GLOBESITY IN ACTION: SYSTEMATIC REVIEW AND PILOT INTERVENTION TO ASSESS THE POTENTIAL HEALTH BENEFIT OF MODERATE PHYSICAL ACTIVITY

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Abstract: Sedentary lifestyle is an important factor in the aetiology of the obesity pandemic – 'globesity'. This multifactorial disorder is exponentially exacerbated in developed countries by 'the obesogenic' environment. The latter is characterised by the lack of physical activity (PA), imbalanced diet, and modernisation shift. Other aetiological factors remain important; genetic, age, sex and ethnicity. Diet, physical inactivity combined with other environmental factors (smoking etc) are responsible for the increasing prevalence of the leading cause of deaths in United Kingdom, cardiovascular disease (CVD). This paper reviews the health outcomes that have been achieved by various physical activity intervention programmes worldwide. Additionally, it assesses the effectiveness of current PA guideline (issued by the National Institute of Health and Clinical Excellence (NICE)) on body fat and total cholesterol (TC) through a pilot intervention. Reviewed literature has endorsed the positive advantage of PA on health and wellbeing. Moreover, the pilot intervention further emphasised these health benefits by the reduction in TC and percentage body fat. Moderate physical exercise (at least 30 minutes five times a week) has an optimal fat oxidation capacity and notably improves cholesterol level. PA as a modifiable risk factor holds a great promise in the prevention and management of non communicable diseases, hence its importance to incorporate it in health promotion strategies and public health policy.

Keywords: *Obesity; Physical Activity; NICE Guidelines; Cholesterol; Body Fat; Intervention Programmes.*

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INTRODUCTION

Since 1960s, the increases in food availability and jobs, contemporary lifestyle, hobbies that necessitate little physical activity have significantly contributed to a sedentary lifestyle in industrialised countries. Along with this increase new range of non communicable diseases (e.g. obesity, hypertension, type 2 diabetes mellitus, cancer and cardiovascular diseases) has emerged. Today the World Health Organisation declares that physical inactivity is by all mean" a public health problem" (Mbalilaki et al., 2007; World Health Organisation, 2009).

With a gene pool containing more orexigenic factors, currently, there are more overweight and obese individuals than malnourished worldwide. In 2004, 1.6 Billon people were classified as either overweight or obese as opposed to just under a Billion that suffer malnourishment (World Health Organisation, 2004; United Nations, 2008).

While cardiovascular disease (CVD) is the number one killer in the United Kingdom (Skoumas et al., 2003), its association is well established with the rising trends in the obesity epidemic (Colhoum et al., 2004; British Heart Foundation, 2009). Furthermore, hypercholesterolemia which causes the accumulation and deposition of fat as plaque along the walls of the arteries increases the odds of cardiovascular disease (Shils et al., 2006).

The beneficial effects of exercise on human health in the prevention of non communicable diseases is well documented (Kesaniemi et al., 2001; Warburton et al., 2006; Bouchard et al., 2006). Recent research proved the potential advantage of regular physical activity in decreasing serum cholesterol levels (Mesa et al., 2006) and body fat in human subjects (Ramadan and Baracnieto, 2001). These findings suggest a simple solution to help decrease both the incidence of CVD and the prevalence of obesity amongst target populations by incorporating a routine exercise into their daily lifestyle (Loos and Bouchard, 2003; Department of Health, 2007).

The current physical activity guidelines proposed by NICE states "at least 30 minutes a day of at least moderate intensity physical activity on 5 or more days of the week." (Department of Health, 2004; NICE, 2009). These guidelines for physical activity were set following a range of research that studied the different beneficial effects of exercise at different frequencies and intensities (NICE, 2007).

The principal aim of this article is to review the beneficial effects of moderate physical activity which have been reported in published research papers. Additionally, it presents the findings of a pilot intervention that aimed to follow on from the NICE guidelines and assess the effect of moderate physical activity on both blood cholesterol and total body fat. The objective of the pilot intervention was to consider the effect of moderate exercise (see table 1.0) on the overall health status of fifteen subjects, and hence their health and well-being.

