**Effect of Short-term Lifestyle Intervention on Biophysical Markers**

**ABSTRACT**

**Background**: The most effective strategy to combat obesity may be through lifestyle intervention. Obesity is more accurately predicted by body composition analysis or fat mass than by body mass index alone.

**Objectives**: The purpose of the study was to determine the effect of a short-term lifestyle intervention on body fat mass, physiological age, and basal metabolic rate (BMR) of overweight and obese in the Agrawal community.

**Materials and Methods**: This pre-post research was carried out in the Agrawal community of Jaipur city. Three-month lifestyle modification intervention that includes 1 hour exercise session, low calories diet and counseling for behavioral changes (on faulty eating habits) was done on ninety overweight and obese members, aged 25 to 60.

**Results**: A significant difference found (P<0.0001) between before and after three months lifestyle intervention fat mass, Physiological age and basal metabolic rate of the participants.

**Conclusion**: Short-term healthy lifestyle changes are beneficial for lowering body fat, and physiological aging.

**Key words**: Lifestyle, BMR, Body fat, Visceral fat, Physiological age

1. **INTRODUCTION**

By 2035, fifty percent world’s population will be unhealthy by body weight. Bulk of these individuals will be in developing countries, where obesity is not well understood and strategies to combat obesity is generally inadequate. A large number of children will be suffering from high blood pressure, hyperglycaemia, and low HDL cholesterol due to their high BMI. Furthermore, children are rapidly developing the NCDs linked to obesity that were previously only observed in adults (World Obesity Atlas, 2024).

 Obesity is associated with several other life style diseases such as cardiovascular diseases and type 2 diabetes. Obesity and associated diseases must be prevented and managed with life style modification. First-line intervention therapy suggested for the obesity and the metabolic syndrome is change in lifestyle which includes change in eating habits and including exercise in daily routine. Along with physical exercise, weight loss has long been recognized as an important component in the management of cardiovascular risk factors. The prevention of type 2 diabetes is one of the clinically important benefits brought about by a comprehensive lifestyle intervention that decreases baseline weight by 7 to 10% (Thomas et al., 2012). The BMI may not adequately represent cardiovascular risks and human metabolic problems since it is merely an indirect measure of body fat mass (Palaniappan et al., 2011). According to Zeng et al. (2012), percentage body fat is a better predictor than body mass index (BMI) since it is independently linked to cardiovascular risk variables.

 According to Dr. Anoop Misra, head of the National Diabetes, Obesity and Cholesterol Foundation, "multi-component intervention programs with stress on rising information, perspective and practices related to healthy nutrition, physical activity and stress management need to be enforced" (Sharma, 2014).

The obesity rising prevalence of portends negative effects for people who are affected, as well as their families and communities. A community-based strategy strengthens community assets, such as cultural customs and wisdom, with significant early community involvement. Studies on cardiovascular risk factors and obesity in particular communities may be helpful in the fight against obesity.

Agarwal is an affluent, successful, and well-known business community in India. Obesity and abdominal obesity may be caused by irregular high calorie consumption brought on by frequent participation in feasts and special events. Multiple cardiovascular risk factors, including as central obesity, hypertension, abnormal lipid profiles, and diabetes, are quite prevalent in the Agarwal community. In large part, socioeconomic and environmental variables determine the degree of obesity, with nutrition likely being the most significant contributor. Obesity linked to insufficient exercise and a diet heavy in calories and fat. Agrawal population consumes excessive amounts of calories and fat during festivities, which trigger life style diseases in Agrawal community (Mathur and Agrawal, 2005) (Gupta and Agrawal, 2009).

The significant frequency of cardiovascular risk factors in overweight and obese adults and the strong link between these risk factors and the degree of obesity highlight the need of controlling and preventing obesity in the Agarwal community from an early stage. With this aim the present study was conducted to reduce body fat and improve other biophysical parameters within the Agrawal population residing in Jaipur city.

