Article published online: 2022-05-23

ORIGINAL ARTICLE

Effectiveness Of Walking With Pedometer And Heart Rate Monitor On The Quality Of Life And Wellbeing In Asian Indians With Type 2 Diabetes

S. Shenoy*, R. Guglani, JS Sandhu

Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar

*Corresponding author: Shweta Shenoy Email: shwet1999@yahoo.com
Published: 05 September 2009
Ibnosina Journal of Medicine and Biomedical Sciences 2009, 1(2):46-57
Received 15 June 2009
Accepted 22 July 2009
This article is available from: http://www.ijmbs.org

Abstract

Introduction: The objective of the study was to analyze the effect of an eight week walking program using a pedometer and heart rate monitor (HRM) for evaluating exercise intensity compared with walking alone on quality of life and general wellbeing (GWB) in Asian Indians with type 2 diabetes.

Methods: Forty adults with type 2 diabetes were randomly assigned to an eight week supervised program of walking alone (group A) and walking using pedometer and HRM (group B). A suitably designed and validated questionnaire was administered before and after eight weeks of training for all patients to assess the quality of life (ADDQoL-19) and general wellbeing (W-BQ12).

Results: At the end of the study, quality of life and general wellbeing scores were found markedly improved in both the groups. In group A, a statistically significant reduction was noted for seven items and in group B a statistically significant reduction was seen in eleven items of the quality of life questionnaire.

General wellbeing scores were improved in both groups by 26.2% in group A and 28.8% in group B (P<0.05).

Conclusion: Walking using a pedometer and heart rate monitor for assessing exercise intensity and motivation was found more effective than walking alone in improving quality of life and general wellbeing for Asian Indians with type 2 diabetes.

Key Words – Type 2 Diabetes, Pedometer, Heart Rate Monitor, Quality of life, General Wellbeing

Inroduction

The incidence and prevalence of type 2 diabetes is increasing worldwide. India is facing an epidemic of diabetes. According to the Diabetes Atlas published by the International Diabetes Federation (IDF), there were an estimated 40 million persons with diabetes in India in 2007, a number predicted to rise to almost 70 million by 2025[1]. There is a relationship between depression and diabetes, as past researches have shown that depression has been associated with hyperglycemia, diabetes related complications, and perceived functional limitations of diabetes [2]. Depression not only adversely affects the quality of life of diabetic patients, but also affects treatment adherence and glycemic control [3].

Diabetes can affect a person's quality of life and Rubin, et al, 2000 [4], called it 'Diabetes Overwhelmus.' They felt this leads to diminished self care, which in turn leads to worsened glycemic control, increased risk for complications, and exacerbations of 'diabetes overwhelmus' in both the short and long term situations. Although psychological wellbeing is an important goal of diabetes management, little attention is given to the psychological implications of this disease [3]. HU Frank (2003) reported that 'walking is the best medicine for diabetes' [5]. Walking interventions can be effective in reducing weight, body mass index, waist hip circumference, body fat, blood pressure, and thus cholesterol and high density lipoproteins ratios and may be effective in improving mood and quality of life [6].

Regular physical activity reduces the risk of diabetes and improves overall physical, emotional and social wellbeing. This leads to enhanced quality of life and wellbeing by reducing depression and anxiety. Croteau, et al (2007), reported that psychology plays a major role in determining if people are successful with goals in the long term. Motivation is the act or process toward a desired goal. Pedometers which measure walking activity in the form of daily step counts while also serving as a motivator, have become popular components of physical activity intervention [7]. Heart Rate Monitor (HRM) is a tool for monitoring the accurate intensity of exercise program thus helping to achieve the right exercise intensity [9], and at the same time providing ongoing fitness motivation [8].

Quality of life issues are crucially important because they may be powerful predictors for an individual's capacity to manage his disease and maintain long term health and wellbeing. ADDQoL – 19 is a 19 item disease specific instrument designed to measure individual perception of the impact of diabetes on health status and this instrument has been validated (Prof. Bradley, Royal Holloway, University of London) for Asian Indians. Therefore, the present study was designed to compare the effect of walking with pedometer and monitoring heart rate with the help of HRM on the quality of life and wellbeing compared to walking alone in Asian Indians with type 2 diabetes.

Materials and Methods

The prospective randomized control study was conducted at the Guru Nanak Dev University, Amritsar during the period from August to October, 2008.

Participants – Forty type 2 diabetic outpatients (13F, 27M) participated in this study recruited from Amritsar. Before the study, all participants were informed about the purpose and the procedures of the study and signed informed consents to participate. The study was given approval by the Medical Ethics Committee of Guru Nanak Dev University, Amritsar.