The experimental specific objectives were therefore divided into two main areas:

(a) Assessment of the serum cholesterol level and percentage body fat before and after the intervention.

(b) Evaluation of the overall health benefits after the physical activity period to weigh-up any changes.

FACTORS AFFECTING THE OBESITY ONSET

Environmental factor

Although genetic factor is known to play an important role in the onset of obesity, environmental factors remain crucial in the determination of the severity of this disease (Barnett and Kumar, 2004). It is worth mentioning that the wider availability of highly palatable, energy dense, foods combined with the low physical activity levels amplify the prevalence of obesity (loos and Bouchard, 2003). Furthermore, the emerged metabolic syndrome (syndrome X) which is correlated with elevated risk of CVD is associated with central obesity and other conditions such as dyslipidaemia, type 2 diabetes and hypertension (Bray and Champagne, 2004). This further evidence of the interconnection in the onset of CVD and obesity explains the favourable effect that physical activity has on both at once.

Leptin

Leptin hormone is secreted by adipocytes and regulates energy intake. Its circulating level is proportional to total body fat (Bray and Bouchard, 1998). Leptin

Table 1.0: Classification of exercise Intensity using vo2 max (Willmore and Costill 2004)

Intensity	VO2 max	Heart rate maximum
Very light	<30%	<35%
light	30-49%	35-59%
Moderate	50-74%	60-79%
Heavy	75-84%	80-89%

resistance is seen in obese individuals, and it is hypothesised that this resistance is due to a reduced action of the hormone in the brain, although circulating levels are elevated (Schwartz et al., 2000). Regular physical activity tremendously decreases the levels of leptin in men with metabolic syndrome (Reselend et al, 2001). It was concluded that with PA, the leptin level is reset to a maintainable point, accordingly restoring energy intake and expenditure homeostasis (Reselend et al.,2001). Interestingly, a higher fat oxidation rate with physical activity was achieved during the shift to a high fat diet; this has further emphasized the ability of physical activity to increase fat utilisation (Smith et al., 2000).

Cardiovascular disease

The association between PA and different morbidities cannot be underestimated (Warburton, 2006). A typical example is cardiovascular disease; which has different manifestations; mainly the heart, brain and peripheral arteries can be affected. These pathologies can have different aetiologies but hypercholesterolemia, atherosclerosis and obesity are proven cofactors (Geissler and Powers, 2005; Bray et al, 1998). Increased circulating levels of serum low density lipoprotein (LDL) are correlated with higher risks of atherosclerosis, a precursor of CVD (Ross, 1999).

A longitudinal research, recruited highly active individuals, had shown a decreased level of both serum triglycerides and LDLs (Della Valle et al., 2004). Moreover, an increase in high density lipoprotein (HDL) for those adhering to a moderate exercise routine can be also achieved (Skoumas et al., 2003). It is also important to remember that physically active individuals maintain easily their body weight and have a greater capacity of using fat preferentially to carbohydrates as a source of energy (Tappy et al., 2003). Therefore, regular physical activity help to decrease the LDL, increase HDL and enhance one's capacity to oxidise fats. This gives rationale to its importance in the prevention and treatment of NCDs such as CVD and obesity, and justifies further the reasoning behind assessing the NICE guidelines.

Other NCDs

Physical activity is also recognised to have other beneficial effects such as its positive impact on chronic diseases including hypertension, type 2 diabetes, depression, osteoporosis, osteoarthritis and some type of cancers (notably colorectal and breast) (Warburton et al., 2006). Obesity is correlated with poorer cancer outcome and higher cancer mortality (Toles and Demark-Wahnefried, 2008); this proposes that PA could potentially have a preventive effect for cancer, while treating obesity.

