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Dumbbell Resistance Training and Upper Arm Fat Percentage Reduction: A Cross-Sectional Study

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Abstract

Introduction: Adults aged 20–40 years often exhibit low awareness regarding the importance of maintaining health. Physical inactivity and poor dietary habits can negatively affect body composition, particularly body fat percentage. Both insufficient and excessive body fat can adversely impact health. Dumbbell resistance training has been proposed as an effective intervention to control subcutaneous fat, particularly in the upper arm. This study aimed to investigate the association between dumbbell resistance training and upper arm fat percentage in adult women aged 20–40 years in Denpasar, Indonesia.

Methods: This cross-sectional analytical study employed purposive sampling to recruit 33 adult female participants who met the inclusion and exclusion criteria. Data on dumbbell resistance training duration were obtained through interviews, while upper arm fat percentage was measured using a skinfold caliper. Spearman's rho correlation test was used to examine the relationship between training duration and upper arm fat percentage.

Results: Analysis revealed a significant negative correlation between dumbbell resistance training and upper arm fat percentage ($p=0.003$, $p<0.05$), indicating that longer training duration was associated with lower fat percentage.

Conclusion: Dumbbell resistance training is significantly associated with reduced upper arm fat percentage in adult women aged 20–40 years in Denpasar, Indonesia.

Keywords: Resistance training, Dumbbells, Body fat percentage, Upper arm, Adult women

Introduction

Adults in Indonesia, particularly those of productive age, generally show low awareness of health importance.1 Higher productivity often correlates with neglect of personal health. Nagai reported that health awareness is age-dependent: 66% of elderly participants (mean age: males 71.7, females 69.1) monitored nutritional intake consistently, compared to younger adults (mean age: males 35.7, females 24.9).[1] Older adults may have higher awareness due to more time or greater concern about disease.

Low health awareness is reflected in the increasing prevalence of low physical activity, which rose from 26.1% in 2013 to 33.5% in 2018 in Indonesia.[1] Physical inactivity is associated with reduced life expectancy. Regular exercise benefits include maintaining blood pressure, preventing obesity, reducing back pain, improving mood, alleviating stress, and supporting overall health.[2] Aerobic exercise is recommended 20–30 minutes per session, three times per week, and resistance training twice per week.[2]

Lifestyle changes, particularly dietary habits, further influence health. Home-prepared meals are increasingly replaced by processed foods and fast food. High consumption of energy-dense, high-fat, and high-carbohydrate foods can reduce quality of life.[2] Technological advances have also reduced physical activity, increasing risk of non-communicable diseases such as obesity. Adult obesity prevalence rose from 14.8% in 2013 to 21.8% in 2018, closely linked to body fat percentage.[3]

Body fat, along with muscle, bone, and water, is a critical component of body composition. Fat percentage reflects overall health, including visceral and subcutaneous fat, and is influenced by genetics, age, ethnicity, and sex.[4] Both insufficient and excessive body fat pose health risks. Low body fat impairs growth and immunity, while excess fat increases coronary artery disease risk through elevated LDL cholesterol and arteriosclerosis.[5] Visceral fat contributes to insulin resistance, metabolic disorders, and cardiovascular disease. Abdominal fat increases with age in men and post-menopause in women.[5] Obesity, arteriosclerosis, and osteoporosis are interrelated and influenced by lifestyle.

Excess body fat increases the risk of type 2 diabetes, respiratory conditions such as asthma and obstructive sleep apnea, and musculoskeletal disorders including osteoarthritis, joint pain, and osteoporosis. Bone mineral density

peaks around 25 years, is maintained until 45, and declines thereafter. Postmenopausal women experience rapid bone loss due to decreased estrogen.[6]

Normal body fat percentages are 25–31% in women and 18–25% in men, with higher levels considered obese. Estrogen contributes to higher fat in women, while testosterone promotes muscle mass in men. Women physiologically store fat in the waist, chest, buttocks, and thighs to support reproductive function.[7] Aging increases the risk of overweight and obesity; a study reported 29.4% of adult women aged 19–55 were overweight, slightly above the national prevalence of 26.9% for women over 18.[7]

Preventing health risks associated with excess fat requires monitoring and a healthy lifestyle. Exercise, especially resistance training, helps maintain healthy body fat percentages. Dumbbell resistance training specifically targets upper arm subcutaneous fat. Higher intensity resistance training is linked to greater reductions in body fat, and regular training in women enhances bone density, mitigating osteoporosis risk.[8]

Fitness centers provide access to various programs for muscle gain, fat loss, and body recomposition. Strength training reduces fat while preserving muscle mass, unlike aerobic training, which may reduce both.[8] The National Council on Aging reported that 80% of adults over 65 develop at least one chronic disease, and 68% develop two.[7] These findings underscore the increasing health risks with age.

