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Changes in coronary heart disease risk profile of adults with intellectual disabilities following a physical activity intervention

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Abstract

Background Regular physical activity is one of the modifiable risk factors for coronary heart disease (CHD). With an increasing age profile and similar patterns of morbidity to the general population, persons with intellectual disabilities (ID) and their caregivers would benefit from data that indicate CHD risk factors. Knowledge of the CHD risk factors and the changes a physical activity intervention may have on theses risk factors will facilitate future intervention programmes.

Methods A cohort of 100 men and women between the ages of 21 and 73 years with ID living in a community group home in the North-West Province of South Africa was recruited. A CHD risk profile was compiled by means of a questionnaire and physical assessment that included resting blood pressure, body mass index, non-fasting glucose and cholesterol and cardiorespiratory fitness. A 12-week physical activity intervention was then conducted 3 days/week after which the baseline measurements were repeated.

Results The results indicated that 85% of the participants were inactive, while 67% were overweight and obese. Hypertension (6.1%) and smoking (6.1%) were relatively low in this population with ID. Glucose concentrations above the recommended cut-off values were observed in 28% of the participants. Total cholesterol concentrations above normal were measured in 23% of the participants. The physical activity intervention reduced inactivity to 50% and resulted in a significant increase in cardiorespiratory fitness and a decrease in percentage body fat in both men and women.

Conclusion Inactivity is a major risk factor in this population with ID living in a community group setting. The implementation of the physical activity intervention significantly reduced the risk factors for CHD.

Keywords coronary heart disease, intellectually disabled, physical activity

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Introduction

The mortality rate in people with intellectual disabilities (ID) because of coronary heart disease (CHD) is reported to be similar to that of the general population (Carter & Jancar 1983; Wells *et al.* 1997; Janicki *et al.* 1999; Patja *et al.* 2001). A study by Beange *et al.* (1995) indicated that the higher mortality rates in an Australian population were due to the increased incidence of inactivity, obesity and hypertension compared with non-handicapped persons. Morbidity data from the USA suggest that the main causes of death are cardiovascular disease and cancer (Janicki *et al.* 2002). An improvement in health care has however led to an increase in longevity in persons with an ID (World Health organisation 2000). In South Africa there is currently no published research on the prevalence of chronic disease in persons with ID. Draheim *et al.* (2003) found that active persons with ID possessed lower cardiovascular disease (CVD) risk factors, on average, than an inactive group of persons with ID.

The primary reason for the increase in CHD in persons with ID may be the high levels of physical inactivity (Van der Ploeg 2004; Emerson 2005). Rimmer *et al.* (1995) have proposed that persons with ID are more prone to hypokinetic diseases as a result of inactivity. Diseases such as type II diabetes mellitus, osteoporoses, osteoarthroses and hypertension are also reported to have a high prevalence in persons with ID (Van der Ploeg 2004). Studies investigating risk factors for CHD in persons with ID have indicated that obesity is also one of the major risk factors (Fox & Rotatori 1982). The prevalence of obesity in a large USA cohort of older than 40 years of age was more than 55% (Janicki *et al.* 2002). As is indicated in the literature, long-term obesity could result in eventual type II diabetes, cardiovascular disease and premature mortality (Katzmarzyk *et al.* 2005).

The prevalence of hypertension as a risk factor for CHD, however, is similar in intellectually disabled and non-intellectually disabled persons (Beange *et al.* 1995). Other factors such as smoking and elevated blood lipid levels are also risk factors for CHD. Robertson *et al.* (2000) reported that people with ID tend to smoke less than the average population of non-intellectually disabled. Researchers have previously alluded to atypical antipsychotic, clozapine and olanzapine to cause hyperglycaemia and hyperlipidaemia (Henderson *et al.* 2000; Melkersson *et al.* 2000; Koro *et al.* 2002).