RESULTS

The results section will be divided into two parts:-

Part 1: review of literature for appropriate intervention programmes relevant to the current pilot study

Part 2: pilot intervention to weigh-up the health benefits on recruited, subjects

PART 1: REVIEW OF LITERATURE FOR APPROPRIATE INTERVENTION PROGRAMMES RELEVANT TO CURRENT PILOT STUDY

Table 2.0 illustrates the major outcomes of nineteen published research studies (1976-2007) focusing on the positive effect of physical activity on health status and wellbeing. These studies were mainly investigating values correlated with NCDs such as CVD (coronary heart disease, ischemic heart disease and stroke) obesity, type 2 Diabetes mellitus, hypertension and hypercholesterolemia and cancer.

PART 2: PILOT INTERVENTION TO WEIGH-UP THE HEALTH BENEFITS ON RECRUITED SUBJECTS

A total of twelve subjects aged between 18 to 34 years old were recruited in this study (6 males and 6 females). The inclusion criteria consisted in having subjects that were not athletes and did not meet the NICE guidelines fully, no pregnant female was eligible. Moreover, recruited subjects should have

Table 2.0: Relevant journals and literature outcomes used during the study

Reference	Study design/ subjects	Relevant values tested	Study outcome	Critical appraisal
(Skoumas et al., 2003)	Province of Attica study/ 2772 subjects	Lipids and physical activity	Physically active women: Significantly lower LDL, oxidised LDL, triglycerides, serum cholesterol, apolipoproten B. Higher LDL.	PA ↑ HDL ↓ LDL, but affects only HDL when adjusted with: gender difference and lifestyle factors such as (smoking)
(Tappy et al., 2003)	Review	Physical activity/ body-weight control	Body weight regulation with PA. PA and spontaneous food intake regulation	Physical activity correlated with low body weight and low body fat mass. Biological determinant of low PA in pre-obese hence weight gain.
(Reseland et al., 2001)	186 males / metabolic syndrome	Leptin, BMI, fat mass	All 3 values decreased with long-term reduction in food intake combined with physical activity	Significant decrease in leptin with both Diet and PA intervention. Surpassed expected decrease with fat mass loss.
(Ramadan and Barac-nieto, 2001)	45 males/ office workers	Reported level of PA, aerobic fitness, BMI, 7 skin folds	Higher PA groups had lower skin folds and body fat and body weight	No significant difference in active groups. PA associated with higher levels of energy turnover.
(Bergouignan et al., 2006)	18 subjects / BMI 23.6 ±0.7	Body composition , fatty acids oxidation	Inactivity decrease fat oxidation. Monounsaturated dietary fat oxidation is decreased with physical activity	Mediterranean diet (high in PUFAs) should be recommended for sedentary people and those switching to a less active lifestyle
(Smith et al., 2000)	6 healthy males	Energy expenditure, fat oxidation	Adaptation to high fat diet takes time. Adaptation accelerated with PA, RMR*1.8	Physical activity increases fat oxidation when an individual is switching to a high fat diet
(Ellison et al., 2004)	2309 subjects ,age (25-91)	Alcohol, smoking and PA effects on HDL	Alcohol ↑ HDL Smoking ↓ HDL (more notable in women) Physical activity increases HDL (3-	Alcohol can be beneficial, physical activity help with cardiovascular disease as HDL provides protection against CHD