Although many studies examine body fat and health outcomes, research focusing on productive-age adult women remains limited. This study aims to investigate the effect of dumbbell resistance training on upper arm fat percentage in women aged 20–40 in Denpasar, Indonesia. The focus on women with diverse occupations and activity levels, many of whom rarely exercise, addresses a gap in local evidence.

Methods

This study employed an analytical observational design using a cross-sectional approach.[9] Cross-sectional studies are observational studies in which data are collected at a single point in time. The research was conducted at Iron Paradise Gym, Denpasar, in June 2023. The site was selected based on a survey and observation indicating a high number of female members engaged in resistance training.

Participant selection was conducted from June 19 to 24, 2023. Upper arm fat percentage and body mass index (BMI) were measured for selected participants during the same period. Purposive sampling was applied to recruit participants according to inclusion and exclusion criteria. Out of a population of 68, 33 participants met the study criteria. Inclusion criteria were: female, aged 20–40 years, member of Iron Paradise Gym, routinely performing dumbbell resistance training for at least one month as determined through interview, with optimal training frequency of 3–5 sessions per week (each exercise performed in 3–5 sets of 6–12 repetitions, with 2–5 minutes rest between sets), and willingness to participate by signing informed consent. Exclusion criteria were regular participation in aerobic exercises such as Zumba, treadmill, or Rapid Power Motion (RPM), as assessed via interview. Sample size was determined using the Notoatmodjo cross-sectional formula.[10]

The independent variable was dumbbell resistance training, while the dependent variable was upper arm fat percentage. Control variables included age, sex, and training dose. BMI was considered a confounding variable. Dumbbell training duration was obtained through participant interviews, whereas upper arm fat percentage was measured using a skinfold caliper. Skinfold calipers estimate subcutaneous fat with an accuracy of approximately ±97% and validity coefficients of r = 0.90 for seven-site measurement and r = 0.89 for three-site measurement.[11] Measurements were conducted directly by professional physiotherapists.

Control variables—age, sex, and training dose—were recorded through interviews. Participants were limited to females aged 20–40 years with a training frequency of 3–5 sessions per week to minimize confounding bias. BMI, a potential risk factor affecting upper arm fat percentage, was calculated as weight in kilograms divided by height in meters squared. Weight was measured using a calibrated scale, and height was measured using a microtoise.[12]

Statistical analysis included univariate and bivariate methods. Univariate analysis described age, weight, height, BMI, duration of dumbbell training, and upper arm fat percentage. Bivariate analysis was performed using Spearman's rho correlation test to assess the relationship between dumbbell training duration and upper arm fat percentage.Ethical approval for this study was obtained from the Research Ethics Committee of the Faculty of Medicine, Udayana University/Sanglah General Hospital, Denpasar, under ethical clearance number 1593/UN14.2.2.VII.14/LT/2023. The study protocol had previously undergone institutional review without the need for revisions.

Results

Participant Characteristics

Table 1 presents the descriptive statistics of the study sample (n = 33) based on age, weight, height, BMI, duration of dumbbell resistance training, and upper arm fat percentage. The mean age of participants was 30.82 ± 7.13 years, ranging from 21 to 40 years. The mean duration of resistance training was 20.21 ± 36.55 months, with a minimum of 1 month and a maximum of 180 months. The average body weight was 61.96 ± 10.82 kg (range: 46–85 kg), and the mean height was 159.70 ± 5.38 cm (range: 150–170 cm). The mean BMI was 24.31 ± 4.33 kg/m², ranging from 17.4 to 34.5 kg/m².

Upper arm fat percentage averaged 25.18 ± 6.69 mm, with a minimum of 15 mm and a maximum of 45 mm.

Table 1. Descriptive statistics of study participants (n = 33), including age, body weight, height, body mass index (BMI), duration of dumbbell training, and upper arm fat percentage. This table provides an overview of the general characteristics of the sample.