1. **MATERIAL AND METHODS**

**Sample Selection**: Research was carried out in Jaipur's Agrawal community. Dhabariya et al. (2015) secondary data on the prevalence of dietary risk factors for chronic degenerative illnesses in the Agrawal population served as the basis for the sample selection. Using secondary data, a list of all people with a BMI more than or equal to 25 who are between the ages of 25 and 60 was created. The list was then further examined and classified on the basis of sub-zonal committee (*Up Nagariya Samaj Samiti*). Community leaders were approached for the approval from the zoning committees that had more than 50 persons (25 men and 25 women) with a BMI of less than 25. The president and secretary of these zonal committees were contacted and provided a thorough explanation of the study by the researcher. Three locations, namely Janta colony, Lal kothi, and Malviya Nagar, were chosen for the intervention program based on willingness and prolonged cooperation in providing the place for activity and organizing the people. Ninety overweight and obese volunteers, equally divided between men and women, were chosen based on their shown interest and participation. Ethical clearance was obtained by the departmental ethics committee.

**Data collection**: Baseline data were gathered, and a selected group of individuals received a three-month lifestyle intervention, which includes supervised one hour physical activity session, low calorie diet (1200 calories) recommendation, individual dietary counseling weekly. Every week one group counseling sessions were organized on different issues (Table 1) for behavioral and several customary routine changes.

**Table 1: Contents of group counseling**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Session** | **Contents** | **Method**  | **Time** | **Aids used** |
| 1 | Importance of physical activity | Face to face |  1 Hour | Power point presentation |
| 2 | Concept of a balanced diet | Face to face |  1 Hour | Charts  |
| 3 | Faulty dietary practices | Face to face |  1 Hour | Pamphlets  |
| 4 | Wrong dietary practices associated with cultural practices | Face to face |  1 Hour | Pamphlets |
| 5 | Ways to correct faulty cultural practices among Agrawals | Face to face |  1 Hour | Pamphlets |
| 6 | Quality and types of fats and oils | Face to face |  1 Hour | Power point presentation |
| 7 | Low-calorie recipes | Face to face |  1 Hour | Pictures, Demonstrations  |
| 8 | Harmful effects of smoking, alcohol, and betel nut chewing | Face to face |  1 Hour | Power point presentation |
| 9 | Dietary management in cardiovascular diseases. | Face to face |  1 Hour | Power point presentation |
| 10 | Dietary management in diabetics. | Face to face |  1 Hour | Power point presentation |
| 11 | Dietary management in obesity | Face to face | 1 Hour | Power point presentation |
| 12 | Dietary management in hypertensive patients | Face to face | 1 Hour | Power point presentation |

**Tools & Techniques:** Self-made booklet and handouts pertaining to food and exercise were distributed to the participants. Omron body composition monitor to evaluate body composition were used at the pre- and post-intervention stages.

**Data analysis:** Frequencies and percentages were computed for univariate variables. A paired t test was performed to compare changes between the pre- and post-intervention stages.

1. **RESULTS AND DISCUSSION**

**Demographic profile:** More than 60 percent of the study population was in their middle years. About 75% of the subjects have graduate degrees. Almost all participants (89%) were married, among them 75% of the participants were in administrative or business-related roles. Nearly 37% of research participants belong to nuclear family, while 23% from extended family. None of the research participants were discovered to be active smokers. Only 11% male participants reported that they occasionally drink. The majority of the research participants were vegetarian and eating less than three servings of fruits and vegetables each day (97%).It clearly demonstrates that intake of fruits and vegetables are far lower than ICMR recommendations. The majority of the research participants (85%) consumed more fat on a daily basis than advised, which a contributing factor in obesity. Almost 50 percent of the research participants used refined soybean oil as their main cooking fat.

 To maintain a degree of health and fitness, there should be a balance between body fat and muscle mass. When a person has a higher BMI, it is vital to analyze body composition to assess obesity. A body composition with higher muscular mass and less body fat is healthier. Higher body fat may have the risk of developing diabetes, heart disease, cancer and other illnesses.

 **Effect of intervention on fat mass**

Although body fat plays several vital roles in human health but excess fat leads to intricate adjustments to hormones and metabolism. Adipose tissue, a key endocrine organ, generates hormones that regulate body metabolism. A range of metabolic effects can lead to increase in fat cell mass that results from abnormalities in hormone release (Singla et al., 2010).

Table 2 depicted that participants had a mean body fat of 35.62 percent, which reduced to 32.99 percent after the intervention. It was statistically significant (P<0.0001) and the variance in the percent fat was 2.63. Similarly, a lifestyle intervention conducted for same duration on 53 overweight or obese women in South Korea. Intervention included physical activity under supervision of registered physiotherapist, individual counseling, weekly sessions of health information focusing on weight, control, diet, diet recipes and diet behavior. Results of the study showed that body fat percent reduced significantly at 5 percent level of significance after intervention. (Nho and chae, 2021).

