P-ISSN: 2394-1685
E-ISSN: 2394-1693
IJPESH 2015; 1(5): 11-16

www.kheljournal.com
Received: 08-04-2015
Accepted: 25-04-2015

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The Impact of Nutrition and Exercise on Weight Management

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Abstract
Excess weight is a global health risk and an important feature in discussions on the strategy for primary and secondary health care. Many obesity related health conditions can be substantially improved through changes in exercise and diet.
Exercise in weight management does not only function in the reduction of weight, it can also be used in maintaining or increasing weight depending on how nutrition is adjusted.
This paper reviewed various research contributions on nutrition, weight loss, weight gain and weight maintenance and the role of exercise and diet in weight management. The paper concludes that a positive relationship exists between lifestyle changes regular exercise, nutrition, weight management and good health.

Keywords: Weight management, Exercise, Nutrition, Lifestyle

1. Introduction
Increasing incidence of overweight and obesity along with the weight-related illnesses and associated escalating health care costs have become a major concern in our society today. As a result of these, health professionals have devised methods of balancing nutrition and exercise into people's lifestyles in order to solve this global problem.
Exercise is very important in weight management. Increased activity levels increase the body's fuel consumption. Physical activity is an important component of interventions to prevent weight gain and to enhance weight loss. Physical activity is also critically important for maintaining weight. Physical activity can also positively impact other health-related outcomes. Therefore, physical activity is recommended in intervention programs for the prevention and treatment of overweight and obesity in adults (President's Council on Fitness, Sports, and Nutrition Research Digest, 2013).
Low-fat diets have been advised for many years to reduce obesity. However, their effectiveness has been recently challenged, partly because the prevalence of obesity continues to rise despite reductions in fat intake. There are also concerns regarding the methodology of clinical trials showing benefits of fat reduction in weight loss. Although often viewed as a fad diet, very low-carbohydrate (ketogenic) diets are very popular and several recent clinical trials indicate they are more effective at promoting short-term weight loss and improving characteristics of the metabolic syndrome than low-fat diets. However, there is a need to obtain long-term safety and efficacy data. (Volek, VanHeest & Forsythe, 2005). Obesity or excessive weight gain is a condition characterized by excess accumulation of adipose tissue (i.e. fat stores). Fat stores can only be changed by a whole body energy imbalance brought on by a change in energy intake, energy output, efficiency of energy use, or a combination of any of these components. Combination of exercise and diet is far more effective in weight management than just diet alone. Exercise in weight management does not only function in the reduction of weight, it can also be used in maintaining or increasing weight depending on how nutrition is adjusted.

2. Review of research studies on the impact of nutrition and exercise on weight management.
The following research works on exercise, nutrition and weight were reviewed. Some of these focused on exercise and nutrition as tools for weight loss; exercise and weight loss; exercise and weight maintenance; exercise and diet for weight gain.

2.1 Exercise and Weight Loss
Williams, Krauss, Vranizan, Albers, Terry and Wood (1989), in their research on Effects of Exercise-induced Weight Loss on Low Density Lipoprotein Subtractions in Healthy Men, selected eighty-one sedentary men, ages 30 to 55 years who were assigned at random to either a supervised running group of 48 persons or to a sedentary control group of 33 persons and were followed up for 1 year. Those assigned to the exercise group were encouraged to run 5 days a week, 45 minutes per day after 6 weeks,

