REVIEW ARTICLE

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A STUDY ESTABLISHING THE IMPORTANCE OF BODY COMPOSITION ANALYSIS, REGULAR PHYSIOTHERAPY AND DIETARY MODIFICATIONS FOR INDEPENDENT AND HEALTHY LIVING AMONG GERIATRIC POPULATION: A DETAILED SYSTEMATIC REVIEW ARTICLE

*[1]Dr. Rohit Subhedar
[2]Dr. R. K. Sinha
[3]Dr. Saumi Sinha

ABSTRACT

Background: This systematic review article aims towards comprehensive and elaborative collection of research articles related to the importance of body composition analysis, Physiotherapy and nutrition for independent geriatric lifestyle. The review article includes articles which suggest the importance of Body composition analysis, Physiotherapy interventions, specific exercises and a combination of fat free, fiber, fruit and fluid diet.

Methods: A comprehensive electronic search was conducted using electronic databases Pub Med, MEDLINE, Google Scholar, Science Direct, Research gate, ICMJE, DOAJ, DRJI, IOSR, WAME and many others. In Total 3714, Research papers were reviewed which reported, Age ≥50 years, changes in Body composition in elderly , effects of Diet &Exercises on Body composition and effects of regular Physiotherapy in Geriatric health and obesity. Literature search was restricted to the studies conducted during 1980-2015.

Results: Finally 55 papers along with references in research proposal were included. Review shows that ageing, body composition, Physiotherapeutic intervention and nutrition play an interdependent role in providing independent and healthy living among geriatric population.

Conclusion: Combined and comprehensive interventions in form of periodic Body Composition Analysis, Physiotherapy interventions with Exercise therapy sessions and Nutritional Supplementation, will be more effective in combating ageing and independent healthy living among Geriatric population. Finally with this review we shall conclude that achieving perfect geriatric health depends upon awareness among the geriatric community to periodically analyze their body composition and regularly comply with exercise therapy sessions, subjective Physiotherapy modality sessions and nutritional supplementation. These principles help in achieving physically fit, healthy, happy and independent geriatric Community.

Keywords: Geriatric population, Body composition, Nutrition, Physical exercises, Physiotherapy

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[2]Principal,
Jaipur Physiotherapy College,
MV Global University Jaipur,
Rajasthan-India
[3]Professor,
Jaipur Physiotherapy College,
MV Global University Jaipur,
Rajasthan-India

CORRESPONDING AUTHOR

***[1]Dr. Rohit Subhedar**

PhD Reg. No. MVGU13PB1PT10
PhD Research Scholar,
Jaipur Physiotherapy College,
MV Global University Jaipur,
Rajasthan - India

BACKGROUND

It is seen in today's challenging and ever demanding life style, that geriatric community faces enormous stress in maintaining a quality lifestyle, having physically and psychosocially independent Geriatric health. Our detailed review addresses the same concern and is an extension for our previously published research proposal "A comparative study establishing the importance of physiotherapeutic principles and body composition analysis in promoting independent and healthy living among randomized geriatric population of Indore District" for PhD in Physiotherapy.[1] This review elaborates the research by including a vast collection of Literature Reviews and thus enriches our study. Our study aims towards perfect and healthy living among randomized geriatric population of Indore District.

Advancing age is associated with profound changes in body composition, the most notable of which is sarcopenia, a major determinant of frailty, disability and mortality.[2] Sarcopenia is an age related loss of muscle mass and strength, and is associated with a lower quality of life resulting from a reduced ability to perform daily living tasks.[3] Body composition changes with aging.[4] The process of ageing involves decrease in Total body water, bone mass and fat free mass and increase in fat mass.[5] Thus it is desirable to measure body composition in elderly.[6] Describing the aging effect on body composition provides, important epidemiological information for identifying possible etiologic mechanisms as targets for treatment and prevention of such adverse health outcomes, given the worldwide growth rates of obesity[7] and the increase of the aging population.[8] Two important modifiable factors for loss of muscle mass are physical activity[9] and diet[10]; other factors are fixed (such as sex, size, heritability, and early life environment).[11] Nutritional status and physical activity are mutually dependent since nutrition without physical activity cannot preserve the body's muscle mass and physical activity without an adequate amount of nutrition results in poor nutritional status.[12] Inadequate nutrition, oxidative stress, low physical activity levels, inflammation, and reduced hormone concentrations contribute to age related muscle loss.[13] Weight loss and (protein-energy) malnutrition in older persons are predominantly caused by a decline in food intake.[14-15] Numerous studies have found that these nutritional supplements enhance the magnitude of gain in lean body mass and muscle strength in older adults undergoing exercise training.[3,13,16] Physical activity is one of the most important lifestyle factors that determine human health status and biological growth.[17] PA affects total fat oxidation and fat balance through the promotion of a better body composition (loss of fat mass and maintenance of lean mass).[18] Thus, the purpose of this research article is to review the age related changes in body composition, effects of exercises on body composition and effects of exercises and nutrition on body composition among geriatric population. Aim of this review is to establish the importance of body composition as a deciding factor for developing a subjective physiotherapy program specifically aiming towards geriatric health; creating awareness among geriatric community and encouraging preventive approach rather than curative for healthy and independent living among geriatric population of our region.