Similarly, an intensive lifestyle intervention (weekly individual counseling, diet prescription and education of healthy lifestyle) conducted on 249 overweight or obese participants with metabolic syndrome and revealed a reduction of 5% body fat at week 13 which increased to nearly 8% at week 26 (Guzman et al., 2020).

**Table 2: Effect of intervention on body fat percentage of the study participants**

|  |  |  |
| --- | --- | --- |
| **Body fat percentage** | **Pre-intervention** | **Post-intervention** |
| **Men (n=45)** | **Women****(n=45)** | **Total (n=90)** | **Men****(n=45)** | **Women****(n=45)** | **Total (n=90)** |
| Higher than ideal body fat | 45 | 37 | 82 | 45 | 25 | 70 |
| Ideal body fat | 0 | 8 | 8 | 0 | 20 | 20 |
| Lower than ideal body fat | 0 | 0 | 0 | 0 | 0 | 0 |

Visceral body fat, sometimes known as "hidden" fat, is stored as a reserve in the deep abdominal cavity and is wrapped around the pancreas, liver, and intestines. Ten percent of the body's total fat stores are made up of it. The more visceral fat someone retains, risk for certain diseases including type 2 diabetes and heart disease become higher. Visceral obesity has also been associated with an increased chance of developing musculoskeletal and nonspecific discomfort (Li et al., 2020).

 The individuals' mean visceral fat was 14.65 percent, but following the intervention, it fell to 13.69 percent. A significant change between the subjects' pre- and post-intervention visceral fat percentages was found (P<0.0001). According to Table 4.21, visceral fat levels were greater in roughly 58% of individuals, but they dropped to 51% following the intervention.

Similarly, Krittayaphong et al. 2024 conducted a dietary intervention of 12 weeks in which almost all participants were obese and found that visceral adipose tissue decreased significantly after intervention. Our study is also in line with another study in which 7 days of diet induced energy restriction at 50 percent total daily energy expenditure resulted in favourable changes in body mass and body composition in overweight and obese subjects (Arcon et al., 2023).

**Table 3: Effect of intervention on body visceral fat percentage of the participants**

|  |  |  |
| --- | --- | --- |
| **Range of visceral fat percentage** | **Visceral fat % before intervention** | **Visceral fat % after intervention** |
| **Men (n=45)** | **Women****(n=45)** | **Total (n=90)** | **Men****(n=45)** | **Women****(n=45)** | **Total (n=90)** |
| 1-12 (Healthy) | 22(48.88) | 16 (35.56) | 38(42.22) | 26(57.78) | 18(40.00) | 44(48.89) |
| 12-59 (Unhealthy) | 23(51.11) | 29 (64.44) | 52(57.78) | 19(42.22) | 27(60.00) | 46(51.11) |

Values in parantheses are percentages

**Effect of intervention on BMR**

The basal metabolic rate is the rate at which the body expends energy while at rest to sustain vital functions including breathing, heartbeat, and brain activity. BMR is affected by a person's height, weight, age, gender, level of exercise, and body composition. Some of these features, such as weight and body composition, may be modifiable by an individual. A person's BMR may fluctuate by adding more lean muscle mass and lose weight from fat. This may be accomplished via a well-balanced diet, physical activity, and frequent cardiovascular activity (Fletcher, 2020). Men have more muscular mass than women, which raises their BMR.

 The mean real BMR before and after the intervention, were found to be greater than the mean anticipated BMR (1512.73 Kcal), as computed using the method provided by WHO/UNU/FAO, 2004. The subjects' average real BMR was 3.83 and 3.48 percent higher than their average anticipated BMR before and after the intervention, respectively.

A significant difference in the participants real BMR (P<0.0001) was observed after intervention, which decrease from 1573 Kcal to 1524.5 Kcal. In another intervention, with same calorie diet for 48 weeks in obese patients revealed 9.4 percent reduction in metabolic rate (Wadden et al., 1990). Our results are also in line with the study, which assessed effect of 24 week diet and exercise on BMR of post-menopausal women found small but significant reduction in BMR at week 12 and week 24. Reduction in BMR may be due to small but significant reduction in fat free mass (Thompson et al., 1997).