while those assigned to the control group were asked to remain sedentary throughout the year. Laboratory measurements were taken at baseline and after 3, 6, 9, and 12 months. Waist girths were measured as the horizontal circumference at the umbilicus, and hip and thigh girths were measured as the largest horizontal circumference around the buttocks and thigh with standard cloth tapes. Body compositions were estimated from hydrostatic weighing, caloric intakes were calculated from 3-day diet records, and maximal oxygen uptakes were determined from treadmill tests to exhaustion. Averages for distance run per week were obtained from diaries maintained by the runners. Lipoproteins were measured by analytic ultracentrifugation of fasting serum samples, and concentrations of total lipoprotein mass were estimated by using computer techniques for HDL2 (flotation rate F1JM 3.5 to 9), HDL3 (F1i20 0 to 3.5), small LDL (S, 0 to 7), large LDL (S, 7 to 12), intermediate density lipoprotein (IDL) (S, 12 to 20), small VLDL (S, 20 to 60), and large VLDL (S, 60 to 400) mass concentrations, and changes in the mode of the LDL particle distribution (LDL peak flotation rate). Fasting lipoprotein cholesterol concentrations were determined by the methods of the Lipid Research Clinics. The result got indicated that one-year changes in low density lipoprotein (LDL) peak flotation (SO rate and serum mass concentrations of LDL of S, 0 to 7 (small LDL), LDL of S, 7 to 12 (large LDL), Intermediate density lipoprotein (IDL) of S, 12 to 20, and very low density lipoprotein (VLDL) of S, 20 to 400 were compared between men assigned at random to a 1-year exercise program (N=48) or to a sedentary control condition (N=31). Distance run among exercisers varied substantially (mean ± SD: 12.7±8.9 km/week). Mean changes were not significantly different *between* the exercise and control groups for any of the low to very low density lipoprotein measurements. However, within the exercise group, distance run correlated negatively with changes in the mass concentrations of small LDL; and weight loss and reduced upper body obesity correlated positively with changes in small LDL, IDL, and VLDL mass and negatively with change in LDL peak flotation rate. Analyses with partial correlations suggest that weight loss may primarily affect LDL mass distributions through metabolic processes associated with high density lipoprotein or small VLDL (S, 20 to 60). The decrease in small LDL concentrations and the Increase in LDL peak flotation rate suggest that exercise-induced weight loss may be effective in reducing coronary heart disease risk in persons genetically predisposed to a high-risk lipoprotein profile. In conclusion, the majority of the exercisers who lost weight did so by running rather than by dieting.

Furthermore, the cooper institute in the year 2005 carried out a research on exercise duration and intensity in a weight-loss program in order to examine the effect of duration and frequency of exercise on weight loss and cardiorespiratory fitness in previously sedentary, overweight, women. At the end of the research, it was concluded that significant weight loss and improved cardiorespiratory fitness were achieved through the combination of exercise and diet during 12 months, although no differences were found based on different exercise durations and intensities in this group of sedentary, overweight women.

A study of 201 overweight women published in the "Clinical Journal of Sports Medicine" found that longer duration exercise at a moderate intensity had a more profound effect on weight loss than training for less time at a higher intensity.

2.2 Impact of Exercise and Diet on Weight Loss

In their research on Short-term effects of weight loss with or without low-intensity exercise training on fat metabolism in obese men, Aggel-Leijssen, Saris, Hul & A van Baak selected forty obese men who were divided randomly into 2 groups: diet (D) and diet plus exercise (DE). Both groups followed an energy restriction program for 10 wk. Subjects in the DE group also participated in a low-intensity exercise training program [40% maximal oxygen uptake (·*V*O2max)] for 12 wk. Before the intervention and after 12 wk, with subjects at stable body weights, we measured the body composition, · *V*O2max, and substrate oxidation at rest, during exercise at 50% ·*V*O2max, and during recovery. Measurements were made with and without administration of the -adrenergic antagonist propranolol. Results from the research showed that both interventions led to significant decreases in body weight, fat mass, and fat-free mass ($P < 0.001$); these decreases did not differ significantly between the D and DE groups. Neither intervention significantly affected · *V*O2max. The effect of the intervention on the respiratory exchange ratio differed significantly between the D and DE groups [two-way analysis of variance (ANOVA), $P < 0.05$]. The effect on the -adrenergic-mediated respiratory exchange ratio tended to be different between the 2 groups (two-way ANOVA, $P = 0.09$). They therefore concluded that addition of low-intensity exercise training to energy restriction counteracts the decline in fat oxidation during the post diet period.