METHODS

Literature Search

A comprehensive electronic search was conducted using electronic databases (Pub Med, MEDLINE, Google Scholar, Science Direct, Infotrieve, Research gate, ICMJE, DOAJ, DRJI, IOSR, WAME and many others. Mentioned here are few of those very important databases that helped us the most.). The study was limited to the research papers published in the period from 1980-2015. Key words for the electronic databases searches are shown in table 1. The entire study has been conducted at Bombay hospital – Indore, India.

Study Selection criteria

Research papers were reviewed based upon following criteria-

1. Age ≥50 years
2. Original research
3. Those Papers, which reported the age, related changes in Body composition.
4. Those Papers, which reported effects of Diet, Exercise and Body composition among elderly.
5. Those Papers, which reported effects of different exercises, Body composition analysis and aging.
6. Those Papers, which reported role of Physiotherapy in Geriatric health, in obesity & in preventing effects of aging by promoting physiotherapy for Independent geriatric life.[7]

Table 1: Search terms

Facets	Search Terms
Physical exercises	- Physical activity, strength & Endurance training, Bio Electrical Impedance, sarcopenia
Old people	- Elderly, aged, older, ageing adult, old men & women, elders, Physiotherapy, Independence
Nutrition	- Diet, Dietary intake, dietary supplementation, nutritional supplementation, Fat analysis, etc.
Physiotherapy	- Pain, Fat, Fitness, Exercise Therapy, Physiotherapy interventions, Body composition etc.

Data collection and Scrutiny

A descriptive method and theoretical analysis was used for this review article, with references & review's from a huge Database of previous literatures from the year 1980 to 2015. Finally this study short listed few studies and included 55 Research studies very closely associated with our inclusion criteria. Summary of literature search is shown in Fig 1

