DOI: https://doi.org/10.53350/pjmhs2023175471

ORIGINAL ARTICLE

During Resistance Training the Effect of Ibuprofen on Muscle Hypertrophy Regarding Strength and Soreness. A Population Based Cross-Sectional Study

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ABSTRACT

Background: Non-steroidal anti-inflammatory medicines (NSAIDs) are frequently used to speed up post-exercise recovery and lessen discomfort and soreness in muscles. There is a concept that Ibuprofen at high doses has been found to prevent the production of muscle proteins following a session of resistance training.

Aims and Objectives: To examine the effects of 400 mg/ day dose of ibuprofen on muscular hypertrophy and strength following resistance exercise.

Study Design: This was a population based cross-sectional study.

Place and Duration: Present study was conducted in different work out gyms of Lahore region from October 2022 to April 2023.

Research Rationale: The combined findings of in vitro and human studies indicate that NSAIDs may blunt the early skeletal muscle responses to exercise. Their widespread use is due to their effectiveness in reducing inflammation, fever, and discomfort.

Methodology: Total 100 participants were in this study and all of them provided written informed consent and completed questionnaires about their past training experiences. 70 males and 30 females 20-30 years of age trained their right and left biceps on alternate days 6 sets of 4–10 repetitions, 5 days in week–1, for 8 weeks. All subjects before selection for study completed medical examination blood analysis and health history questionnaires. All participants were received, 400 mg/day of ibuprofen after training their left or right arm. Before and after training muscle thickness of both biceps was measured using ultrasound, and 1 repetition maximum (1 RM) arm curl strength was assessed on both arms. The weights of the dumbbells were chosen so that the required number of repetitions would result in training till failure on each individual set.

Practical Implications: According to the study, using a low dose of ibuprofen (400 mg/day) following resistance exercise may help lessen stiffness and pain in the muscles. This practical application can help those who want to recuperate more quickly after exercising and maintain their training regimen more easily. For best outcomes and general well-being, it's crucial to inform people and encourage a balanced strategy that incorporates medicine with appropriate exercise methods and rest.

Results: The demographics of all participants were considered, regarding their age, smoking habit, hypertension, diabetes, BMI and use of alcohol. It was observed after findings of current study, the mean standard deviation levels of Muscle hypertrophy and Intensity of muscle soreness of both male and female participants of Group-A, and Group-B in first weak and after six weak (34.10± 0.01, 51.01± 0.01) (30.10± 0.01, 42.01± 0.01), (34.10± 0.01, 53.01± 0.01) (30.10± 0.01, 43.01± 0.01) showed a significant (P≤ 0.05) changes.

Conclusion: The findings of current study generally accepted that the most significant mechanism driving training-induced muscle hypertrophy is the recurrent increases in muscle protein synthesis following each exercise session. Ibuprofen low doze i.e. 400mg/day decreased the biosynthesis of prostaglandin, Intensity of muscle soreness, muscle protein synthetic response after each training session. There is mounting evidence that prostaglandins and cyclooxygenase (COX) enzymes are key regulators of the molecular processes governing muscle hypertrophy.

Keywords: Biceps, Ibuprofen, Dumbbells, Gym, Exercise, Repetitions, Training, Anti-inflammatory, NSAIDs

INTRODUCTION

In human body Cyclooxygenase (COX) is an enzyme which catalyzed the biosynthesis of prostanoids including prostaglandins. COX-1 and COX-2 are two types of Cyclooxygenase and both play an important role, COX-1 generates prostaglandins which protect gastrointestinal mucosa while COX-2 produced Prostaglandins that mediate inflammation and pain throughout the biological system[1, 2]. The goal of cyclooxygenase (COX) enzyme-targeted non-steroidal anti-inflammatory medicines (NSAIDs) is to lessen inflammation and pain[3]. Prostaglandins, specifically COX-2 enzymes, catalyze inflammation, pain, and fever after an injury. Prostaglandins are decreased by decreasing COX-2 enzymes, which reduce inflammation, discomfort, and fever[4]. The most popular anti-inflammatory drugs used to treat acute musculoskeletal injuries, muscular soreness after exercise, and joint pain are NSAIDs[5].