Procedure - Eligible participants were diagnosed with type 2 diabetes, aged between 40 – 70 years, not taking insulin, without physical limitations, not currently enrolled in another physical activity program, with duration of diabetes between one to ten years. Subjects underwent a physical examination and medical screening to exclude individuals with subjective or objective evidence of coronary artery disease, uncontrolled hypertension, advanced retinopathy or neuropathy, severe orthopedic/cardiovascular/respiratory conditions restricting physical activity.

Subjects were recruited from Amritsar and randomly assigned to one of the following two groups by a random lottery approach: walking alone group (Group A- control group), walking group using pedometer and HRM (Group B-experimental group). In group B the aim was to achieve a target of 150 min/week moderate intensity of aerobic physical activity (50%-70% of maximum heart rate) [10] through a walking program.

In Group A, subjects were engaged mainly in a comfortable pace walking activity alone for 30-40 minutes/day 5 days a week. For Group B, a pilot study was conducted to obtain an estimate of the average number of steps participants could walk at a comfortable pace in 30 min. This was approximately 3000 steps/session at 50%-60% of maximum heart rate for most subjects. A few initial sessions for familiarization with pedometer and heart rate monitor were given to all subjects in Group B until they could self-monitor physical difficulty and relate this to the intensity effort. Subjects were then taught to adjust the intensity of the activity by speeding up or slowing down the speed of walking. Thus our walking program began at a 3000 step count approximately and ranged between 50%-60% of maximum heart rate. Progression was to achieve a max of 4000 steps in 35-40 minutes up to 70% of maximum heart rate in eight weeks.

Subjects were tested on two occasions using identical protocols. Baseline measurements were taken before randomization. Post study, all measurements were taken again.

In Group B subjects were given a time schedule and were asked to walk on regular basis of five days a week with pedometer and HRM. A diary was maintained for all Group B participants in which we noted RHR and step count for each session. Blood pressure was also monitored before and after exercise in both the exercising groups. Subjects were also given information about dietary composition and on adherence about the exercise protocol. Subjects were advised regarding eating one to two hours before exercise to avoid hypoglycemia, maintaining hydration levels, and signs and symptoms of hypoglycemia.

Measurements – The Audit of Diabetes Dependent Quality of Life (ADDQoL 19) and Wellbeing questionnaire (W-BQ12) was used to assess the quality of life and wellbeing in all study participants at pre and post intervention. Special permission was sought from the author of the questionnaire to use the ADDQoL 19 English for S. Asian (Indian) and wellbeing questionnaire (W-BQ12) English for India.

ADDQoL – 19 - The questionnaire includes 19 life domain specific items to be scored between (-9 to +9) depending on impact of diabetes on the quality of life. The quality of life questionnaire included a number of different life domains that may be variously impacted by diabetes, and of varying importance. The product of impact and importance of life domains is the total quality of life score of that domain. Two overview items was also there to determine generic 'present QoL' overview item 1(OV1) and diabetes specific 'impact of diabetes on QoL' overview item 2 (OV2). W-BQ12 – The W-BQ12 was used as assessment tool to determine an individual's psychological wellbeing over time. It includes 12 items to determine general wellbeing (GWB), positive wellbeing (PWB), negative wellbeing (NWB) and energy on a scale from 0 (not at all) to 3 (all the time) for type 2 diabetic patients.

Statistical Analysis

Standard Statistical methods were used for calculations and standard deviation; Results are reported as group mean ± standard deviation.

By using the student't' test panel of significance was calculated. Post training was compared between groups by using 'unpaired't test. Statistical tests were performed using SPSS Software (SPSS 14.0, registered evaluation version from www.spss.com). Statistical significance of the change in results, from pre-study to the post study is indicated at $P \leq 0.05$ level.

Results

There were 40 type 2 diabetic subjects (13 F, 27 M). Subjects matched according to age and sex. Mean ages were similar in both the groups [Table 1]. All participants completed the study by participating in the eight week training program. Differences existed in post study results of quality of life and wellbeing between both groups.

ADDQoL-19 – The pre and post intervention changes in average scores of each group were observed. Groups A and B both showed statistically significant reductions in the impact of diabetes on quality of life after eight weeks of the training program [Table 2]. In group A, statistically significant reductions were noted for the following items: things I could do physically ($P<0.05$), family life ($P<0.05$), close personal relationships ($P<0.05$), physical appearance ($P<0.05$), motivation ($P<0.05$), future worries ($P<0.05$) and freedom

Table 1: Demographic data of both groups

	Group A	Group B
Number (M/F)	20 (12 M/ 8 F)	20 (15 M/ 5F)
Age (Years)	51.5	53.15
Duration of diabetes (Years)	5.1	5.3

 ISSN: 1947-489X

Table 2: Paired t-test of ADDQoL-19 pre and post in control and experimental group.
*p<0.05, NS- Nonsignificant