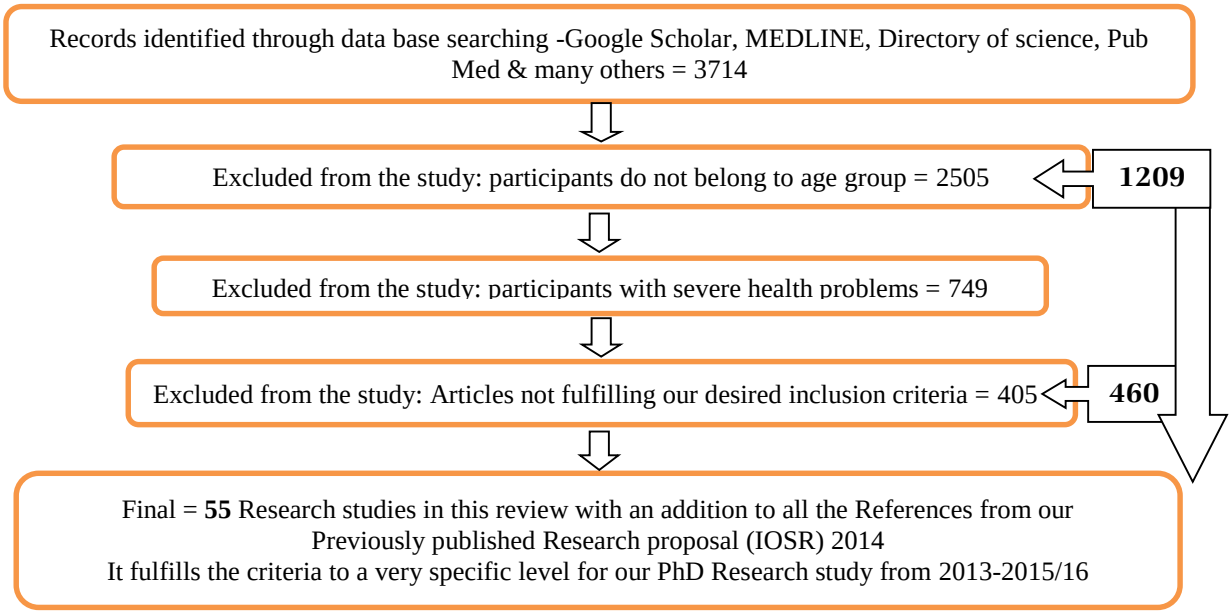

Fig 1 Summary of literature search

RESULT AND DISCUSSION

Table 2: Summary of Literature showing Age related Changes in Body Composition

REFERENCES	STUDY DESIGN	N	MEASURED BODY COMPOSITION PARAMETERS
1. Shumei S Guo et al (1999)	Longitudinal study Participants were white with age group 40-66 years.	102/M 108/F	Height, Weight, BF, FFM and BMI
2. Virginia A Hughes et al (2002)	Longitudinal study Participants with mean age 60.7 ± 708 years	53/M 78/F	FFM and FM
3. John W Mott et al (1999)	Subjects age group was between 20-94 years Four ethnic groups were studied: Asians, blacks, Puerto Ricans, and whites.	1324	BF
4. Andrew S. Jackson et al. (2012)	Longitudinal changes in body Composition of healthy men age group 20-96 years	7235	BM, BMI, FM, %BF and FFM
5. Ying Jiang et al (2015)	Retrospective analysis of the body composition, BMI, and BMD of Chinese male outpatients between 50 and 89 years of age	358	BMD, LM,FM and BMI
6. Richard N. Baumgartner et al (1995)	Age differences in body composition and anthropometry were examined in men and women aged 60 to 95 years.	316	FFM, BCM, TFM, %BF, ASM
7. UG Kyle et al (2001)	Subjects were Healthy ambulatory Caucasians aged 18 ± 94 y	253/M 180/F	ASMM, FFM, BCM,FM and %BF
8. MarjoleinVisser et al (2003)	Population-based cohort subjects were black and white men and women aged 70–79 yr, participants of the Health, Aging, and Body Composition Study		Body weight, %BF, Skeletal muscle mass, ALST mass.
9. KA Shaw et al (2007)	Cross-sectional study. A population-based sample of adults aged between 50 and 79 years underwent measurement of BMI, waist circumference, WHR, DXA total body fat mass, DXA % total body fat, DXA % trunk fat and DXA lean body mass.	731	LBM, TFM,%FM, % TRUNK FAT
10. Anne B Newman et al (2005)	Observed changes in weight and body composition during a 4-y period aged 70–79 y in the Health, Aging and Body Composition Study cohort. Whole-body and appendicular bone-free lean mass and fat mass were measured by using dual-energy X-ray absorptiometry.	1027/M 1136/F	Weight, LBM, FM (Regional And Total)

BF = Body Fat; FFM = Fat Free Mass; LBM = Lean Body Mass; TFM = Total Fat Mass; BM = Body Mass; BMD = Bone Mass Density; ASM = Appendicular Skeletal Mass; ASMM = Appendicular Skeletal Muscle Mass; ALST = Appendicular Lean Soft Tissue; FM = Fat Mass; BCM = Body Cell Mass.

Table 3: Summary of Literature showing Effects of exercises on Body Composition

References	Study Design	N	Intervention	Outcome measures
1. Samaras K et al. (1999)	Cross-sectional and case-control twin study Participants were healthy white female twins Age group 39-70 yrs.	970	Physical activity at home, sport, walking, Leisure time physical activity, Weight bearing and non-weight bearing sport activity	TBF and central Abdominal fat
2. Ales Gaba et al (2009)	Women of age group 56-73 years. Sample divided into individual subgroups according to recommendations concerning moderate physical activity and the number of steps made on average per day.	43	Physical Activity	BFI, BMI, FFMI
3. Shmei S Guo et al (1999)	Longitudinal study Participants were white with age group 40-66 years	102/M 108/F	Physical activity	BF, %BF, FFM, weight, BMI
4. Thaddeus Haight et al (2005)	Age group of participants were 55 yrs and above and participated in a community-based, longitudinal study of the effect of aging on functioning in the elderly	947/F 708/M	Leisure Time Physical Activity	Transitions in Functional Limitation
5. Robert S. Schwartz (1991)	Subjects were of two age groups. Younger group with mean age 28.2 ± 2.4 and older group with mean age 67.5 ± 5.8	13- young age 15- old age	6 month endurance training Jog, bike, cycle	Thigh and arm circumference, WHR, IA fat, weight, %BF, FM
6. Dalino Sales Bocalini et al (2012)	Women of age group >60 years. Randomized into 6 groups according to BMI- Aw, AWC, AWT, OW, OWC, OWT, O, OC, OT	70	Circuit based exercise program; 50 min; 3 times per week for 12 week. Exercises were alternated between upper and lower body. Knee flexion, arm raise, shoulder abduction and adduction/rotation, squat, biceps, triceps. Hip extension.	BW, BF%, BF, FM, LM, BMI
7. Wayne C Campall et al (1994)	14 week metabolic study, initialy 2 week baseline and 12 week-progressive resistance exercise. Age group 56-80 years	8/M 4/F	Diet intervention- 3 different menus of lactogenic food intake 0.6 gm protein $kg^{-1}d^{-1}$Resistance Training- Chest press, front pull, knee flexion/extension.	FM, FFM, TBW, RMR
8. Damian Skrypnik et al (2015)	Women of 18-65 years with abdominal obesity were included and randomized in 2 groups having endurance and endurance strength training for 3 months 3 times per week for 60 min	44	Endurance training- cycle ergo meter prior to that 5 min of low intensity warm up. Endurance Strength Training- cycle ergo meter, strength exercises with neck barbell and gym-ball	BF, BMI, FFM
9. Marco Berganini et al (2013)	Subjects were randomly assigned to Aquatic Group, Land Group and Control Group. Mean age was 71.2 ± 5.4. AG	29/M 30/F	Single leg knee and hip flexion/extension, lateral side bounce, calf raises, shoulder flexion/extension/adduction/abduction, forward and lateral push	FM, FFM, Forearm Fat, Physical Function, Muscle Mass, trunk FM and FFM
10. Kristen M. Beaver et al (2014)	18 month randomized controlled trial included overweight/obese men and women of age group 60-79 years. Treatment group consist of PA+WL (n=98), PA only (n=97) and successful ageing health education group (n=93)	288	PA+WL- PA with dietary WL intervention- walking, interactive group mediated behavioral focused sessions. Gradually increasing home-based moderate intensity activity >150 min/week. Later PA consists of initial phase and then maintenance phase next 12 month.	FM, LM AND BW