Reference	Study design/ subjects	Relevant values tested	Study outcome	Critical appraisal
			3..3 mg/Dl)	
(Bhattacharya et al., 2005)	Mice	Conjugated linoleic acid (CLA), exercise, body fat, leptin	CLA ↓ in fat mass CLA+ exercise decreased further CLA ↓ insulin TNF, glucose Decreased leptin with CLA and exercise	Mice fed a high fat diet (Combination of dietary conjugated linoleic acid) and exercise have lower fat mass and increase lean body mass
(Della Valle et al., 2004)	1075 males, age: 25-75/ Olivetti factory workers	Physical activity, BMI, insulin, serum cholesterol, Skinfolds	Physically active group: Higher BMI Lower abdominal circumference, skinfolds, heart rate, blood pressure, serum cholesterol, triglyceride, glucose, insulin and HOMA	After classification within BMI ranges, active individuals had lower values for all assessed data when compared to the sedentary group. Physical activity plays a beneficial role in the prevention of CVD.
(Mesa et al., 2006)	2090 adolescents age 13-18.5	Blood lipid, aerobic fitness, fasting glycaemia	After adjustment, aerobic fitness was correlated with better glycaemia and blood lipid levels in both overweight and normal weight adolescents	Overweight and obese had data higher than normal weight counterparts for the same aerobic fitness level. Thus, weight management is important to be considered with physical activity levels when discussing metabolic syndrome and CVD
(Mbalilaki et al., 2007)	985 subjects rural and urban Tanzanians	Serum cholesterol and physical activity	Rural population : Higher PAL than urban inhabitants, lower mean weight, BMI, serum cholesterol. Correlation between unintended activity and lipid profile	Urban life predominates today in the westernised society. This lifestyle is correlated with physical inactivity and unfavourable lipid profile. Importance of prevention in developing countries.
(Sofi et al., 2007)	932 subjects from	Mediterranean diet (MD),	No influence of MD on circulating	Adherence to HL, following MD,

(↑) increase; (↓) decrease

Reference	Study design/ subjects	Relevant values tested	Study outcome	Critical appraisal
	Florence Italy	Healthy lifestyle (HL), PA, smoking	biomarkers. HL correlated with better lipid profile (HDL and triglycerides). Significant difference in homocysteine levels between higher and lower ends of HL.	no smoking high leisure time exercise decreases risks of CVD by improving lipid profile and lowering circulating plasma homocysteine.
(Brett et al., 2000)	75 males healthy active Age: 18-66.	Cholesterol, insulin resistance, blood pressure	Diastolic changes during exercise are correlated with serum cholesterol and insulin resistance. Moreover, Diabetic (uncomplicated type2) men have a greater change in diastolic blood pressure as opposed to their non-diabetic counterparts	Great correlation between the main determinants of the metabolic syndrome. These changes in diastolic BP can cause hypertensive complications.
(Lichtenstein et al., 2002)	36 subjects moderately hypercholesterolemic 5mmol/L <Cholesterol<6mmol/L	Lipoprotein, apolipoprotein, glucose homeostasis	Decrease in LDL for both genders. Dietary changes did not have significant effect on the fractional esterification rate of HDL or glucose and insulin levels, for both fasting and non-fasting states	No apparent adverse effects of this therapeutic lifestyle change/step 2 diet were noted. This intervention showed an overall decrease in CVD risks.
(Shorey et al., 1976)	100 males With elevated cholesterol levels	Exercise, diet, cholesterol levels	Faster decrease in serum cholesterol for those combining diet to exercise regime. Weight loss correlated with lipid profile	Exercisers maintain low triglyceride levels. Not only does exercise help lower cholesterol but it also help the maintenance of the better lipid profile
(Raz et al., 1988)	55 males With low HDL	Cholesterol, moderate exercise	Increase in maximal oxygen uptake for the exercise group as opposed to the control group. Decrease in triglyceride levels for the PA group No change in total cholesterol and LDL cholesterol	Exercise help decrease triglycerides but does not affect other lipids. Maybe the facts that subjects had low HDL levels, it takes more time to change

Reference	Study design/ subjects	Relevant values tested	Study outcome	Critical appraisal
(Warburton et al., 2006)	Review	Effect of physical activity	Physical activity decreases: Cardiovascular disease, diabetes, Cancer , Hypertension, Obesity, Depression, Osteoporosis and premature death	Prevention of these non-communicable diseases. Linear relationship between physical activity and health status.
(Kesaniemi et al., 2001)	Review	Dose-response for PA and health	51 studies: The most common change in lipid profile with moderate intensity PA is HDL cholesterol increase (40% of the studies) Beneficial for low back pain and anxiety	Conflicting evidence but HDL – cholesterol remains the first factor affected by exercise.
(King et al., 1995)	149 males/120 postmenopausal females, sedentary, no CVD	Exercise (high and moderate intensities)/ lipoprotein levels	Treadmill test performance increased for all intensities of exercise but more markedly for the highest intensity. Small but significant increase in HDL cholesterol, mainly for the lower intensity group.	Cardiovascular performance enhanced with all intensities training.

normal to mildly high cholesterol (5-6 mmol/L) with no medical condition or treatment that could be affected by moderate exercise. All subjects meeting the entry criteria enrolled for the intervention from the 27th of October to the 28th of November of the year 2008.