Messier *et al.* in Exercise and Dietary Weight Loss in Overweight and Obese Older Adults with Knee Osteoarthritis, also selected three hundred and sixteen community dwelling overweight and obese adults ages 60 years and older, with a body mass index of >28 kg/m2, knee pain, radiographic evidence of knee OA, and self-reported physical disability. They randomized them into healthy lifestyle (control), diet only, exercise only, and diet plus exercise groups. The primary outcome was self-reported physical function as measured with the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Secondary outcomes included weight loss, 6-minute walk distance, stair-climb time, WOMAC pain and stiffness scores, and joint space width. The result revealed that of the 316 randomized participants, 252 (80%) completed the study. Adherence was as follows: for healthy lifestyle, 73%; for diet only, 72%; for exercise only, 60%; and for diet plus exercise, 64%. In the diet plus exercise group, significant improvements in self reported physical function ($P < 0.05$), 6-minute walk distance ($P < 0.05$), stair-climb time ($P < 0.05$), and knee pain ($P < 0.05$) relative to the healthy lifestyle group were observed. In the exercise group, a significant improvement in the 6-minute walk distance ($P < 0.05$) was observed. The diet-only group was not significantly different from the healthy lifestyle group for any of the functional or mobility measures. The weight-loss groups lost significantly ($P < 0.05$) more body weight (for diet, 4.9%; for diet plus exercise, 5.7%) than did the healthy lifestyle group (1.2%). Finally, changes in joint space width were not different between the groups. They concluded that the combination of modest weight loss plus moderate exercise provides better overall improvements in self-reported measures of function and pain and in performance measures of mobility in older overweight and obese adults with knee OA compared with either intervention alone.

In addition to these, Curioni and Lourenco (2005) [10] concluded from their review on Long-term weight loss after diet and exercise that diet associated with exercise results in significant and clinically meaningful initial weight loss. In the review, a total of 33 trials evaluating diet, exercise or diet and exercise were found. Only 6 studies directly comparing diet and exercise versus diet alone were included (3 additional studies reporting repeated observations were excluded). The active intervention period ranged between 10 and 52 weeks across studies. Diet associated with exercise produced a 20% greater initial weight loss. (13 kg versus 9.9 kg; z¼1.86Fp¼0.063, 95%CI). The combined intervention also resulted in a 20% greater sustained weight loss after 1 y (6.7 kg versus 4.5 kg; z¼1.89Fp¼0.058, 95%CI) than diet alone. In both groups, almost half of the initial weight loss was regained after one year.

In like manner, Adegboye and Linne (2013) [1] submitted from the review on diet or exercise, or both, for weight reduction in women after childbirth; that both diet and exercise together and diet alone help women to lose weight after childbirth. Nevertheless, it may be preferable to lose weight through a combination of diet and exercise as this improves maternal cardiorespiratory fitness and preserves fat-free mass, while diet alone reduces fat-free mass. This needs confirmation in large trials of high methodological quality. For women who are breastfeeding, more evidence is required to confirm whether diet or exercise, or both, is not detrimental for either mother or baby. Fourteen trials were included, but only 12 trials involving 910 women contributed data to outcome analysis. Women who exercised did not lose significantly more weight than women in the usual care group (two trials; n = 53; MD -0.10 kg; 95% confidence interval (CI) -1.90 to 1.71). Women who took part in a diet (one trial; n = 45; MD -1.70 kg; 95% CI -2.08 to -1.32), or diet plus exercise programme (seven trials; n = 573; MD -1.93 kg; 95% CI -2.96 to -0.89; random-effects, $T^2 = 1.09$, $I^2 = 71\%$), lost significantly more weight than women in the usual care group. There was no difference in the magnitude of weight loss between diet alone and diet plus exercise group (one trial; n = 43; MD 0.30 kg; 95% CI -0.06 to 0.66). The interventions seemed not to affect breastfeeding performance adversely.

2.3 Exercise and Weight Maintenance

Exercise is not only important in weight loss; it can also be efficient in maintenance of constant weight. From the studies published in the International Journal of Obesity on research carried out by DiPietro and colleagues, some encouraging findings with regard to the benefits of physical activity to weight control were reported. In a large survey of over 5,000 middle-aged men and women, they compared two-year improvements in cardiorespiratory fitness (determined by performance on a maximal exercise test on a treadmill) with changes in body weight over seven and a half years. Each one-minute improvement in treadmill time significantly minimized weight gain by about .60 kilograms (1.3 pounds) over the follow-up period compared to participants who demonstrated no improvement. More substantial improvements of three and five minutes were related to actual weight loss in both men and women. Further, each one-minute improvement in treadmill time reduced the chance of a five-kg (11 pounds) weight gain by 14 percent in men and by nine percent in women and the chance of a ten-kg (22 pounds) gain by 21 percent in both men and women. These results were not due to chance or other factors associated with exercise and body weight, such as smoking. It should be noted, however, that improvements in fitness level were necessary to minimize weight gain; simply maintaining a given fitness level was not sufficient to ward off the slow increase in body weight through middle age. The American Journal of Clinical Nutrition also reported recent findings by Williams that increasing amounts of physical activity may be necessary to effectively maintain a constant body weight with increasing age (ACSM, 2014).