Items		Group A Mean ± SD	t-value	Group B Mean ± SD	t-value
1. Leisure activities	Pre test	-2.5±1.6	1.7NS	-2.6±1.7	2.6*
	Post test	-2.25±1.4		-2.2±1.4	
2. Working life	Pre test	-2.5±1.9	2.1*	-2.7±1.8	3.1*
	Post test	-2.1±1.4		-2.0±1.2	
3. Long distance journeys	Pre test	-1.4±1.5	.62NS	-1.1±1.4	1.4NS
	Post test	-1.6±1.7		-95±1.1	
4. Holiday	Pre test	-2.0±2.1	1.4NS	-2.5±2.5	1.7NS
	Post test	-1.8±1.9		-2.2±1.9	
5. Do physically	Pre test	-4.2±2.6	3.4*	-3.2±3.0	3.8*
	Post test	-3.3±1.9		-2.0±1.9	
6. Family	Pre test	-2.9±2.07	2.4*	-3.0±2.1	4.3*
	Post test	-2.4±1.79		-2.0±1.6	
7. Friendship and social life	Pre test	-2.4±2.1	—	-2.7±2.3	—
	Post test	-2.4±2.1		-2.7±2.3	
8. Close personal relationship	Pre test	-2.7±1.9	2.1*	-2.6±2.0	1.8NS
	Post test	-2.3±1.6		-2.3±1.8	
9. Sex Life	Pre test	-2.7±2.2	1.8NS	-3.4±1.9	2.1*
	Post test	-2.4±1.8		-3.0±1.5	
10. Physical appearance	Pre test	-2.8±2.2	2.1*	-3.3±2.6	2.1*
	Post test	-2.3±1.6		-2.8±2.1	
11. Self confidence	Pre test	-2.9±2.3	1.4NS	-2.8±2.9	3.0*
	Post test	-2.5±1.8		-1.7±1.5	
12. Motivation	Pre test	-2.1±1.7	2.1*	-2.3±2.2	2.2*
	Post test	-1.7±1.5		-1.6±1.3	
13. People general reaction	Pre test	-1.8±1.3	—	-1.3±2.3	—
	Post test	-1.8±1.3		-1.3±2.3	
14. Future worries	Pre test	-3.2±1.3	2.5*	-3.1±3	2.5*
	Post test	-2.7±.9		-2.3±2.1	
15. Financial situation	Pre test	-1.8±1.2	.0NS	-1.6±2.7	1.7NS
	Post test	-1.8±1.4		-1.3±2.0	
16. Living conditions	Pre test	-2.6±1.4	1.8NS	-3.1±2.8	2.1*
	Post test	-2.3±1.3		-2.6±2.0	
17. Dependence	Pre test	-1.9±1.7	1.0NS	-1.5±2.5	1.0NS
	Post test	-2.0±1.9		-1.4±2.1	
18. Freedom to eat	Pre test	-4.9±1.6	2.6*	-4.9±2.9	2.1*
	Post test	-4.2±1.6		-4.3±2.2	
19. Freedom to drink	Pre test	-2.9±2.3	1.3NS	-2.6±2.7	.78NS
	Post test	-2.7±2.4		-2.2±2.4	
20. Over view item 1	Pre test	.90±0.64	2.0 NS	.80±.69	4.9*
	Post test	1.1±0.58		1.4±.51	
21. Over view item 2	Pre test	-1.4±0.88	2.5*	-1.5±1.0	3.0*
	Post test	-1.15±0.67		-.80±.69	

Table 3: Paired 't' test of positive well being, energy, negative wellbeing and general wellbeing for control group *p<0.05.

Well - Being	Control Group	Mean	SD	t-value
Positive well being	Pre test	8.2	2.0	4.3*
	Post test	9.5	1.1	
Energy	Pre test	6.6	2.1	6.3*
	Post test	8.7	1.1	
Negative well being	Pre test	6.4	2.9	6.7*
	Post test	4.7	2.6	
General well being	Pre test	20.2	5.1	8.5*
	Post test	25.5	3.4	

Table 4: Paired t test of positive well being, energy, negative wellbeing and general wellbeing for experimental group (*p<0.05).

Well - Being	**Control Group**	**Mean**	**Standard Deviation**	**t-value**
Positive well being	Pre test	8.5	1.8	5.9*
	Post test	10.4	1.5	
Energy	Pre test	7.0	2.2	6.4*
	Post test	9.6	1.3	
Negative well being	Pre test	5.0	3.4	5.6*
	Post test	3.2	2.6	
General well being	Pre test	22.5	5.5	8.6*
	Post test	29.0	3.8	

Table 5: Comparison of PWB, Energy, NWB and GWB pre and post in experimental and control group
*p<0.05, NS – Non significant