Table 1. Descriptive Statistics of Study Participants (n = 33)

Variable	Minimum	Maximum	Mean ± SD
Age (years)	21	40	30.82 ± 7.13
Body weight (kg)	46	85	61.96 ± 10.82
Height (cm)	150	170	159.70 ± 5.38
BMI (kg/m²)	17.4	34.5	24.31 ± 4.33
Dumbbell training duration (months)	1	180	20.21 ± 36.55
Upper arm fat percentage (mm)	15	45	25.18 ± 6.69

BMI Classification

Table 2 shows the distribution of participants according to BMI categories. The majority were classified as normal weight (n = 19, 57.6%), followed by overweight (n = 9, 27.3%), obese (n = 4, 12.1%), and underweight (n = 1, 3.0%). Table 2. Frequency distribution of participants according to BMI categories. This table illustrates the proportion of participants in underweight, normal, overweight, and obese categories, reflecting the overall nutritional status of the sample.

Table 2. Frequency Distribution of BMI Categories (n = 33)

BMI Category	Frequency	Percentage
Underweight	1	3.0%
Normal	19	57.6%
Overweight	9	27.3%
Obese	4	12.1%

Correlation Between Dumbbell Training and Upper Arm Fat Percentage

Spearman's rho correlation was performed to examine the relationship between duration of dumbbell resistance training and upper arm fat percentage (Table 3). The results indicated a statistically significant negative correlation (r = -0.498, p = 0.003), demonstrating a moderate inverse relationship.

Table 3. Spearman's rho correlation between dumbbell training duration and upper arm fat percentage. This table presents the strength and direction of the relationship between the duration of dumbbell training and the percentage of upper arm fat among adult women aged 20–40 years in Denpasar.

Table 3. Spearman's Rho Correlation Between Dumbbell Training Duration and Upper Arm Fat Percentage

Variables	r	p
Dumbbell training duration vs. upper arm fat percentage	-0.498	0.003

The negative correlation indicates that longer or more frequent dumbbell training is associated with lower upper arm fat percentage. Conversely, shorter or less frequent training corresponds to higher upper arm fat percentage. These findings suggest that dumbbell resistance training contributes to reductions in subcutaneous fat in the upper arm among adult women aged 20–40 years in Denpasar.

Discussion

Participant Characteristics

This study was conducted in Denpasar, specifically at Iron Paradise Gym, with a total of 33 participants. Sample selection was performed using a simple random sampling technique, in which participants were first screened according to inclusion and exclusion criteria, and then randomly selected to form the final sample. Data collection and measurement of independent and dependent variables were conducted over one week.

As shown in Table 1, the mean age of participants was 30.82 years, ranging from 21 to 40 years, with the highest frequency observed at age 40 (n = 5, 15.2%). The age range aligns with the predetermined inclusion criteria of 20–40 years. Similar research conducted in Saudi Arabia among gym-goers aged 22–70 years reported a mean age of 37.5 years, with the majority (70%) under 40 years.[13] Another study involving 132 participants engaged in CrossFit training reported a mean age of 32.3 years.[14] Salin noted that adult gym attendance is often motivated by intrinsic factors (66.8%) and extrinsic factors (33.2%), including health-related motivations, which are common among adults.

The mean duration of dumbbell resistance training in this study was 20.21 months, ranging from 1 to 180 months, while the mean upper arm fat percentage was 25.18 mm (range: 15–45 mm). Table 2 illustrates that most participants had a normal BMI (n = 19, 57.6%), with the remaining classified as underweight, overweight, or obese. Similar findings were reported by Mahfud, where the majority of university soccer athletes had a normal BMI (mean 20.46 kg/m²), and Wibowo, whose study on national athletes at the 2018 Asian Games also found predominantly normal BMI. Regular physical activity likely contributes to maintaining normal BMI through increased energy expenditure,

improved body composition, enhanced mobility, fat oxidation, appetite regulation, and lipid profile improvement. The American College of Sports Medicine recommends engaging in moderate to vigorous physical activity for at least 250 minutes per week to achieve weight and fat reduction goals.[15]

Relationship Between Dumbbell Resistance Training and Upper Arm Fat Percentage

The results presented in Table 3 demonstrate a statistically significant correlation between dumbbell resistance training duration and upper arm fat percentage ($r = -0.498$, $p = 0.003$), indicating a moderate inverse relationship. This suggests that longer or more frequent dumbbell training is associated with lower upper arm fat percentage, whereas shorter or less frequent training corresponds to higher fat levels.