2.4 Impact of Exercise and Diet (nutrition) on Weight Gain

The goal of weight gain should be to increase lean body mass (LBM) and to minimize gains in body fat. LBM consists of muscle tissue, connective tissue and bone density. Increase in LBM is best accomplished through specific weight training programs (exercise) in combination with increased caloric intake (nutrition).

Mozaffarian *et al.*, 2011 carried out research on Changes in Diet and Lifestyle and Long-Term Weight Gain in Women and Men. They performed prospective investigations involving three separate cohorts that included 120, 877 U.S. women and men who were free of chronic diseases and not obese at baseline, with follow-up periods from 1986 to 2006, 1991 to 2003, and 1986 to 2006. The relationships between changes in lifestyle factors and weight change were evaluated at 4-year intervals, with multivariable adjustments made for age, baseline body mass index for each period, and all lifestyle factors simultaneously. Cohort-specific and sex-specific results were similar and were pooled with the use of an inverse variance–weighted meta-analysis. The result showed that within each 4-year period, participants gained an average of 3.35 lb (5th to 95th percentile, −4.1 to 12.4). On the basis of increased daily servings of individual dietary components, 4-year weight change was most strongly associated with the intake of potato chips (1.69 lb), potatoes (1.28 lb), sugar-sweetened beverages (1.00 lb), unprocessed red meats (0.95 lb), and processed meats (0.93 lb) and was inversely associated with the intake of vegetables (−0.22 lb), whole grains (−0.37 lb), fruits (−0.49 lb), nuts (−0.57 lb), and yogurt (−0.82 lb) ($P \leq 0.005$ for each comparison). Aggregate dietary changes were associated with substantial differences in weight change (3.93 lb across Quintiles of dietary change). Other lifestyle factors were also independently associated with weight change ($P < 0.001$), including physical activity (−1.76 lb across quintiles); alcohol use (0.41 lb per drink per day), smoking (new quitters, 5.17 lb; former smokers, 0.14 lb), sleep (more weight gain with <6 or >8 hours of sleep), and television watching (0.31 lb per hour per day). They concluded that specific dietary and lifestyle factors are independently associated with long-term weight gain, with a substantial aggregate effect and implications for strategies to prevent obesity.

2.5 Exercise and Nutrition in Weight Management

In a study conducted by Dorien, Wim, Gabby, & Marleen, (2001) titled Short-term effects of weight loss with or without low-intensity exercise training on fat metabolism in obese men using Forty obese men were divided randomly into 2 groups: diet (D) and diet plus exercise (DE). Both groups followed an energy restriction program for 10 wk. Subjects in the DE group also participated in a low-intensity exercise training program [40% maximal oxygen uptake (VO2max)] for 12 wk. Before the intervention and after 12 wk, with subjects at stable body weights, we measured body composition, · VO2max, and substrate oxidation at rest, during exercise at 50% · VO2max, and during recovery. Their result shows that both interventions led to significant decreases in body weight, fat mass, and fat-free mass ($P < 0.001$); these decreases did not differ significantly between the D and DE groups. Neither intervention significantly affected ·VO2max. The effect of the intervention on the respiratory exchange ratio differed significantly between the D and DE groups.

Using data from the Continuing Survey of Food Intakes by Individuals (CSFII), Lin and colleagues (2002) found that obese men consumed significantly fewer vegetables and more white potatoes than men in lower BMI categories. Among women, however, vegetable or white potato consumption did not differ by BMI category. Both obese men and women consumed significantly less fruit than those in lower BMI categories. Finally, in the Cancer Prevention Study II, a cohort study, Kahn and colleagues reported an inverse association over 10 years between vegetable intake and both BMI and waist circumference among both men and women. (Kahn HS, Tatham & Rodriguez, 1997). Multivariate analysis found a decrease of 0.12 BMI units and a decreased likelihood of gain in waist circumference associated with vegetable intak greater than 19 servings per week (2.7 servings per day) versus less than 19 servings per week.