Risk factors for CHD in the general population are mostly managed by introducing regular physical activity and a healthy diet. The salutogenic benefits of regular physical activity on physiological changes are observed when physical activity is performed as prescribed by the American College of Sports Medicine (Armstrong *et al.* 2006). With persons with ID it is not always possible to achieve a regular physical activity programme, as muscle weakness and hypotonia, increase in heart defects as well as circulatory and respiratory abnormalities are observed in these persons (Dodd & Shields 2005). The afore-mentioned are often the reasons for low physical activity levels reported for persons with ID. A decade ago, Messent *et al.* (1998) found that adults with ID in the UK were more sedentary than the general population. Draheim *et al.* (2002) however reported inactivity in 51% of persons with ID, which was similar to that of the general population. Peterson *et al.* (2008) reported that persons with ID achieved a similar number of steps per day as the general population when physical activity was objectively measured by means of a step counters in an population with ID.

The purpose of this study was to determine the CHD risk profile of adults with ID residing in a care facility in Potchefstroom, South Africa and to determine the effect of a physical activity intervention on the CHD risk profile of the residents. The importance of this study is to present the caregivers with an indication of the CHD risk factors that are present in this specific population. The results will give an indication of the influence that a regular physical activity programme may have on the CHD risk factors and the necessary action that needs to be taken to improve the quality of life of the ID residents.

Methods

Setting and participants

Amelia is a community setting in Potchefstroom, North-West Province of South Africa where persons with an ID are cared for. The residents live in three-bedroom apartments with a full-time caregiver for each apartment. During the day the residents are occupied with various hand crafts, and metal and wood work. All the residence of Amelia ($N = 130$) were asked to participate in the study. Informed consent was obtained from the participants as well as from the registered nurse, who also serves as the legal guardian for the residents. One hundred of the residents gave consent to be tested, of which 47 were men and 53 women. The participants were chronologically aged between 21 and 72 years, while intellectually aged between 4 and 12 years. The severity of the participant's ID was determined before their acceptance in the care facility and was obtained from their medical files.

Procedure

A coronary risk profile questionnaire (Bjürstrom & Alexiou 1978) was completed with the help of the registered nurse and the official medical files of the participants. In order to complete the coronary risk profile, body composition, resting blood pressure and cardio-respiratory fitness were determined. Physical activity of the participants was determined by their reported physical activity habits as indicated by their full-time caregivers and sport coach. Participation in physical activities considered moderate to vigorous in intensity by the Ainsworth Compendium (Ainsworth *et al.* 1993) on a weekly basis (one or more times per week) were categorised as active. Participants that performed no physical activities considered as moderate to vigorous in intensity by the Ainsworth Compendium (Ainsworth *et al.* 1993) were categorised as inactive.

All the participants who gave consent to be tested were familiarised with the testing procedure, which was performed in one of the empty apartments on the premises. Body mass (Seca® 700) to the nearest 0.1 kg and stature with a stadiometer to the nearest 0.1 cm were determined. Skinfolds were measured with a calibrated skinfold caliper (Harpenden®) by a level two accredited anthropometrist to the nearest 0.1 mm. The percentage body fat was then determined by means of the seven skinfold equation (Jackson & Pollock 1985) according to the guidelines of the International Society for the Advancement of Kinanthropometry (Marfell-Jones *et al.* 2006). Waist and hip circumference was also determined according to the guidelines of International Society for the Advancement of Kinanthropometry (Marfell-Jones *et al.* 2006) with a non-elastic measuring tape to the nearest 0.1 cm. The body composition measurements were followed by the non-fasting blood glucose and cholesterol measurements (Accutrend®, Roche Diagnostics) that analysed a peripheral blood drop. After the participants had relaxed for at least 5 min, a once-off resting heart rate and blood pressure (Baumanometer®) were measured. Participants were sub-maximally tested on a bicycle ergometer (Monark 828E, Sweden) to 70% of the age predicted maximal heart rate as determined by Karvonen's formula (Armstrong *et al.* 2006) to determine indirect cardiorespiratory fitness. Tests were performed after the participants had been familiarised with the procedure on one previous occasion. The cardiorespiratory fitness test was performed according to the sub-maximal adapted YMCA protocol (Armstrong *et al.* 2006). The protocol required participants to cycle at a speed of 50 rpm with a resistance of 25 watt for 4 min. The load (watt) was increased after every 4 min according to the heart rate attained at the end of the fourth minute by means of a polar hear rate monitor. Blood pressure and heart rate response was measured at the end of each 4-min level. The incremental increase in resistance resulted in a target heart rate being reached after 12 min of cycling. The participants then performed a 3 min recovery stage with no resistance at 40 rpm. Participants who presented with more than three risk factors for CHD according to the American College of Sport Medicine's guidelines (Armstrong *et al.* 2006) were monitored with an electrokardiogram (EKG) (Schiller, Switzerland) during the fitness test. A medical doctor was on standby during testing in the event of an incident. All baseline measurements were repeated after 12 weeks of the physical activity intervention.