BF = Body Fat; FFM = Fat Free Mass; LM = Lean Mass; BW = Body Weight; FM = Fat Mass; TBW = Total Body water; RMR = Resting Metabolic Rate; WHR = Waist Hip Ratio; IA = Intra -Abdominal

Description of the entire Literature in Brief:

1. Age related changes in body composition

- Table 2 describes in brief the literature summary of Age related changes in Body composition. The summary shows that Significant changes in body composition are known to occur with aging and are believed to be a consequence of imbalances between energy intake and energy needs associated with increasing sedentary life style.
- Shumei S Guo et al showed the changes in body composition with age in his longitudinal study. There was an age-related, increasing trend in body weight in the men of <0.3 kg/y and

women of <0.55 kg/y. Total BF values also increased with age in men by <0.37 kg/y and in women by <0.41 kg/y, whereas the average annual increase in percentage BF was 0.32%/y. BMI in men increased with age at an average annual rate of <0.11 kg·m22·y21 and no change in women. FFM decreased with age at an annual average rate of <0.07 kg/y and in women <0.11 kg/y. this study also compared body composition changes in pre, peri and postmenopausal women which shows Postmenopausal women had significantly higher total BF and percentage BF than did pre, peri and postmenopausal women.[19]

- Longitudinal study done by Andrew S Jackson et al reported the changes in men with decrease in body mass with 0.80 and 1.97 kg in the seventh and eight decade. Also there was increase in body mass till the sixth decade. Fat mass changes with age showed increasing trend with ageing till sixth to seventh decade but decreased in eighth decade by 0.25kg. BF% and BMI also increase up to 88 years and 77 years respectively then no change after that.[20]
- John Mott et al in their study concluded that there is decrease in body fat in elderly.[21] Many other studies also reported decrease in FFM, BMI and Body weight and increase in FM.[22-24] With weight change, a greater proportion of lean mass than of fat mass was conserved, but, especially in older men, significantly more lean mass was lost with weight loss than was gained with weight gain.[25] Appendicular skeletal muscle mass was found significantly lower in elders as compared to young age group[26-27] and Loss of ALST was greater in men compared with women.[28]

2. Effects of Exercises on Body composition: Table 3 shows the summary.

- Samaras K et al investigated the effect of physical activity on body fat in their cross sectional study. Total-body and central abdominal fat found to be lower with 5.6 kg and 0.44 kg, respectively, in participants who reported vigorous weight-bearing activity and higher level of home and sport activity associated with sweating showed lower total body and central abdominal fat.[29-30]
- Aleš Gaba et al in their study reported less amount of visceral fat among the active women and higher proportion of soft lean mass in the right and left upper limb and on the trunk. Other than total body fat, physical activity is also associated with other body composition parameters.[30] Studies also showed reduction in percentage BF and weight in men and increase in FFM in women with decrease in BMI.[21] Some studies shows significant decrements in weight, percent body fat, and fat mass and small decrements were noted in the WHR in men[31] and women.[32] Other than fat mass total body lean and total body fat-free mass also increases in the women participated in endurance strength training.[32] Physical exercise + Weight Loss program resulted in a significant reduction in percent body fat with a concomitant increase in percent body lean mass.[33] It was found in one study that resistance training decreases the Fat mass and percent Body Fat and increases the FFM.[34]
- Wayne W Campbell et al study that increase in FFM is associated with increase in TBW. TBW increases with an average of 4.2% and also there is increase in RMR by 6.8%.
- Danilo Sales Bocalini et al showed the effect of circuit based exercise program on body composition. The values (mean ± standard deviation [SD]) of relative changes to BW (−8.0% ± 0.8%), BF (-21.4% ± 2.1%), LM (3.0% ± 0.3%), and FM (−31.2% ± 3.0%) to the obese trained were higher (P , 0.05) than in the appropriate weight trained (BW: −2.0% ± 1.1%; BF: −4.6% ± 1.8%; FM: −7.0% ± 2.8%; LM: 0.2% ± 1.1%) and overweight trained (BW: −4.5% ± 1.0%; BF: −11.0% ± 2.2%; FM: −16.1% ± 3.2%; LM: −0.2% ± 1.0%) groups showing that it is an effective method for promoting reduction in anthropometrics parameters in obese older women.[35]
- Bergamin et al results showed that Aquatic based (AG) exercises can also prove a potential tool for improving physical performance and body composition.[36] Leisure-time Physical Activity and body composition also have their effects on transitions in physical functioning in elderly.[37] It showed higher levels of physical activity appeared to reduce the risk of future functional limitation conditional on the level of functioning established early in the disablement process by lean mass: fat mass ratio.