Muscle injuries brought on by exercise occur after resistance training. Normal human skeletal muscle reacts to this damage by increasing the activity of the COX-1 and COX-2 enzymes, which then release prostaglandins into the damaged muscle tissue to begin a natural process of tissue regeneration[6]. Fluid containing these prostaglandins surrounds the acutely damaged tissues during post-exercise recovery in humans to promote mending and healing[7]. NSAIDs have been demonstrated to reduce COX-1 and COX-2 activity, thereby reducing prostaglandin output. Within the first three hours following resistance exercise, prostaglandin activity in injured skeletal muscle tissue peaks, whereas NSAID activity peaks 1-4 hours after consumption[8].

Reduced COX-1 and COX-2 activity first inhibits the expression of the MEK-ERK gene at the molecular level, which then prevents the production of protein in the human skeletal muscle[9]. NSAIDs are a class of pharmacological medications that have similar modes of action but differ in their structural and pharmacodynamics properties[10]. By blocking cyclooxygenase (COX) enzymes, they produce analgesic, antipyretic, and anti-inflammatory actions[11]. NSAIDs can both temporarily and permanently inhibit COX. This allows us to separate them into two further functional categories: aspirin (acetylsalicylic acid) and non-aspirin NSAIDs (such as ibuprofen, naproxen, indomethacin, and diclofenac)[12]. Therefore, COX inhibition and decreased platelet aggregation with non-aspirin NSAIDs are only seen while the

medication is circulating in the blood[13]. Compared to lipophilic bases and esters of such acids, non-aspirin NSAIDs are rarely impacted by pre-systemic metabolism because they are weak, lipophilic acids. Consequently, after oral administration, have a high bioavailability[14].

A study by Lilja et al. tested hypothesis in their study that high doses of anti-inflammatory drugs give resistance training's adaptive reaction as compared with low doses[15]. In their trial, 31 healthy men and women between the ages of 18 and 35 were randomized to take either 75 mg of acetylsalicylic acid (ASA) or 1200 mg of ibuprofen daily for eight weeks[16]. Before and after training, they measured muscle volume, evaluated strength, and examined muscle biopsies for the expression of the muscle growth regulator gene and protein[17]. In another study by Krentz et al. the effect of 400 mg/day ibuprofen on protein synthesis, muscle soreness and exercise were seen. The findings of this study were very similar to the previous studies[18].

MATERIAL AND METHODS

Background: Non-steroidal anti-inflammatory medicines (NSAIDs) are frequently used to speed up post-exercise recovery and lessen discomfort and soreness in muscles. There is a concept that Ibuprofen at high doses has been found to prevent the production of muscle proteins following a session of resistance training.

Aims and Objectives: To examine the effects of 400 mg/ day dose of ibuprofen on muscular hypertrophy and strength following resistance exercise.

Study Design: This was a population based cross-sectional study.

Place and Duration: Present study was conducted in different work out gyms of Lahore region from October 2022 to April 2023.

Exclusion Criterial: Participants less than 20 years and older than 30 years were not involved. Individuals taking other NSAIDs than 400 mg/Day ibuprofen. Addicted persons and receiving other non-pharmaceutical interventions. Current or previous medical conditions and injury.

Inclusion Criterial: All male and female participants were of 20-30 years old. All were receiving 400 mg/Day ibuprofen for muscular pain following resistance exercise. One week before the study trial, each participant completed strength testing by executing a barbell squat, leg press, and leg extension exercise.

METHODOLOGY

Total 100 participants were in this study and all of them provided written informed consent and completed questionnaires about their past training experiences. 56 males and 44 females 20-30 years of age trained their right and left biceps on alternate days 6 sets of 4–10 repetitions, 5 days in week–1, for 8 weeks. All subjects before selection for study completed medical examination blood analysis and health history questionnaires. All participants were received, 400 mg/day of ibuprofen after training their left or right arm. Before- and after-training muscle thickness of both biceps was measured using ultrasound, and 1 repetition maximum (1 RM) arm curl strength was assessed on both arms. The weights of the dumbbells were chosen so that the required number of repetitions would result in training till failure on each individual set.

Groups of Participants: In current study total 100 male and female individuals were selected and divided them into two groups Group-A, 21 male and 19 female how were not receiving ibuprofen 400 mg/Day after training while in Group-B 35 male and 25female participants were receiving 400 mg/Day ibuprofen regularly.