Physical activity intervention

The physical activity intervention entailed a walking programme 3 days/week for 12 weeks. A 400-m circle route was measured on the residing grounds of the participants, as it was a safe environment with a level walking surface. During the first 4 weeks the participants walked for 20 min continuously. The walking time was increased with 5 min every 4 weeks up to 30 min of walking in the final 4 weeks. Stretches of the major muscle groups were performed after the walk. To determine the distance walked during each session, an elastic band was given to each subject when passing the start/finish line. This also served as motivation to continue walking and to increase the walking distance each time. After each intervention the number of elastics received by each subject was counted and converted to the distance walked in the time allocated. The number of elastic bands recorded for each subject also served as their compliance record. The compliance for this population was 47.7%.

Statistical analyses

Statistical analyses were performed with the SPSS 15.0 (SPSS Inc., Chicago, IL, 2008). Descriptive statistics were performed on the baseline measurements to determine the baseline characteristics of all the variables that were determined. Independent *t*-tests were performed to determine significant differences between the men and women. Frequency analyses were performed to determine the distribution of the CHD risk factors of this population in total and for the various age groups. The influence of the intervention was analysed by means of dependent *t*-tests determining the percentage change that occurred from baseline to end, corrected for baseline values, for the men and women separately. Finally, to determine the levels of activity that were needed to elicit changes in the two most prevalent CHD risk factors, an one-way ANOVA was performed to compare changes in the measured variables of participants with a <50% compliance, 50–70% compliance and >70% compliance with each other. The level of significance was set at $P < 0.05$.

Results

Baseline

Not all the participants tolerated the testing well and therefore only 53 women and 47 men were tested. Of the 100 who were tested, only 67 could perform the physical work capacity test on the bicycle ergometer. The baseline characteristics of the participants (Table 1) indicated that the men were significantly taller and heavier than the women, but the body mass index (BMI) of both genders did not differ significantly. The average BMI for both genders (men = 29.0, SD 8.5 kg/m^2; women = 29.3, SD 6.8 kg/m^2) was higher than the healthy norm (20–25 kg/m^2) as indicated by the World Health Organisation (1998). The significant difference in the body fat percentage between the men and women (men = 19.9, SD 7.5%; women = 29.9, SD 8.6%) indicated that the women had more subcutaneous fat than the men. At baseline the men also presented with a higher fitness level (1.85, SD 1.1 watt/kg) than the women (1.52, SD 0.6 watt/kg), although the difference was not significant.

The most prevalent CHD risk factors (Fig. 1) in this population of persons with ID were physical inactivity (85%) as well as overweight and obesity

Table 1 Baseline characteristics of the determined variables (mean ± SD)

Variables	*N*	Men	Women
Age (years)	100	39.2 ± 8.9	37.5 ± 10.1
Height (m)	100	1.69 ± 0.13*	1.59 ± 0.10*
Body mass (kg)	100	82.05 ± 22.3*	73.8 ± 17.8*
BMI (kg/m^2)	100	29.0 ± 8.5	29.3 ± 6.8
WHR	100	0.87 ± 0.08*	0.80 ± 0.12*
Body fat (%)	99	19.9 ± 7.5*	29.9 ± 8.6*
SBP (mmHg)	100	117 ± 14	118 ± 17
DBP (mmHg)	100	76 ± 13	77 ± 13
PWC (watt/kg)	67	1.85 ± 1.1	1.52 ± 0.6
T-Chol (mmol/L)	100	4.6 ± 0.8	4.8 ± 0.9
Glucose (mmol/L)	100	4.6 ± 2.2	4.9 ± 1.8

