477-1479.
29. Folsom AR, Cook TC, Sprafka JM, Burke GL, Norsted SW, Jacobs DR. Differences in leisure-time physical activity levels between blacks and whites in population based samples: the Minnesota heart survey. Journal of Behaviour Medidicne. 1990;14:1-9.
30. Washburn RA, Kline G, Lackland DT. Leisure-time physical activity: are there black/white differences? Prevalence Medicine. 1992;21:127-135.
31. Wing RR, Kuller LH, Bunker C, Matthews K, Caggiula A, Meihlan E, et al. Obesity, obesity-related behaviors and coronary heart disease risk factors in black and white premenopausal women. International Journal of Obesity. 1989;13:511-519.
32. Adams LL, LaPorte RE, Haile GT, Kuller LH. Sex differences in high-density lipoprotein cholesterol and sub fractions among young black adults. Prevalence Medicine. 1986;15:118-126.
33. Hardeman W, Kinmonth AL, Michie S, Sutton S. Impact of a physical activity intervention program on cognitive predictors of behaviour among adults at risk of Type 2 diabetes (ProActive randomised controlled trial). International Journal of Behavioural Nutrition and Physical Activity 2009;6(16):1-10.
34. Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Llane-Parikka P, et al. Prevention of Type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. New England Journal of Medicine.2001;344(18):1343-50.
35. Hagger MS, Chatzisarantis NLD, Biddle SJH. A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: predictive validity and the contribution of additional variables. Journal of Sport and Exercise Psychology. 2002;24:3-32.
36. Hausenblas HA, Carron AV, Mack DE. Application of the theories of reasoned action and planned behavior to exercise behavior: A meta-analysis. Journal of Sport & Exercise Psychology.1997;19:36- 51.

Cite this article as: Nair R. Predictors of health behaviours among people with recently diagnosed Type 2 diabetes. Int J Med Sci Public Health 2013; 2:364-375.
Source of Support: Nil
Conflict of interest: None declared