3. Effects of Diet, exercise and body composition among elderly

- Understanding the benefits of maintaining sufficient levels of physical activity and diet quality in older age is central to considerations of current and future public health strategies, to promote better physical function and health in later life.[11] Many studies have been conducted to evaluate the effects of resistance training and dietary intakes on muscle strength, functional performance and body

composition among elderly which motivated us for further research.

- Maria A. Fiatarone et al, A randomized controlled clinical trial of 10 weeks was conducted by them ,in which participants were assigned to receive lower-extremity resistance training, a multi-nutrient supplement, both treatments, and a placebo activity and supplement. Subjects assigned to exercise training underwent a regimen of high-intensity progressive resistance training of the hip and knee extensors 3 days per week. The nutritional supplement [240-ml liquid supplying 360 kcal in the form of carbohydrate (60 percent), fat (23 percent), and soy-based protein (17 percent)] was given once each day in the evening to minimize the effect of exercise training on habitual food intake and augment calorie intake by about 20%. Supplement. The main finding was increase in Muscle strength by 113 $\pm$8 percent. Gait velocity and stair climbing power also increases in exercising group and augmentation of total energy intake that was attributable to exercise.[38]
- D. Bunout et al, studied elderly subjects from two outpatient clinics received a nutritional supplement that provided 400 Kcal, 15 g /protein and 50% of vitamin DRVs per day. Half the subjects receiving and not receiving the supplement were randomly assigned to a resistance exercise-training program with two sessions per week. Every six months, body composition using DEXA, limb muscle strength, maximal inspiratory and expiratory pressures and walking capacity were assessed. Results of this study showed significant increase in Upper and lower limb strength and walking capacity in trained subjects whether supplemented or not. Maximal inspiratory pressure and right hand grip strength increased only in the supplemented and trained group. No change was observed in fat free mass but fat mass increased from 22.5$\pm$7.3 to 23.2$\pm$7.3 kg in all groups.[39]
- Andrea Brose et al and Joan Trabal et al also showed the effect of resistance training, but the nutritional supplement they used was creatine[40] and leucine[41] Andrea Brose et al study included Twenty-eight healthy men and women over the age of 65 years. All participated in a whole body resistance exercise program 3 days per week for 14 weeks. This study confirms that supervised heavy resistance exercise training can safely increase muscle strength and functional capacity in older adults. The addition of CrM supplementation to the exercise stimulus enhanced the increase in total and fat-free mass, and gains in several indices of isometric muscle strength.[40]
- Joan Trabal et al conducted a randomized, double blind, placebo-controlled, parallel study with two intervention groups. Analysis of changes in strength revealed a possible beneficial effect for maximal overcoming isometric leg strength in LG when compared to CG at both time point of assessment i.e. 4 weeks and 12 weeks.[41]
- ErikRosendah et al, determines the positive effects of high-intensity functional exercise program in improving balance, gait ability, and lower-limb strength in older persons. Intake of protein-enriched energy supplement immediately after the exercises increases the effects of the training.[42]
- Denise K Houston et al in Health Ageing and Body composition study[43] determined the association between dietary protein and changes in total LM and non-bone appendicular LM (aLM) in older, community-dwelling men and women. Participants in the highest quintile of protein intake lost40% less LM and aLM than did those in the lowest quintile of protein intake (-0.501$\pm$0.106 kg compared with -0.883$\pm$0.104 kg for LM; 0.400 $\pm$ 0.058 kg compared with -0.661$\pm$0.057 kg for aLM; P for trend-0.01). Thus results suggest that low protein intake may be a modifiable risk factor for sarcopenia among older adults.[43]
- KE Foster-Schubert et al had done the study on overweight to obese postmenopausal women to determine the effects of a calorie-reduced, low-fat diet, a moderate-intensity, facility-based aerobic exercise program, or the combination of both interventions, vs. a no-lifestyle change control on change in body weight and composition. Participants were randomly assigned the groups according to the intervention. Group D consists of participants taking calories reduces diet, group E consist of exercise intervention participants. Control group is group C. Average weight loss at 12 months was $-$8.5% for the D group ($P<0.0001$ vs. C), $-$2.4% for the E group ($P=0.03$ vs. C), and $-$10.8% for the D+E group ($P<0.0001$ vs. C), while the C group experienced a non-significant $-$0.8% decrease. BMI, waist circumference, and % body fat were also similarly reduced.[44]
- Marijke J.M et al[45] conducted a 17-week randomized, placebo-controlled trial. Thirty-nine subjects participated in a twice-weekly group exercise designed to improve daily