*Significantly different, $P < 0.05$.
BMI, body mass index; WHR, waist-hip ratio; SBP, systolic blood pressure; DBP, diastolic blood pressure; PWC, physical work capacity; T-Chol, total cholesterol.

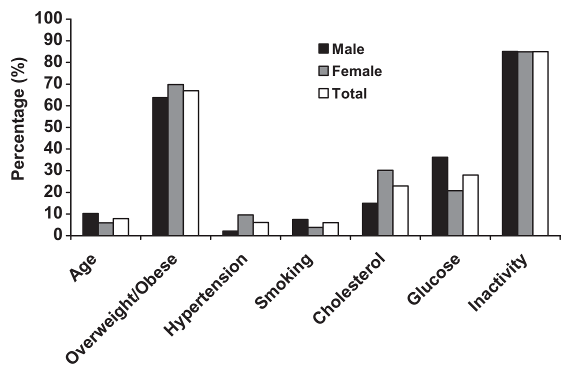

Figure 1 The distribution of coronary heart disease risk factors for men, women and the total group of persons with intellectual disabilities.

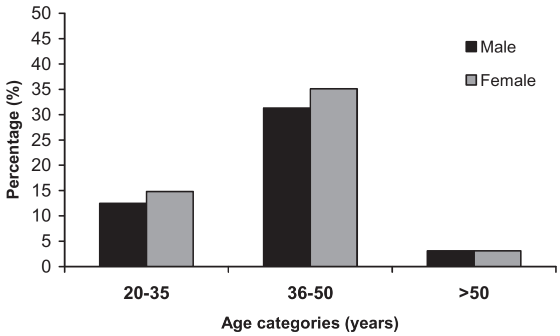

Figure 2 Percentage of inactive persons with an intellectual disability per age category.

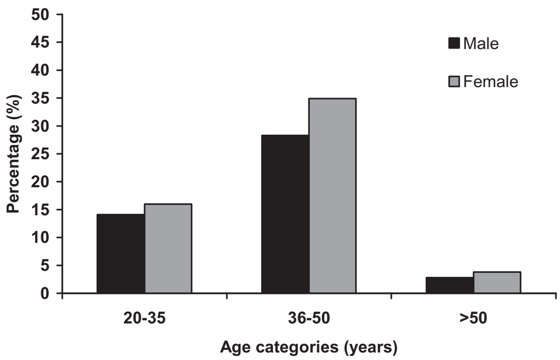

Figure 3 Percentage of intellectually disabled persons overweight and obese per age category.

(67%). More women were over weight and obese (70%) than men (64%), with both genders being similarly inactive. The high percentage of participants with elevated average total cholesterol (23%) and glucose concentrations (28%) that were observed in this population could be as a result of non-fasting blood samples. Risk factors that were less prevalent in this population were hypertension (6.1%), smoking (6%) and age (7.8%).

The distribution of the risk factors per age group (Figs 2,3) indicated that the most inactive persons were between the ages of 36–50 years with an equal number of male and female participants being inactive. In the 20–35 years age group, the men were slightly more active than the women. In the overweight and obese participants, the 36–50 years age group reported the highest percentage of overweight and obese persons, with the women being more overweight and obese than the men.

Physical activity intervention

The changes in the CHD risk factors of the participants during the physical activity intervention (Table 2 & Fig. 4) indicated that statistically significant changes were only observed in the decrease of the percentage body fat (men = –8.0%; women = –18.7%) and in the increase in the fitness of the participants (men = 12.4%; women = 12.4%) as measured with the physical work capacity test. These results indicated that the participants had increased their fat-free mass, as percentage body fat decreased, while body mass did not decrease significantly. The significant increase in the functional work capacity was expected, as the participants were extremely sedentary before the intervention.