Methodology:

Anthropometric measures including body weight and height were taken first, after which, the blood cholesterol and body fat were assessed. The subjects were then given the food diary and physical activity diary to fill during their two week exercise period.

The blood cholesterol assessment consisted of taking a finger prick of the participants' blood, which is placed on a small strip that is inserted into the Roche Accutrend machine; this machine gives a reading of the total serum cholesterol. The body fat and weight assessment was performed using the BodPod machine.

After which, participants were asked to exercise (endurance training) following the NICE guidelines for 2 weeks. Both anthropometric and serological assessments were repeated following the same protocol at the end of the intervention.

Table 3.0 presents the changes in the percentage of body fat, total blood cholesterol and body weight for all subjects. It also states the level of satisfaction of each subject with the intervention.

Overall there was a mean decrease in all data collected for all participants in the study. The only unexpected increase was noted in total serum cholesterol for male participants. Statistical analysis for subjects (n=12) resulted in a mean decrease in body fat percentage of 0.40%, (P=0.32); total cholesterol showed a decrease of 0.19 mmol/L (P=0.15). Likewise BMI was lower for all subjects who had a decrease in their body fat at the end of the study. More importantly, serum cholesterol decrease was significantly lower for females with a mean decrease of 0.45mmol/L, P=0.07 (85% of n).

PART 3: DISCUSSION

Literature review rationalised the pilot intervention

Extensive literature combined with thorough research programmes were used to propose the NICE guidelines for physical activity (Department Of Health, 2007). The reviewed research

Table 1: participants' weight (kg), body fat (%), cholesterol (mmol/L) and satisfaction (scale 1-10) before and after pilot intervention

Subject (#)	Weight (kg)	Weight after (kg)	Body fat (%)	Body fat after (%)	Cholesterol (mmol/L)	Cholesterol after (mmol/L) (Normal range <5 mmol/L)	Satisfaction (Scale 1 -10)
1	61	60.4	29.8	28.5	4.9	4.42	10
2	90.5	90.9	20.5	21.1	4.02	3.91	10
3	60	59.7	6.6	5.7	< 3.0	4.12	10
4	80.3	79.3	18.6	16.7	3.92	4.18	8
5	59.2	58.3	37.4	37.7	4.28	4.05	10
6	59.8	59.6	26.8	24.6	5.25	4.41	3
7	53.7	54.4	24.2	27	5.21	4.49	8
8	69.1	68.1	26	24.9	4.82	4.31	10
9	56.6	56.6	27.6	27.5	4.83	4.37	9
10	60.9	61.1	30.4	30.8	3.88	3.94	9
11	84.1	83.6	24.4	24.1	5.56	6.18	7
12	77.3	77.1	17.5	16.3	4.06	4.08	8

looked at the effect of different exercise intensities (table 1.0) on various health indicators such as weight control (Tappy et al, 2003), blood pressure (Brett et, 2000), fat oxidation (Smith et al, 2000) and cholesterol levels (Della valle et al, 2004) (Table 2.0). This has further confirmed a positive effect on these indicators. However, no research to date has assessed the NICE guidelines outcome(s) on preventing and curing major health conditions suffered in the United Kingdom.