functioning. 39 subjects daily ate foods enriched with vitamins and minerals (at 25%–100% of the recommended daily allowances); 42 subjects exercised and ate enriched foods. Performance sum scores were significantly enhanced in trained (-8%) compared with non-trained subjects (-8%). Fitness sum scores were significantly enhanced as well. No exercise effects on the disability score were observed. Consumption of enriched products showed no benefits in 17 weeks. Many studies showed the relationship between physical exercise, dietary supplements and body composition.

- Nynke de Jong et al conducted a 17-week randomized, controlled intervention trial, following a factorial design—(1) enriched foods, (2) exercise (3) both (4) neither— was performed in 143 frail elderly persons. Subjects had to consume 2 products per day: 1 from a series of fruit products and 1 from a series of dairy products. Muscle strength, coordination, flexibility, speed, and endurance were trained with use of different materials, such as balls, ropes, weights, and elastic bands. Group sessions were held twice a week for 45 minutes and were of moderate; gradually increasing intensity main outcome measures were body composition and bone. The main findings were Exercise preserved lean mass (mean difference between exercisers and non-exercisers: 0.5 kg and 1.2 kg; P < . 02). Groups receiving enriched food had slightly increased bone mineral density (+0.4%), bone mass (+0.6%), and bone calcium (+0.6%) compared with groups receiving non-enriched foods[46].
- Gurpreet Kaur et al determined the relationship of body composition with dietary factors and physical activity level of women in four age groups i.e. 21 - 30, 31 - 40, 41 - 50 and 51 - 60 years. This cross sectional study was conducted on 152 sedentary Indian women. A structured "24 Hour Recall" questionnaire to collect the information regarding food intake was developed and pre tested. The subject was asked about the types of food preparations and Physical Activity Diary Method for different activities. The life style of the subjects was determined on the basis of Physical Activity level values. A high fat mass and low lean body mass of the subjects was observed.[47]Their diets were low in protein but high in fat. Majority of the subjects from different age groups had sedentary life style. Liza Bowen et al study also showed the association between diet physical activity and fat distribution. There was an inverse association between PA and body fat. Associations between body fat and dietary variables differed between the younger population and older population.[48]
- M. Bonnefoy et al[49] The effect of exercise and protein–energy supplements on body composition and muscle function in frail elderly individuals was also assessed by them in their study. Exercise and nutritional combination was assessed in a 9-month randomized trial with a factorial design. Fifty-seven elderly volunteers over 72 years participated in the study. Dietary supplements were compared with placebo, and physical exercise was compared with memory training. Main outcome measures were fat-free mass (FFM) and muscle power. Exercise intervention included progressive strengthening exercises (using dumbbells and elastic bands) performed in both the seated or kinetic chair position (weight bearing); balance training exercise; flexibility exercise. Conclusion can be made from these studies that, there exist a strong association between diet, physical activity and body composition.[49]
- MJM Chin A Paw et al examine the effects of 17 weeks of physical exercise and micronutrient supplementation on the psychological wellbeing. 139 elderly inactive participants were included and randomly assigned to four groups consisting of comprehensive, moderate intensity, group exercise; (b) daily micronutrient enriched foods (25–100% recommended daily amount); (c) both; (d) neither. Moderate to low but significant correlations were found between general wellbeing scores and physical fitness (r = 0.28), functional performance (r = 0.37), and blood concentrations of pyridoxine (r = 0.20), folate (r = 0.25), and vitamin D (r = 0.23) but not with physical activity levels and other blood vitamin concentrations. The moderate but significant correlations between wellbeing and physical fitness and several blood vitamin concentrations at baseline suggest that changes in wellbeing may occur after long-term interventions.[50]