The changes during the intervention were further analysed to determine if a threshold for the level of activity could be determined, through investigating changes observed in participants with a difference in compliance to the physical activity intervention programme. The participants were divided into three categories for physical activity compliance: <50%; 50–70% and >70% (Fig. 5). The results indicated that the participants who complied less than 50% ($n = 32$) to the intervention had the biggest decrease in percentage body fat (–15.3%). The participants who complied to the physical activity intervention between 50–70% ($n = 11$) had the largest increase in fitness (36.3%). These results can be explained by the fact that the participants who complied more than 70% ($n = 21$) to the intervention were also mostly the participants who were highly active at the beginning of the intervention. Cardiorespiratory fitness was already higher and a large improvement in these participants was not expected. Predominantly sedentary persons could modify their risk factors for CHD with only a 50% increase in activity. The principle of: 'the less you can do, the more you can improve' is well illustrated in these results.

Discussion

This study examined the risk factors for CHD in a community home group of adults with ID living in Potchefstroom, North-West Province of South Africa. Although this population is not a

Table 2 Changes in variables from baseline to end for the men and women with intellectual disability (mean ± SD)

	Men		Women	
Variables	**Baseline**	**End**	**Baseline**	**End**
Age (years)	39.2 ± 8.9		37.5 ± 10.1	
Height (m)	1.69 ± 0.13		1.59 ± 0.10	
Body mass (kg)	82.05 ± 22.3	81.23 ± 22.53	73.8 ± 17.8	74.13 ± 17.15
BMI (kg/m^2)	29.0 ± 8.5	25.91 ± 11.54	29.3 ± 6.8	26.56 ± 10.71
WHR	0.87 ± 0.08*	0.88 ± 0.07†	0.80 ± 0.12*	0.79 ± 0.09†
Body fat (%)	19.9 ± 7.5‡	17.20 ± 6.52§	29.9 ± 8.6‡	23.53 ± 7.3§
SBP (mmHg)	117 ± 14	112 ± 14	118 ± 17	111 ± 15
DBP (mmHg)	76 ± 13	72 ± 11	77 ± 13	70 ± 13
PWC (watt/kg)	1.85 ± 1.1	1.90 ± 0.73¶	1.52 ± 0.6	1.45 ± 0.70¶
T-Chol (mmol/L)	4.6 ± 0.8		4.8 ± 0.9	
Glucose (mmol/L)	4.6 ± 2.2		4.9 ± 1.8	

Similar symbols indicate significant difference $P < 0.05$.
BMI, body mass index; WHR, waist-hip ratio; SBP, systolic blood pressure; DBP, diastolic blood pressure; PWC, physical work capacity; T-Chol, total cholesterol.

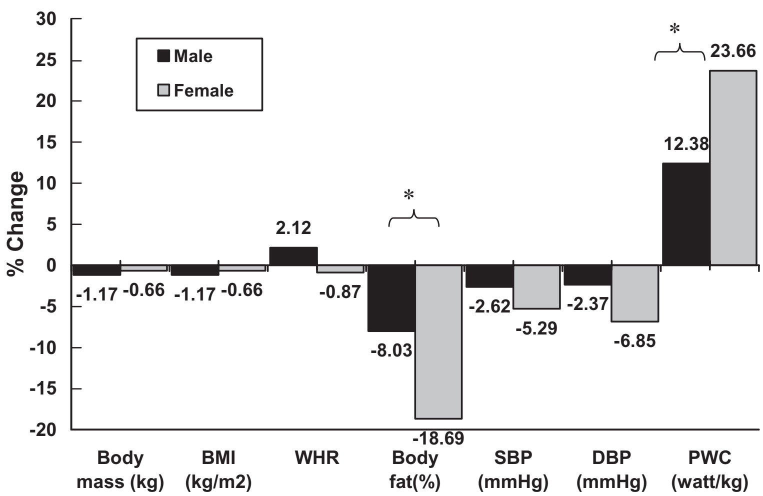

Figure 4 Percentage change (corrected for baseline) in coronary heart disease risk factors of the men and women respectively after a physical activity intervention $^*P < 0.05$ (significantly different). BMI, body mass index; WHR, waist-hip ratio; SBP, systolic blood pressure; DBP, diastolic blood pressure; PWC, physical work capacity.