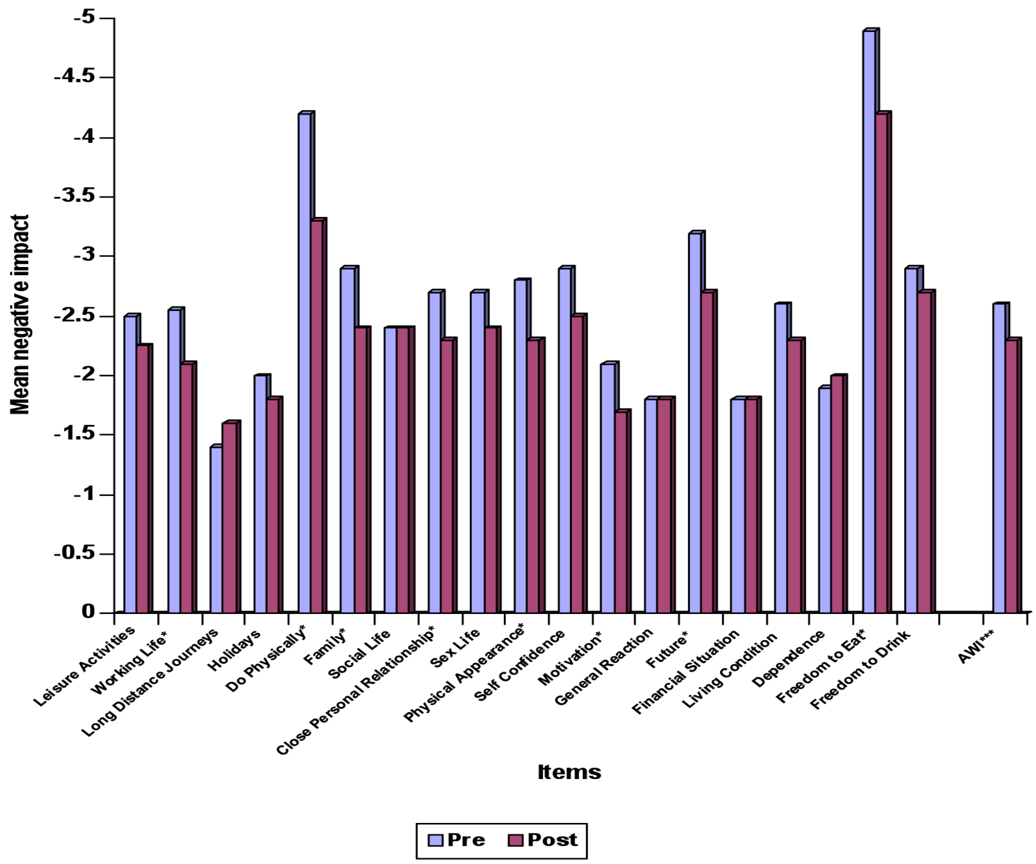
Well-Being		Group	Mean	Std. Deviation	t-value
Positive well being	Pre test	Experimental	8.5	1.8	0.4NS
		Control	8.2	2.0	
	Post test	Experimental	10.4	1.5	2.0*
		Control	9.5	1.1	
Energy	Pre test	Experimental	7.0	2.2	0.57NS
		Control	6.6	2.1	
	Post test	Experimental	9..6	1.3	2.2*
		Control	8.7	1.1	
Negative well being	Pre test	Experimental	5.0	3.4	1.4NS
		Control	6.4	2.9	
	Post test	Experimental	3.2	2.6	1.8NS
		Control	4.7	2.6	
General well being	Pre test	Experimental	22.5	5..5	1.3NS
		Control	20.2	5.1	
	Post test	Experimental	29.0	3.8	.56*
		Control	25.5	3.4	

Table 6: Steps and RHR per week in experimental group

	Steps	RHR
Week 1	3292	82.75
Week 2	3587	82.61
Week 3	3696	80
Week 4	3830	79.7
Week 5	3935	78.6
Week 6	4045	77.1
Week 7	4170	75.9
Week 8	4277	74.5