Adult women in the productive age range (20–40 years) have undergone physical, intellectual, and social development from adolescence, gaining independence, decision-making capability, and self-regulation. This life stage often involves seeking a partner and striving for physical appearance optimization, including maintaining an ideal body shape.[16] Body composition, defined by fat mass, muscle mass, bone mass, and water content, can be optimized through regular exercise aimed at reducing body fat, which often impacts self-esteem.[2]

Dumbbell resistance training, a form of anaerobic exercise, provides high-intensity stimuli in short durations, utilizing internal energy sources such as glucose and fats rather than oxygen. [17,18] This type of training promotes fat mobilization, particularly in the upper arm region, thereby reducing localized subcutaneous fat. Fat is a hydrophobic organic compound composed of carbon (C), hydrogen (H), oxygen (O), phosphorus (P), and nitrogen (N), and its body content can be expressed as a percentage relative to total body composition.[19] Consistent with the present findings, dumbbell training effectively reduces upper arm fat percentage.

Previous studies support these findings. Razy reported that 12 sessions of combined resistance exercises, including press-down machines, dumbbells, and leg curls over one month, reduced body fat and increased muscle mass, particularly in the triceps, abdominal, and posterior thigh regions.[20] Uga demonstrated that resistance training reduced triglyceride levels in elderly participants, highlighting fat mobilization for energy during short-term exercise.[21] Sun-Ho found that 10 weeks of dumbbell resistance training in obese adolescents decreased body fat, weight, insulin, and leptin, while increasing muscle mass, cortisol, ghrelin, and growth hormone levels.[22]

Resistance training enhances muscle hypertrophy, increasing basal metabolic rate and facilitating fat oxidation. During exercise, energy is supplied primarily from phosphocreatine (PCr), carbohydrates, and fats, with minor contribution from protein (<5%).[18] Fat metabolism involves lipolysis of triglycerides stored in adipose tissue and intramuscular stores, producing free fatty acids and glycerol. Fatty acids undergo β-oxidation to generate ATP, requiring oxygen and carbohydrates, while glycerol can enter gluconeogenesis or convert to pyruvate for energy production.[18] Morphological changes in muscle fibers, including increased diameter and mitochondrial content, improve ATP synthesis via phosphocreatine hydrolysis, further supporting energy supply for resistance training.

Study Limitations

Several limitations must be noted. This study controlled for age and sex but did not include dietary patterns or BMI as covariates. Previous research by Fayasari and Susantini indicated that diet and BMI influence body fat percentage.[23,24] Additionally, training intensity was not controlled; only duration (in months) was considered. Other forms of exercise performed by participants may have influenced fat percentage outcomes, introducing potential bias. The study focused exclusively on dumbbell training, neglecting other exercise modalities.[25]

Despite these limitations, the study benefits from targeting a productive adult population (20–40 years), a group often engaged in diverse occupations with varying health behaviors, including low physical activity and suboptimal dietary habits. Findings cannot be generalized to all women aged 20–40 in Bali or Indonesia due to the homogeneous gym-based sample. Future studies should expand methodology, populations, and examine additional factors related to dumbbell resistance training and upper arm fat percentage.

Conclusion

Based on the results of this study, it can be concluded that there is a significant relationship between dumbbell resistance training and upper arm fat percentage in adult women aged 20–40 years in Denpasar. The finding that this relationship is stronger among individuals with moderate strength suggests that dumbbell resistance training may be particularly effective in reducing upper arm fat in this population. Therefore, implementing training programs involving dumbbells can be considered an appropriate and effective strategy to improve body composition and overall well-being for adult women within this age group.

To achieve optimal outcomes, it is recommended that training programs be carefully designed and tailored, taking into account individual variability in strength, proper exercise technique, and adequate supervision. Structured and monitored programs are likely to maximize the benefits of dumbbell resistance training for reducing upper arm fat while promoting safe and effective exercise practices.

Author Contribution

Adinda Claudia Dalimbua: Conceptualization, methodology, data collection, data analysis, and manuscript drafting.

Ni Luh Putu Gita Karunia Saraswati: Supervision, guidance on research design, and critical review of the manuscript.

Anak Ayu Nyoman Trisna Narta Dewi: Supervision, validation, and manuscript editing.

Anak Agung Gede Angga Puspa Negara: Supervision, methodological consultation, and final manuscript review.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this study.

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Ethics Statement

This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was not required as the study involved only non-invasive procedures (blood pressure measurement and questionnaire surveys) and posed minimal risk to participants. Informed consent was obtained from all participants prior to their inclusion in the study, and confidentiality was strictly maintained.

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