Obesity and Cardiovascular disease being the major public health concerns today, this pilot study assessed the effect of the NICE guidelines on these; blood cholesterol and percentage body fat were used as indicators of these diseases. This study hypothesised that "there may be a notable decrease in total blood cholesterol as well as a diminution in body fat percentage for recruited subjects who followed the NICE guidelines". It is worth noting that the guidelines should be integrated to the population's daily lifestyle. Hence, this project only assessed the potential acute changes attributable to these guidelines during a short period of time. It is imperative to remember that the duration of the intervention was two weeks

Table 2: Mean (±SD) changes in serum cholesterol (mmol/L) and body fat percentage for all subjects before and after pilot intervention

Statistical Analysis	Before (mean± SD)	After (mean± SD)	P value
Total cholesterol (mmol/L)			
All subjects n=12	4.56±0.60	4.37±0.60	0.15
Female n=7	4.74±0.49	4.28±0.20	0.07*
Male n=5	4.31±0.69	4.49±0.95	0.22
Body fat (%)			
All subjects	24.15±7.78	23.74±8.15	0.32
Female	28.88±4.32	28.71±4.49	0.79
Male	17.52±6.64	16.78±6.99	0.15
Body weight (kg)			
All subjects	67.71±12.23	67.42±12.17	0.10*
Female	60.04±4.77	59.78±4.33	0.31
Male	78.44±11.42	78.12±11.56	0.23

*Statistically Significant

which explains the statistical non-significance of the final results.

Anthropometric indices: body weight, percentage fat

The outcomes of this pilot study has underpinned the literature review that moderate intensity PA decreases body weight, % fat and subsequently decreases the risks of obesity (Table 2.0). The mean decrease of body weight was 0.28 kg (p=0.10) and subjects had a mean decrease of body fat of 0.40% (p=0.32), which might be translated to a loss of up to 4.0 % total fat in twenty weeks, with a predicted significant drop in TC levels (Della valle et al, 2004). A decrease in body weight as small as 5% is correlated with great health benefits (Barnett and Kumar, 2004). These findings illustrate the promising potential that physical activity holds when embedded in globesity intervention. Moreover, physical activity is important in the aetiology of paediatric obesity confirming the sustainability and long term implications of moderate intensity exercise (Reilly and McDowell, 2003); this can help target the source of the problem as childhood obesity which is greatly associated with adulthood perpetuation of the disease (Bray et al., 1998).

Weight loss mechanisms

There are two main mechanisms involved in fat and weight loss procured by physical activity. Firstly, the energy deficit procured by exercise increases fat oxidation and utilisation as an energy source (Wilson and Wilson, 2005); secondly the excess post-exercise oxygen consumption (EPOC), which is the extra energy expended after exercise, plays a secondary but important role in energy expenditure (Vella and Kravitz, 2004). For instant, subject number 10 could not achieve weight loss, during the pilot study, though was the most active of the group; it is clearly understood that individuals that are physically active have a greater capacity to balance their energy intake with their energy expenditure hence maintain their body metabolism homesostasis (Westerterp et al., 1995). This finding proposes that the NICE guidelines should be the first step of the adherence to a healthy lifestyle, helping to prevent the onset of NCDs and decrease risks for sedentary individuals. It is important to remember that the sustainability of weight loss will depend on the adaptation to the behavioural modification and level of motivation of the subject. It is commonly reported that sedentary individuals have the most difficulty to adhere to an exercise regime, proving the importance of behavioural modification (Pemberton and Mcsweigin, 1993). If NICE guidelines are sustained over a long term, optimal benefits are achieved; therefore, the intensity of exercise has to be increased when aiming at improved health profiles.

Biochemical index: Serum cholesterol outcome

'It is recommended to maintain a cholesterol level of (<5 mmol/l)' (National Institute for health and Clinical Excellence, 2008).

This pilot study did not draw a clear conclusion on the difference in serum cholesterol outcomes by gender, although an L-shaped association between physical activity and CHD was revealed (Sesso et al, 2000).

The female subjects had a diet lower in saturated and trans fats and consumed more fruits and vegetables, based on the reported food diaries. This explains precisely the significant decrease in their serum cholesterol by the end of the intervention (before= 4.74mmol/L, after=4.28mmol/L; p=0.07) (Table 4.0). Females are normally more conscious about their weight and aesthetics as reflected in the collected food diaries data. They consumed a healthier diet which is low in cholesterol, high in MUFAs and PUFAs throughout the intervention in contrast with their male counterparts. These nutritional choices are correlated with enhanced lipid profile (Haas and Levin, 2006). With that said it is important to remember that two thirds of the cholesterol is synthesised within the body (British Nutrition Foundation, 1999). Ultimately, it can be hypothesized that for female subjects, the combination of exercise with their healthier diets, resulted in decreased LDL cholesterol that overruled the increase in the HDL cholesterol; hence, the overall significant lower serum cholesterol.