**Effect of intervention on Physiological age**

Physiological age is sometimes referred to as biological age. It depends on a person's lifestyle, diet, and exercise habits. One's physiological age can be slowed down by a nutritious diet, exercise, stress management, and enough sleep. Fresh produce, unprocessed meats, good fats, avoiding unhealthy diets, and lowering blood pressure and bad cholesterol all contribute to improve cognitive function, reduce the aging process, and lower blood pressure. Exercise enhances mood, reduces anxiety and depressive symptoms, builds bones and muscles, and increases the body's ability to store and transmit oxygen (Waters, 2023). A person's health can be inferred from a comparison of their chronological age and physiological age. Table 4 showed that significant change in the physiological ages of the individuals (P<0.0001) was found. Individuals with a greater Physiological age decreased from 92 to 88 percent after three-month lifestyle intervention. The participant’s mean Physiological age before the intervention was 57.1 years, which reduces to 53.7 years after the intervention.

 Similarly, in a study conducted by Thomas et al., 2023 tested the association of diet and physical activity with physiological aging and revealed that participants who adhere to diet and did more physical activity had an average 3.62 years lower physiological age than their chronological age as compared with those who had less healthy lifestyles.

In another lifestyle intervention (diet and exercise) of one year conducted on 93 older obese, could reduce physiological age 1.7 year by 6 months and 2.2 year by 1 year (Ho et al., 2022).

**Table 4: Effect of intervention on Physiological age of the study participants**

|  |  |  |
| --- | --- | --- |
| **Physiological age Vs. chronological age** | **Physiological age before intervention** | **Physiological age after intervention** |
| **Men (n=45)** | **Women****(n=45)** | **Total (n=90)** | **Men****(n=45)** | **Women****(n=45)** | **Total (n=90)** |
| Higher physiological age | 41(91.12) | 42(93.33) | 83(92.22) | 39(86.67) | 40(88.89) | 79(87.78) |
| Similar (Healthy) | 2(4.44) | 0(0.00) | 2(2.22) | 2(4.44) | 0(0.00) | 2(2.22) |
| Lower (Healthy) | 2(4.44) | 3(6.67) | 5(5.56) | 4(8.89) | 5(11.11) | 9(10.00) |

Values in parantheses are percentages

Additionally, it was discovered that the subjects' total body fat, visceral fat, age, and BMR were significantly decreased (P<0.01). Given that body weight was used to calculate BMR and that participants' BMR decreased after the intervention, it is possible that this is what caused the change.

1. **CONCLUSIONS**

It is concluded that a three months lifestyle intervention that included supervised daily one hour exercise, low calorie diet, individual and group counseling session with educational printed material had a positive effect on body fat and physiological age of overweight and obese adults. Significant reduction in BMR may be an indication of loss of lean body mass. To increase the health benefits or improvement in health a person should adhere to long term intervention.

**LIMITATIONS AND FUTURE DIRECTIONS**

There are some limitations to the study. First, since the study sample was from one specific community, the findings might not generalize to the entire overweight and obese population. Second, the intervention lasted 3 months; however there were limitations in identifying the positive effect on basal metabolic rate, and since it is necessary to maintain healthy weight, long term studies are needed. Third, absence of the control group restricts casual reference and makes it difficult to rule out the influence of external factor on observed outcomes. Future studies should consider including a control group to strengthen the validity of findings. Additionally, Seasonal variations were not recorded.

**ACKNOWLEDGEMENT**

 UGC offered financial assistance in the form of a Senior Research Fellowship.