4. Nutrients in form of Vitamin B_{12} and Vitamin D-

- Vitamin B12 deficiency is now emerging as a worldwide problem.
- Sally P. Stabler and Robert HAllen reported that Dietary deficiency of vitamin B12 due to vegetarianism is increasing and causes hyperhomocysteinemia. The breast-fed infant of a vitamin B12–deficient mother is at risk for severe developmental abnormalities, growth failure, and anemia[51]. Dietary vitamin B12

deficiency is a severe problem in the Indian subcontinent, Mexico, Central and South America, and selected areas in Africa. Dietary vitamin B12 deficiency is not prevalent in Asia, except in vegetarians. Vitamin B_{12} deficiency is estimated to affect 10%–15% of people over the age of 60; it was found that absorption of protein-bound vitamin B_{12} is decreased in the elderly compared to young, owing to a high prevalence of atrophic gastritis in this age group. Atrophic gastritis results in a low acid-pepsin secretion by the gastric mucosa, which in turn results in a reduced release of free vitamin B_{12} from food proteins.[52]

- Yao Y et al, found higher prevalence of Cbl deficiency in geriatric outpatients. In a prospective study, 100 geriatric outpatients with age group ≥65 years were tested. Sixteen percent of geriatric outpatients had serum Cbl levels of 200pg/mL or below, and 21% had levels between 201 and 299 pg/mL. Among the 16 patients with levels < or = 200 pg/mL, 2 patients had macrocytic anemia, 3 patients had peripheral neuropathy, and 8 patients had type Agastritis. Among the 21 patients with levels of 201 to 299 pg/mL, 2 patients had peripheral neuropathy, 9 patients had type A gastritis, and none of the patients had macrocytic anemia. It has been suggested that the lower limit of the normal range for Cbl level should be increased to 300pg/mL.[53] Relationship between maternal vitamin B12 status and cognitive function of their offspring was studied by Vidya Bhate et al. Children born in the Pune Maternal Nutrition Study were investigated. Two groups of children were selected on the basis of maternal plasma vitamin B12 concentration at 28 weeks of gestation: group 1 (n = 49) included children of mothers with low plasma vitamin B12 (lowest decile, < 77 pM) and group 2 (n = 59) children of mothers with high plasma vitamin B12 (highest decile, > 224 pM). Thus Maternal vitamin B12 status in pregnancy influences cognitive function in offspring.[54]
- Sonia Arunabh et al evaluated 410 healthy women between 20 and 80 yr of age. The subjects varied from lean to mildly obese with body mass index (BMI) ranging from 17–30 kg/m2. The levels of serum 25-OHD inversely correlated with percentage body fat. This study suggests that percentage body fat is independently associated with serum levels of 25-OHD in healthy women besides other well-known factors such as dietary vitamin D intake, season, age, and race. The levels of serum intact PTH and 1, 25-hydroxyvitamin D are elevated in morbidly obese patients, whereas levels of 25-hydroxyvitamin D (25- OHD) have been found to be low (1– 4).[55]
- Denise K. Houston et al, baseline serum 25(OH) D was measured in 1998–1999, and physical performance and strength were measured at baseline and at 2- and 4-year follow-up. Participants with 25(OH) D < 50 nmol/L had poorer physical performance at baseline and at 2- and 4-year follow-up than participants with 25(OH) D ≥75 nmol/L ($P < 0.01$). Older adults with low 25(OH) D concentrations had poorer physical performance over 4 years of follow-up.[56]

5. Physiotherapy and exercise interventions among obese elderly.

- The continuously growing segment of the geriatric population with the high incidence and prevalence of co morbidity and disability suggests that enhanced preventive and rehabilitative programs will be mandatory.[57] Very limited papers were available including physiotherapy interventions for obese elderly in their title of research. These research findings prompted us to include similar papers describing different exercises on elderly targeting the obesity and weight loss.
- Dennis T. Villareal et al targeted 27 frail obese older volunteers and assigned them to treatment and control group. Subjects were randomized to receive either 26 weeks of diet and exercise therapy (treatment group) or no treatment (control group). The diet contained approximately 30% of energy as fat, 50% as carbohydrate, and 20% as protein. Total calorie intake was adjusted to prevent more than a 1.5% loss of body weight per week, with the goal of 10% weight loss at the completion of the study. Participants were instructed to take a multivitamin supplement daily. The exercise program focused on improving flexibility, endurance, strength, and balance under the supervision of Physical Therapist. The findings of the study suggested reduction in body weight (8.4% ± 5.6%) and fat mass (−6.6 ± 3.4 vs +1.7 ± 4.1 kg; P<. 001) in treatment group compared to control group and no change in fat free mass.[58]
- Stephen P. Messier's Arthritis, Diet, and Activity Promotion Trial (ADAPT).[59] All the interventions used were effective in together than individual intervention. It was a randomized, single blind clinical trial lasting 18 months. 316 overweight and obese adults having knee OA were assigned to four groups consisting of control with healthy lifestyle, diet

only, exercise only, and diet plus exercise groups. 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. The diet-only group was not significantly different from the healthy lifestyle group for any of the functional or mobility measures.[59]