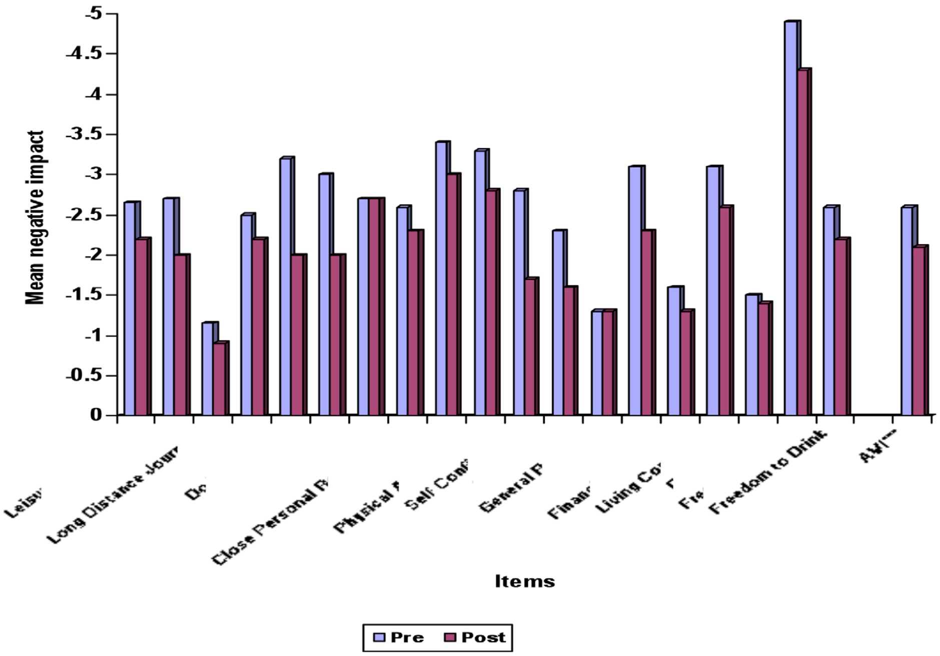
to eat (P<0.05) [Fig 1]. There were statistically significant decreases in thes negative impact of diabetes in overview item two after eight weeks of training in group A [Fig 3]. For group B, statistically significant reductions were seen in leisure activities (P<0.05), working life (P<0.05), things I could do physically (P<0.05), family life (P<0.05), sex life (P<0.05), physical appearance (P<0.05), self confidence (P<0.05), motivation (P<0.05), future worries (P<0.05), living conditions (P<0.05) and freedom to eat (P<0.05) [Fig 2]. Both overview item one (P<0.001) and overview item two

Fig 1: Impact of diabetes on individual life domains pretraining and post training in group A



(P<0.01) also showed statistically significant reductions in group B [Fig 4]. The Average Weighted Impact (AWI) also showed statistically significant decrease by (-2.6±.19 to -2.3±.13) in group A and (-2.6±.19 to -2.1±.17) in group

Fig 2: Impact of diabetes on individual life domains pretraining and post training in group B



B. 'Unpaired t' test showed nonsignificant results for post training quality of life in between groups.

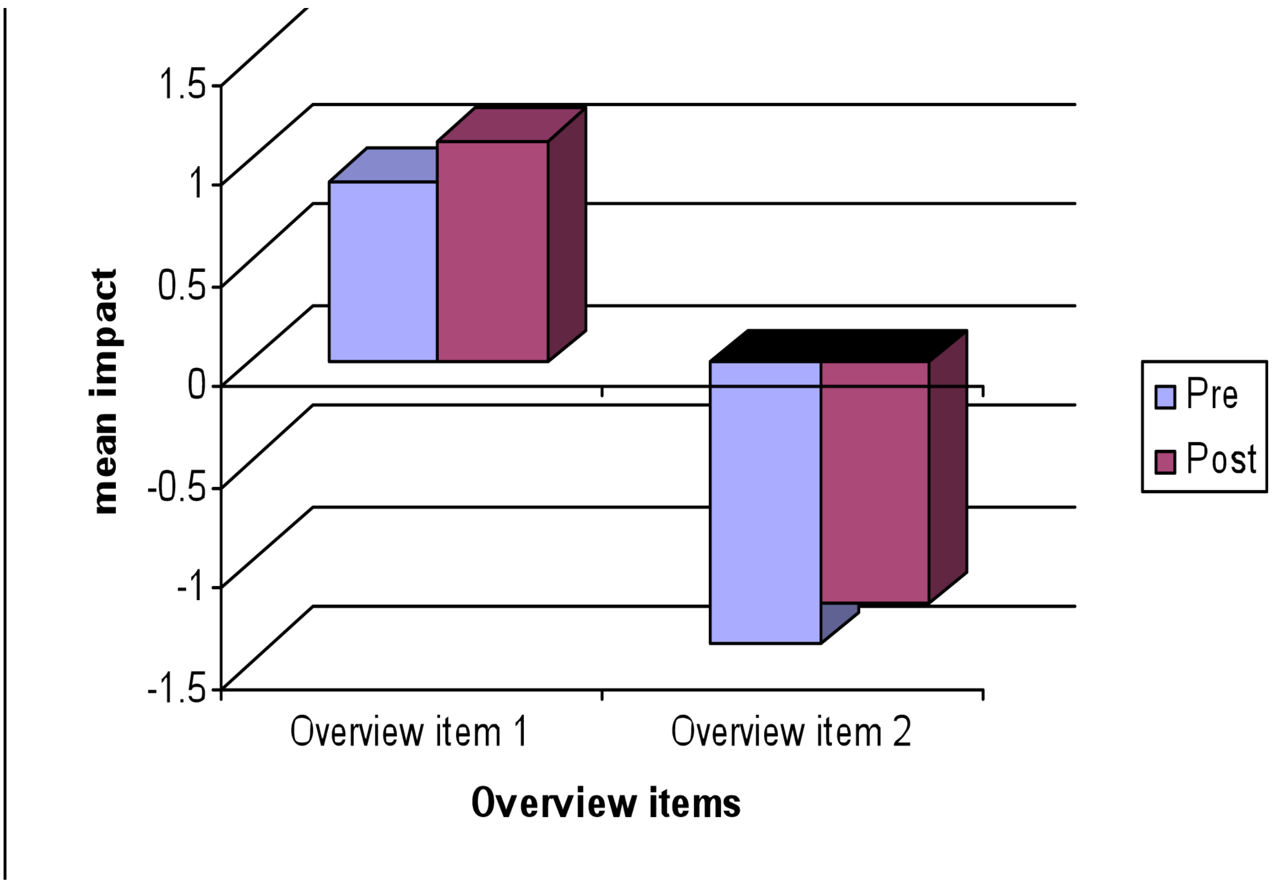
General wellbeing (GWB) - There were changes in GWB scores in both the groups with a 26.2 % increase in group A (P<. 001) and 28.8% (P<. 001) increase in group B [Tables 3 and 4]. There was significant improvement in positive wellbeing and energy in both groups. 'Unpaired t' test showed highly significant results after the eight week training in between groups [Table 5].Table 6 showing the steps and resting heart rate per week in group B.