Also in a study carried out by Pedro, Paula, Chandler-Laney, Krista, Barbara, Gower, & Gary 2009) [34] on effect of Dietary Adherence with or without Exercise on Weight Loss: A Mechanistic Approach to a Global Problem using 141 premenopausal women for period of 8 weeks. The intervention for their study is 800-kcal/d^{-1} of diet provided, and the exercise groups were engaged in three sessions per week. They found out that all groups had similar weight loss (∼12.1 ± 2.5 kg) and length of time to reach target BMI (∼158 ± 70 d). Caloric restriction averaged 59 ± 9%, and adherence to diet was 73 ± 34%. Adherence to diet was inversely associated to days to reach target BMI ($r = -0.687$; $P < 0.01$) and caloric restriction ($r = -0.349$; $P < 0.01$). Association between adherence to diet and percent weight lost as fat was positive for the diet-endurance training ($r = 0.364$; $P < 0.05$) but negatively correlated for the diet-only group ($r = -0.387$; $P < 0.05$). Therefore concluded that dietary adherence is strongly associated with rates of weight loss and adversely affected by the severity of caloric restriction. Weight loss programs should consider moderate caloric restriction relative to estimates of energy requirements, rather than generic low-calorie diets.

Abby, Barbara, Darlene, Dreon, Peter and Wood, (1989) worked on Diet vs Exercise in Weight Maintenance: The Effects of Minimal Intervention Strategies on Long-term Outcomes in Men. The effect of a minimal intervention strategy on maintenance of weight lost through either energy restriction alone or exercise alone during the previous year was studied in a sample of middle-aged men. At the end of the initial year of weight loss, dieters (n = 44) and exercisers (n = 46) were randomly assigned to either an intervention condition, comprising monthly mailed informational packets and monthly to quarterly telephone contacts, or an assessment-only condition. The intervention had a significantly greater impact on weight maintenance in exercisers than it did in dieters. In addition, dieters showed a more variable pattern of weight gain and weight loss during the maintenance year than did exercisers. Based on 7-day food records and a 7-day physical activity recall questionnaire, exercisers reported a greater energy intake and a greater amount of time spent in vigorous activity relative to dieters at both the beginning and the end of the maintenance year. We conclude that exercise is easier to maintain in men using minimal contact strategies than dietary approaches to weight control focusing, on modification of energy intake, with subsequent benefits in terms of both overall maintenance and stability of weight.

Skender, Goodrick, DelJunco, Reeves, Darnell, Gotto & Foreyt (1996) [45] carried out a combined study titled Comparison of 2-year weight loss trends in behavioral treatments of obesity: diet, exercise, and combination interventions. They made use of 127 men and women who were at least 14 kg overweight (according to height-weight tables) were recruited from an urban community and assigned randomly to the experimental conditions. The intervention employed are; dietary intervention was a low-energy eating plan adjusted to produce a 1 kg/week loss of weight. The exercise component involved training in walking and a home-based program of up to five exercise periods per week. There were 12 weekly instructional sessions, followed by 3 biweekly and 8 monthly meetings. The reesult of this study at 1 year, shows no significant differences were noted among the three groups. The diet-only group lost 6.8 kg, the exercise-only group lost 2.9 kg, and the combination group lost 8.9 kg (P=.09). During the second year, the diet-only group regained weight--reaching 0.9 kg above baseline; the combination group regained to 2.2 kg below baseline; and the exercise-only group regained slightly to 2.7 kg below baseline (P=.36). Repeated measures analysis of variance showed a group-by-time interaction (P=.001); data for the dieting groups best fit a U-shaped regain curve (P=.001).

3. Conclusion

The vast majority of scientific evidence supports a beneficial role of exercise on achieving body weight stability and overall health. The goal is to find ways to motivate people to exercise and adopt healthy lifestyles. In order to achieve this objective, we must be innovative and creative in finding ways to fight against the modern way of living that drives excess energy intake relative to expenditure. Future research will be needed to give a better insight into the many issues impacting physical activity levels of people, including the barriers to healthy active living. Furthermore, we need to pay particular attention to the disparities in physical activity practice, because children with disabilities and those from low socio-economic status backgrounds are at a disadvantage. With experts around the world sounding the alarm about the consequences of escalading rates of obesity, type 2 diabetes, and cardiovascular disease, a concerted action including legislative measures to promote healthy active living is more than warranted. Specifically, government intervention needs to take the form of appropriate legal and fiscal measures designed to make healthy choices more affordable, accessible, and acceptable. By doing so, we expect that the population as a whole will be healthier

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