Forty percent of the reviewed studies showed that the most common change in lipid profile attributable to moderate PA was an increase in HDL-Cholesterol (Table 2.0). This is thought to be induced by an increase in HDL-Cholesterol which promotes an increase in lipoprotein lipase activity (Kesaniemi et al, 2001). Since most of the subjects had normal serum cholesterol at the beginning of the study, it can be hypothesised that moderate exercise seems equally beneficial for individuals who are not at high risks or suffering hypercholesterolemia or atherosclerosis. Moreover, BMI is more strongly correlated with lipid profile within the highest BMIs while in the lower BMIs physical activity is a better indicator of lipid profile (Mora et al, 2006). Interestingly, after a single session of moderate PA, there was a notable decrease in triglycerides and an increase in HDL between 4-43%. The Panel of the American college of Sports Medicine agrees that the acute changes of HDL-cholesterol accountable for physical activity has strong background evidence (Kesaniemi et al., 2001; Skoumas et al., 2003). Moreover studies assessing different exercise intensities showed that the highest increase in HDL-Cholesterol was noted in the moderate intensity group (King et al, 1995; Ellison et al, 2004). Cholesterol assessment in the present intervention was for total serum cholesterol; verifying the difference between the HDL and LDL cholesterol would have been more accurate to impact of current intervention on different lipoprotein types. This emphasises the rationale behind the noticeable increase in total serum cholesterol for the male participants during the present intervention.

Nonetheless King et al, reviewed four American prospective studies and reported that even the smallest increase in HDL cholesterol as low as 0.02586 mmol/L, can lower risks of cardiovascular disease by up to 2% (King et al., 1995). This proves yet again the great importance of exercise for tackling NCDs particularly cardiovascular disease. Hence, even if the results of this study showed no significant decrease for male cholesterol levels, the noted slight increase in TC could be due to significant increase in the HDL levels following PA that subsequently lower the risks of CVD among regular participants.

CONCLUSION

Regular moderate physical activity following the NICE guidelines showed its effectiveness in decreasing body fat and serum cholesterol therefore endorsing its efficacy when combating CVD, obesity and other NCDs. The latest campaigns demanded by the department of health (DH) to the NICE, aims at encouraging physical activity in the workplace. This new innovative development on guidance was proposed by the NICE in May 2008 and will sensitize the employers responsible for the health and safety in different organizations on the importance of encouraging the employees to become more active (NICE, 2008). Health professionals should emphasize the importance of integrating physical activity to a healthy lifestyle programme not only for patients at risk but also as a mean of prevention. Integrated public health approaches are needed to help achieve the government target for the year 2020.

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BIOGRAPHY

Miryem Salah is currently working as a nutritionist at Age Concern UK involved in educating the elderly on various aspects of healthy eating. Previously she worked as a researcher at East London Food Access and has contributed to studies involved in weight programs at social action for health. Miryem obtained a First class degree in BSc Human Nutrition, University of Westminster researching the effect physical activity on health following the NICE guidelines. She pursued her postgraduate research via Master degree at

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Ihab Tewfik is the Course Leader for BSc in Human Nutrition, University of Westminster, UK. Besides his biochemistry background, he holds a Master and a Doctorate in Public Health-Nutrition from the University of Alexandria, Egypt in addition to a PhD from London South Bank University. He has worked as an International Consultant for UNICEF and BC. Ihab is a Registered Public Health Nutritionist, his current research interest is body fat and its relationship with metabolic syndrome indicators in overweight childhood and adolescent stages. He also has an interest in food sciences and technology transfer. He is a member of the Editorial Advisory Boards of many international journals and a Fellow of the Royal Society of Public Health.

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