Discussion

Type 2 diabetes constitutes 95% of the diabetic population in India and this high incidence is mainly due to sedentary lifestyle, lack of physical activity, obesity, stress, and consumption of diets rich in fat, sugar, and calories that lead India to earn the title of 'the diabetes capital of the world' [11]. Many studies have reported a worse quality of life for people with diabetes compared to the general population, especially regarding physical functioning and wellbeing [4]. Diabetes leads to an array of disabling complications and Edward, et al, 2003 [12], stated that walking and other

 ISSN: 1947-489X

Figure 3: Impact of diabetes on QoL pre- training and post training in group A.

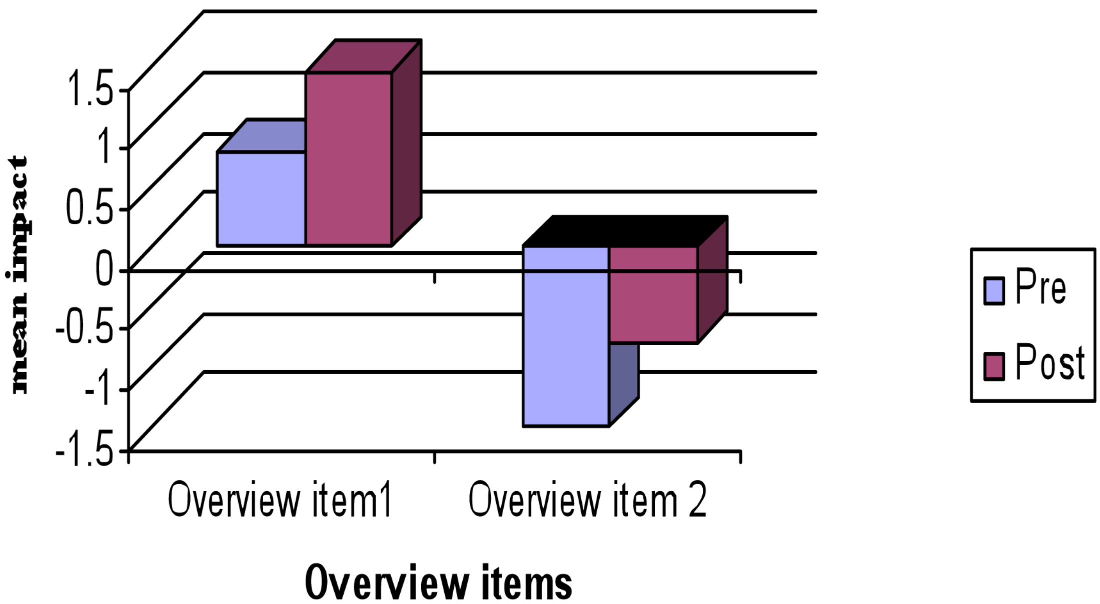


forms of exercise were key components of lifestyle changes shown to prevent progression to diabetes among people with impaired glucose tolerance.

Research has suggested that the pedometer may be an effective motivational tool to promote walking [6] since it promotes healthy life style changes that include daily physical activity. It results in significant improvements in plasma glucose and reduce cardiovascular risk in type 2 diabetic patients [13]. The heart rate monitor (HRM) is a tool that helps determine a safe and effective exercise heart rate zone by accounting for current physical condition of the subjects.

 ISSN: 1947-489X

Figure 4: Impact of Diabetes on QoL pre-training and post-training in group B.