**REFERENCES**

1. World obesity atlas. 2024. https://www.worldobesity.org/news/world-obesity-atlas-2024
2. Thomas et al., 2012
3. Palaniappan LP, Wong EC, Shin JJ, Fortmann SP, Lauderdale DS. Asian Americans have greater prevalence of metabolic syndrome despite lower body mass index. *Int J Obes.*2011; 35:393–400.
4. Zeng, Q., Dong, S. Y., Sun, X. N., Xie, J., & Cui, Y. (2012). Percent body fat is a better predictor of cardiovascular risk factors than body mass index. Brazilian journal of medical and biological research = Revista brasileira de pesquisas medicas e biologicas, 45(7), 591–600. <https://doi.org/10.1590/s0100-879x2012007500059>
5. Sharma, T., Kalra, J., Dhasmana, D.C., Basera, H. (2014). Poor adherence to treatment: A major challenge in diabetes. *The Journal, Indian Academy of Clinical Medicine,* 15(1), 26-29.
6. Mathur, R., & Agrawal, M. (2005). A study on presence of risk factors of obesity among adult population of Agrawal community. [MSc dessertation, University of Rajasthan].
7. Gupta R, Agrawal M. (2009). High cardiovascular risks in a North Indian Agarwal community: a case series. Cases journal, 2, 7870. https://doi.org/ 10.1186/1757-1626-2-7870
8. Dhabriya, R., Agrawal, M., Gupta, R., Mohan, I., and Sharma, KK. (2015). Cardiometabolic risk factors in the Agarwal business community in India: Jaipur Heart Watch-6. Indian heart journal.
9. Singla, P., Bardoloi, A., & Parkash, A. A. (2010). Metabolic effects of obesity: A review.  , 1(3), 76–88. https://doi.org/10.4239/ wjd.v1.i3.76
10. Nho, J.-H.; Chae, S.-W. Effects of a Lifestyle Intervention on Health-Promoting Behavior, Psychological Distress and Reproductive Health of Overweight and Obese Female College Students. Healthcare 2021, 9, 309. https://doi.org/10.3390/healthcare9030309
11. Guzmán, M., Zbella, E., Shah, S., Alvarez, J., Nguyen, L., Imperial, E. Troncale, F J, Holub, C., Mallhi, A. K. and VanWyk, S. (2020). Effect of an intensive lifestyle intervention on the prevalence of metabolic syndrome and its components among overweight and obese adults, *Journal of Public Health*, 42 (4), 828-838, <https://doi.org/10.1093/pubmed/fdz170>
12. Li, S, Schwartz, AV, LaValley, MP, Wang, N, Desai, N, Sun, X, Neogi, T, Nevitt, M, Lewis, CE, Guermazi, A, Roemer, F, Segal, N, Felson, D, & Multicenter Osteoarthritis Study Group (2020). Association of Visceral Adiposity with Pain but Not Structural Osteoarthritis. *Arthritis & rheumatology (Hoboken, N.J.)*, *72*(7), 1103–1110.
13. Arcon M, Malone J, Barton KL, Rocha J. (2023). The acute effects of diet-induced energy restriction on physical activity energy expenditure and basal metabolic rate in men and women with overweight and obesity. Human Nutrition & Metabolism. 1(32):200185.
14. Fletcher, J. (2020, March 9). What to know about basal metabolic rate. <https://www.medicalnewstoday.com/articles/basal-metabolic-rate>
15. Wadden TA, Foster GD, Letizia KA, Mullen JL. Long-term Effects of Dieting on Resting Metabolic Rate in Obese Outpatients. *JAMA.* 1990;264(6):707–711. doi:10.1001/jama.1990.03450060053028.
16. Thompson, J.L., Gylfadottir, U.K., Moynihan, S., Jensen, C.D., Butterfield, G.E. (1997). Effects of diet and exercise on energy expenditure in postmenopausal women,

The American Journal of Clinical Nutrition, 66 (4), 867-873, ISSN 0002-9165,<https://doi.org/10.1093/ajcn/66.4.867>. (https://www.sciencedirect.com/science/article/pii/S0002916523180191)

1. Water, D. (2023, April 13). <https://www.womanandhome.com/health-and-wellbeing/biological-age-calculator-20430/>
2. Ho, E., Qualls, C., and Villareal, D.T. (2022). Effect of Diet, Exercise, or Both on Biological Age and Healthy Aging in Older Adults with Obesity: Secondary Analysis of a Randomized Controlled Trial. J Nutr Health Aging, 26 (6):552-557. doi: 10.1007/s12603-022-1812-x. PMID: 35718862; PMCID: PMC9236175.
3. Thomas A, Belsky DW, Gu Y. Healthy Lifestyle Behaviors and Biological Aging in the U.S. National Health and Nutrition Examination Surveys 1999-2018. J Gerontol A Biol Sci Med Sci. 2023 Aug 27;78(9):1535-1542. doi: 10.1093/gerona/glad082. PMID: 36896965; PMCID: PMC10460553