representation of the total population with ID of South Africa, the results obtained in this study indicate that physical inactivity is a major risk factor for CHD in this population with about 85% of the men and women being inactive. This is similar to the results reported in other population-based studies in countries like UK and Ireland (Messent & Cooke 1998; McGuire *et al.* 2007) that also reported less than a quarter of the persons with ID participating in regular activity as recommended for a healthy lifestyle. The remaining 15% who are active are highly active as they participate in athletics, swimming and cricket for persons with ID on a regular and structured basis.

The earlier onset of old age in individuals with an ID (Janicki *et al.* 1985; Pitetti & Campbell 1991) suggest that a faster decline in physical capacities are observed compared with the general population (Pitetti & Campbell, 1991; Fernhall *et al.* 1996). Of the 100 participants tested, 27.3% of the participants who are inactive are between the ages of 20 and 35 years, while 66.4% of the inactive partici-

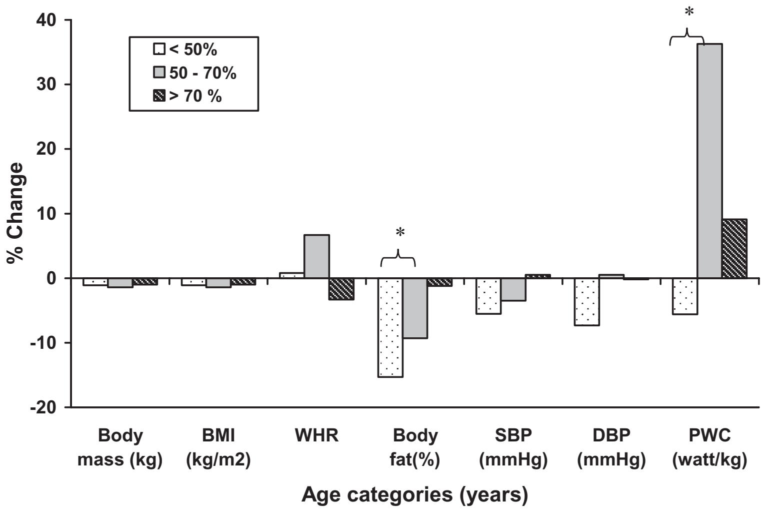

Figure 5 Percentage change (corrected for baseline) in the coronary heart disease risk factors of the total group of persons with intellectual disabilities for different physical activity intervention compliance (<50%, 50–70% and >70%). *$P < 0.05$ (significantly different). BMI, body mass index; WHR, waist-hip ratio; SBP, systolic blood pressure; DBP, diastolic blood pressure; PWC, physical work capacity.

pants are between the ages of 35 and 50 years. It is known that levels of physical activity decrease with an increase in age. The results obtained from the different percentages of compliance to the physical activity intervention indicated that the cardio-respiratory fitness improved the most and significantly for the participants who attended between 50–70% of the intervention programme. This was also the situation for the change in percentage body fat. In the general population it is indicated that as soon as inactive participants become moderately active, health benefits are obtained (Armstrong *et al.* 2006). The participants attending more than 70% of the intervention programme were the participants who were already highly active and they reported less health benefits with regard to the parameters determined. These results are in support of the findings by Temple *et al.* (2004) that reported in a review that persons with ID are highly sedentary.