In this study we aimed to achieve around 4000 steps/session after an eight week training program in Group B. Subjects exercising thus safely moved out of their sedentary zone and could derive benefits from being physically active.

Health care professionals are become increasingly aware of the need to assess and monitor the quality of life as an important outcome measure of diabetic care [14]. Literature contains evidence that certain interventions, such as blood glucose–lowering medications or new insulin delivery systems together with education and counseling designed to improve coping skills for diabetics can improve not only glycemic control but quality of life [4]. Quality of life is an important outcome in its own right, representing the ultimate goal of all healthcare interventions [15]. The awareness of and focus on physical activity to improve quality of life in the control of diabetes and its complications currently is lacking in India as well as in other parts of Asia.

Therefore the present study was designed to investigate the effect of HRM and pedometer to monitor and motivate patients for walking at a moderate intensity compared with walking alone on the quality of life and wellbeing. To the best of our knowledge, this study may be the first to explore the effectiveness of walking with pedometer and HRM on the quality of life of type 2 diabetics.

Exercise training and quality of life

The ADDQoL-19 was used to assess changes in quality of life of patients in this study population. In our observations we found that all domains in the questionnaire were affected by diabetes. Interestingly enough, we also discovered that the most commonly affected domain of quality of life in this population was 'freedom to eat' at baseline in both groups. Costa, et al (2006) [16], found the domain 'freedom to eat' revealed the greatest negative impact in diabetic patients in the Portuguese population. Adepu, et al, (2007) [17], found the most commonly affected domains of quality of life were freedom to eat, to drink, and to enjoy food, followed by family life and sex life among Indians. Harsimran, et al (2006) [14], reported that in India self confidence was generally affected to a greater extent by diabetes while family life was more negatively impacted. All aspects of life were negatively impacted to a great degree [146]. After eight weeks of intervention, we found a significant decrease in the negative impact of nearly all domains in both groups. Group A showed a statistically significant decrease in the seven domains (Fig 1) [Table 2], and group B showed a statistically significant decrease in 11 domains (Fig2)[Table 2]. In terms of percentage of average weighted impact (AWI), group A showed an 11.5% decrease while group B showed a 19.2% decrease in the negative impact of diabetes on quality of life. There was an improvement in the present 'quality of life' and a decrease in the negative 'impact of diabetes on quality of life' in groups A and B. However, an increase was seen in group B compared to group A (Fig 3 and Fig 4). Our study revealed that a walking intervention together with pedometer and HRM monitor significantly improved quality of life in the patients we studied. Although the improvement in quality of life in our study was statistically not significant between groups, the improvement was clinically significant when measured on a long term basis.

Exercise training & psychological wellbeing

Psychological wellbeing is an important factor for people with diabetes and their healthcare providers. Diabetes leads to diminished self-care, which in turn leads to worsened plasma glucose and increased risk of complications. Emotional wellbeing should be monitored in diabetes care [18]. Poor well-being impedes self-care in this population, Adaptational tasks in chronic illness (coping), maintenance of emotional balance after diagnosis (loss of health, self-esteem), coping with physical complaints and functional limitations, maintenance of social roles and cope with negative labeling (stigma) [19]. In this study, the percent decrease for negative wellbeing was 26.5% and 36% respectively in groups A and B. The percent increase for energy and positive wellbeing was 31.8% and 15.8% respectively in group A and 37%, 22.3% for group B respectively. There was an improvement in General wellbeing in both the groups by 28.8% in group B and 26.2% change improvement in group B.

The decreased improvement in group A is worth noting. We hypothesized that group B would benefit by regular monitoring and our results supported this. Improvement in all the 3 parameters was seen in both groups though group B did have increased scores. It is possible that this group may find greater reassurance by using the HRM and pedometer. Physiologically it has been postulated that the release of monoamines and endorphins with physical activity are responsible for the effects of physical activity on mental health. Peluso, et al (2005), reported that monoamines act similarly to antidepressant drugs, and endorphins are responsible for both sensation of calm and improved mood experienced after exercise [20]. Thus both exercising groups did improve.

The positive and important role of exercise in enhancing the quality of life, positive wellbeing, and energy cannot be ignored and indeed is as important as improvement in any physiological parameter. To our knowledge, no other study has used HRM and pedometer together for monitoring the quality of life in diabetes. Other activities have reported the use of pedometer alone, but they have not used a control group in an exercise program such as ours.

Therefore, it can be concluded that monitoring psychological wellbeing and quality of life is recommended in patients with diabetes.

Strength of the present study –A perusal of relevant literature indicates that a combination of pedometer and HRM has been used for the first time in a study of physical activity in type 2 diabetes. We used a control group to compare improvement using exercise with the above mentioned tools, and psychological evaluation using a quality of life and well being scale to measure outcomes.