- Mohan Nallathambi conducted a study to determine the effect of community-based Physiotherapy training program, to determine the effect of graded manual muscle strengthening versus stretching techniques for improvements in muscle strength, gait and quality of life of elder people in Bangladesh. 120 healthy elderly subjects of over 60 years of age were randomly included in the study. Subjects were allocated to both a graded manual muscle strengthening group (n = 60) and stretching program group (n = 60). A graded manual muscle strengthening exercise had a greater effect than stretching program on both upper and lower limb muscles. The results suggest a graded manual muscle strengthening exercise produces greater strength, balance and gait improvements than a stretching exercise group.[60]
- Lia Mara Wibelinger et al conducted a study on Effects of conventional physiotherapy and wii therapy on pain and functional capacity of elderly women with knee osteoarthritis.71 women with knee OA were included in the sample. Reported results showed that the women submitted to conventional physiotherapy (group I) have presented, as compared to wii therapy (group II), lower pain scores (11.05 ± 8.15 versus 19.24 ± 16.96; $p = 0.00$) and incapacity (12.42 ± 7.91 versus 17.42 ± 14.08; $p = 0.06$) after intervention. Stiffness (25.13 ± 15.99 versus 14.39 ± 17.43; $p = 0.00$) and balance (50.94 ± 1.45 versus 53.45 ± 5.16; $p = 0.00$) scores were better for patients submitted to wii therapy, with statistical significance in both items.[61]
- Senthilkumar Thiyagarajan aims to determine the effectiveness of targeted multiple physical therapy interventions to enhance functional capacity of elderly people livelihood in residential care facilities. Result showed that continuous home based physiotherapy intervention was effective to improve functional capacity of the elder people living in residential care facilities. 21 elderly individuals ranged from 65 to 97 years were selected for this study. Various individualized physiotherapy interventions like pain relief modalities, specific muscle strengthening, aerobic exercise, pacing, stretching, group therapy, chest physiotherapy, gait training were applied every day for 45 min to one hour which continues for 2 months.[62]
- Ae Wha Ha et al in their study evaluated obesity-related dietary behaviors and determined long-term exercise effects on obesity and blood lipid profiles in elderly Korean subjects. A total of 120 subjects, aged 60-75 yr, were recruited, and obesity-related dietary behaviors were determined. An exercise intervention was conducted with 35 qualified elderly females for 6 months, and body composition and blood lipids were measured 6 times at 4 week intervals. In conclusion, elderly females had better eating habits and were more concerned with nutrition information and healthy diets compared to elderly males. However, misperceptions of weight and obesity-related stress tended to be very high in females who were overweight and obese, which can be a barrier to maintain normal weight. Long-term Danhak practice, a traditional Korean exercise, was effective at reducing body fat (%) and abdominal obesity, and improved lipid profiles, self-confidence, and stress.[63]

CONCLUSION

This systematic review article concludes by aiming towards comprehensive and elaborative collection of research articles related to the importance of body composition analysis, Physiotherapy and nutrition for independent geriatric lifestyle. Finally 55 papers along with references in research proposal were included in the study. Review showed that Ageing, body composition, Physiotherapeutic intervention and nutrition plays an interdependent role in providing independent and healthy living among geriatric population. It can be concluded after this extensive systematic review that combined and comprehensive interventions will be more effective in combating ageing. Our research base also showed high level of prevalence among the geriatric community in pretext with compliance of exercise as a regular mode of physical fitness and good health. Research on review database also showed unawareness among the geriatric community regarding the benefits of regular body composition analysis and appropriate nutritional supplementation in form of vitamin D, vitamin B_{12}, fiber diet, fruit diet and subjective exercise prescription from a qualified Physiotherapist. After thorough study on the review we conclude that our study will emphasize

the geriatric community to periodically analyze their body composition and regularly comply with exercise therapy sessions, Physiotherapy modality sessions and nutritional supplementation for physically fit healthy happy and independent geriatric population. Still researches are lacking in the field of Physiotherapy in context to body composition and dietary modifications among elderly. There is wide scope of future research to evaluate the importance of combining Physiotherapeutic principles with dietary modifications including nutritional supplements periodic Body composition analysis. We firmly conclude at the end of this extensive research study on various scientific literatures related to our area of study and in close association with our hypothesis that the statement of problem which initiated our PhD research program in 2013 shall definitely prove our hypothesis, as our study was accomplished on more than 3000 subjects signifying our quantitative analytical study and shall definitely establish the importance of Physiotherapeutic interventions and Body Composition Analysis in promoting independent and healthy living among randomized Geriatric Population of Indore District.

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