Overweight and obesity are the second most prevalent risk factor for CHD reported in this study, with more than two-thirds of the participants being overweight or obese. These are similar to results reported by Merriman *et al.* (2005) on a UK population stating that one-third of the participants were overweight and another third of the participants obese. These high levels of overweight and obesity in persons with ID were also reported by Lea (1999), Marshall *et al.* (2003) and Braunschweig *et al.* (2004). Previous studies have found obesity to be more common in participants with mild and moderate opposed to severe ID (Fox & Rotatori 1982; Rimmer *et al.* 1993). In this study there were fewer participants (30%) with severe ID. The high percentage of overweight and obesity may also be explained by the sedentary nature of the participants' daily vocation. The more disabled the participants, the less physically active tasks are given to them.

Although the total levels of blood lipids and blood glucose are the risk factors that have a high prevalence in this population, it was impossible to obtain peripheral blood drops to analyse the post-intervention cholesterol and glucose concentrations. The baseline concentrations were also non-fasting values.

The prevalence of hypertension (6.1%) and smoking (6%) was very low in this population. This resembles the results presented by Merriman *et al.* (2005) who also reported a 6.1% prevalence of hypertension with once-off blood pressure measurements in a smaller sample size. About 10% of the participants were Down syndromes who are known to have lower blood pressure (Draheim *et al.* 2002).

The prevalence of smoking was also low in this population, similar to that reported by Rimmer *et al.* (1993) and Robertson *et al.* (2000), but contrary to the result reported by Merriman *et al.* (2005). The low prevalence might be explained by the example set by the caregivers as only one of them smoke and possibly also because the participants are limited with regard to money for supporting the smoking habit. Participants have to visit a nearby grocery store to purchase cigarettes.

The changes that occurred in the CHD risk profile of the subject with ID because of a physical activity intervention significantly change the two most prevalent risk factors, namely inactivity and overweight and obesity. Although the adherence to the intervention was low (47%), physical inactivity was reduced with 50% in the population with ID as 50% of the participants continued walking daily after the intervention was completed. The low compliance to the intervention programme could be a lack of motivation. Being physically active was a new concept for the participants. The cardio-respiratory fitness of the participants improved significantly for both men and women. These results support the results obtained by Carmeli *et al.* (2004), where a walking programme for participants with Down syndrome increased walking distance and time significantly indicating an increase in fitness. A study by Anchuthengil *et al.* (1992) reported a 38% increase in cardiovascular fitness after 12 weeks of a treadmill walking intervention in a sample size of six participants. Fitness in participants with ID was also significantly improved in a recent study with a Virtual Reality Intervention programme of 6 weeks (Lotan *et al.* 2009).

Although the BMI of both the men and women decreased, the significant decrease in the percentage body fat from baseline to end indicated that the intervention programme had retained muscle mass while subcutaneous fat was decreased. Very few studies reported changes in body composition (Chanias *et al.* 1998). Pommering *et al.* (1994) found no significant changes in body composition after a 10-week aerobic exercise programme.

Systolic and diastolic blood pressure also decreased slightly from baseline to end, but this was not a significant change. Cholesterol and glucose results are not reported, as the participants were not willing to consent to peripheral blood sampling at the end of the intervention period. One person stopped smoking during the intervention.

As a result of this study, the governing body of this care facility has invested in the building of a gymnasium where the residents can participate in regular physical activity in a structured manner. All the residents are evaluated every 6 months to determine their progress. The results of the evaluation are used to compile a scientifically based exercise programme that ensures that all the residents participate in training for 1 h twice per week. This study has raised the awareness of regular physical activity in a population with ID. Exercise is now compulsory for all residents and optional for caregivers.

Conclusion

This study on the risk for CHD of residents with ID and the influence of a physical activity intervention on the CHD risk factors revealed that inactivity and overweight/obesity are the two major health risk factors. The implementation of a physical activity programme reduced inactivity with 50% and also decreased the percentage body fat significantly in both men and women. Participants participating in 50–70% of the intervention programme reported the most comprehensive and significant increase in cardio-respiratory fitness and a decrease in percentage body fat. Further research is needed to determine the functional capacity and tasks of daily living in this population and how specific physical activity interventions can help a population with ID to be physically independent.

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