The present study has some Limitations-

1. Training period was short.
2. Sample size was small.

Despite these limitations our study documents and lends support to the effectiveness of walking in improving quality of life and general wellbeing regardless of the method of monitoring the intensity. Accurate monitoring of the diabetic patients in the cut off zone of 50% to 70% maximum heart rate has enabled us to accurately quantify the intensity of activity and thus all benefits observed in the patients can be attributed to this particular intensity of exercise.

Conclusion

The results of our study clearly reveal that walking using pedometer and heart rate monitor affects quality of life and wellbeing to a greater degree than walking alone.

Competing Interests.

The authors declare that they have no competing interests.

For access to the W-BQ12 Questionnaire

The W-BQ12 and ADDQoL–19 questionnaires are available from Professor Clare Bradley, Health Psychology Research, Department of Psychology, Royal Holloway, University of London, Egham Surrey TW20 EX, United Kingdom. Email- c.bradley@rhul.ac.uk

REFERENCES

1. Gupta R. Diabetes in India:current status. Express HealthCare. 2008 Aug [cited 2009 July 1]. available from: http://www.expresshealthcaremgmt.com/200808/diabetes02.shtml
2. Engum A, Mykletun A, Midthjell K, Holen A, Dahl AA. Depression and Diabetes. Diabetes Care 2005; 28: 1904-9.
3. Pouwer F, , Snoek FJ, Henk M. Ploeg VD, Adèr HJ, and Heine RJ. Monitoring of Psychological Well-Being

in Outpatients With Diabetes. Diabetes care 2001; 24: 1929-35.
4. Rubin RR. Diabetes and quality of life. Diabetes Spectrum 2000; 13: 21.
5. Frank B HU, Manson JE. Walking: The best medicine for diabetes. Archives of Internal Medicine 2003; 163: 1397-8.
6. Baker G, Gray SR, Wright A, Fitzsimons C, Nimmo M, Lowry R, et al. The effect of a pedometer based intervention " Walking for wellbeing in the west" on physical activity levels and health outcomes: a 12 week randomized controlled trial, Int. J. Behav. Nutr. Phys. Act. 2008: 5:44
7. Croteau KA, Richeson NE, Farmer BC and Jones DB. Effect of a pedometer – based intervention on daily step counts of community – dwelling older adults. Research quarterly for exercise and sport 2007; 78(5): 401-6
8. Fit sense Australia Wellness Newsletter 2008; November.
9. Clarke SP. Not Just A Stroll In The Park: Fitness Walking Is More Than Putting One Foot In Front Of The Other. Heart Insight 2007; 1(3); August 30-3.
10. Sigal RJ, Kenny GP, Wasserman DH, and Castaneda-Sceppa C. Physical activity/Exercise and Type 2 diabetes. Diabetes Care 2004; 27: 2518-39.
11. Neogi S. India: World Diabetes Capital. Hindustan Times, New Delhi, 2007 Sept 03.
12. Gregg RW, Gerzoff RB, Caspersen CJ, Williamson DF, Venkat Narayan KM. Relationship of walking to mortality among US adults with diabetes. Archives of internal medicine 2003 June 23;163(12):1440-47.
13. Araiza P, Hewes H, Gashetewa C, Vella CA, Burge MR. Efficacy of a pedometer-based physical activity program on parameters of diabetes control in type 2 diabetes mellitus. Metabolism 2006 Oct;55(10):1382-7.
14. Singh H, Bradley C. Quality of life in diabetes. International journal of diabetes in developing countries 2006; 26: 7-10
15. Rubin RR, Peyrot M. Quality of life and diabetes. Diabetes Meta Res Rev 1999 May- June: 15(3):205-18.
16. Costa FA, Guerreiro JP, Duggan C. An Audit of Diabetes Dependent Quality of Life (ADDQoL) for Portugal: exploring validity and reliability. Pharmacy and Practice 2006, 4(3): 123-8
17. Adepu R, Rasheed A, Nagavi BG, Effect of patient counseling on quality of life in type 2 diabetes mellitus patients in two selected south Indian community pharmacies: A Study, Indian Journal of Pharmaceutical Sciences, 2007 , 69(4): 519-524
18. Krans HMJ, Porta M, Keen H, Staehr Johansen K (Eds): Diabetes Care and Research in Europe: The St Vincent Declaration Action Programme Implementation Document. Copenhagen, WHO, 1995
19. Frank J. Snoek Medical Psychology, Diabetes Psychology Research group, VU University, Medical Centre, Amsterdam-Netherland: Diabetes: A Psychological Perspective, http://baku2004.prodiabet.net/materials/snoek/
20. Aurélio M, Peluso M, Helena L, Guerra de Andrade S. Physical activity and mental health: the association between exercise and mood. CLINICS 2005 60(1):61-70.

 ISSN: 1947-489X