Sample Collection Method: A comprehensive questioner personally filled by researchers from each participant during research period. The process of collecting data was kept going for another eight weeks. Researchers met with participants' 3-4 time per week regularly and Personnel working on the study informed the primary investigator of every negative event. All adverse events or suspected adverse events were reported on case report forms, together with information about the severity, date, and time of each event, as well as any potential connections to the study drugs.

Parameters: Body mass index (BMI), before and after-training muscle thickness of both biceps, muscle strength, muscle soreness, muscle hypertrophy.

Bio- Statistic: The collected raw data was processed through bio-statistical analyses of Mean Standard Deviation (Means ± SD) in which significant (P≤0.05) value was considered comparatively. The variables such as Time, muscle thickness and Before- and after-training muscle thickness of both biceps was measured soreness and severity of pain were analyzed.

RESULTS

There were time-main effects on muscle thickness and strength after 6 weeks of training.

Table-1: Demographics of all Participants

Parameters	Units	Group	Mean ± SD	P≤ 0.05
Gender = n	Male	A	21.01± 0.01	0.01
	Female	A	19.01± 0.01	0.01
	Male	B	35.01± 0.02	0.02
	Female	B	25.01± 0.01	0.01
Age	Years	A+B	26.02± 0.01	0.01
Smoking	Yes/No	A+B	07.02± 0.01	0.01
Alcohol	Yes/No	A+B	00.02± 0.04	0.04
Hypertension	Yes/No	A+B	09.02± 0.02	0.02
Diabetes	Yes/No	A+B	04.01± 0.03	0.03
BMI Kg/m^2	Male	A	20.02± 0.01	0.01
	Female	A	22.02± 0.04	0.04
	Male	B	19.02± 0.03	0.03
	Female	B	21.01± 0.01	0.01

Table-2: G-A Male Participants do not Receiving Ibuprofen Regularly

Parameters	Units	After First weak Mean ± SD	After Sixth weak Mean ± SD
Muscle thickness of both biceps	cm	35.10± 0.01	45.12± 0.02
Muscle strength	1RM/Kg	65.12± 0.01	85.11± 0.01
Muscle hypertrophy	Tape measurement cm	34.10± 0.01	46.01± 0.01
Intensity of muscle soreness	Percentage	51.01± 0.01	25.11± 0.01

(P≤ 0.05)

In table-1 the demographics of all participants were described, regarding their age, smoking habit, use of alcohol, Hypertension, Diabetes and BMI. The mean standard deviations levels of Muscle thickness of both biceps, Muscle strength, Muscle hypertrophy and Intensity of muscle soreness of both male and female participants of Group-A, in first weak and after six weak (35.10± 0.01, 65.12± 0.01, 34.10± 0.01, 51.01± 0.01) (45.12± 0.02, 85.11± 0.01, 46.01± 0.01, 25.11± 0.01), (30.10± 0.01, 35.02± 0.01, 30.10± 0.01, 42.01± 0.01) (38.01± 0.01, 46.01± 0.01, 37.01± 0.01, 35.11± 0.01) were noted shown in table-2 and table-3.

Table-3: G-A Female Participants do not Receiving Ibuprofen Regularly

Parameters	Units	After First weak Mean ± SD	After Sixth weak Mean ± SD
Muscle thickness of both biceps	cm	30.10± 0.01	38.01± 0.01
Muscle strength	1RM/Kg	35.02± 0.01	46.01± 0.01
Muscle hypertrophy	Tape measurement cm	30.10± 0.01	37.01± 0.01
Intensity of muscle soreness	Percentage	42.01± 0.01	35.11± 0.01

(P≤ 0.05)

Table-4: G-B Male Participants do not Receiving Ibuprofen Regularly

Parameters	Units	After First weak Mean ± SD	After Sixth weak Mean ± SD
Muscle thickness of both biceps	cm	34.10± 0.01	46.12± 0.02
Muscle strength	1RM/Kg	64.02± 0.01	94.11± 0.01
Muscle hypertrophy	Tape measurement cm	34.10± 0.01	47.01± 0.01
Intensity of muscle soreness	Percentage	53.01± 0.01	09.11± 0.01

(P≤ 0.05)

Table-5: G-B Female Participants do not Receiving Ibuprofen Regularly

Parameters	Units	After First weak Mean ± SD	After Sixth weak Mean ± SD
Muscle thickness of both biceps	cm	31.10± 0.01	39.21± 0.01
Muscle strength	1RM/Kg	37.02± 0.01	49.01± 0.01
Muscle hypertrophy	Tape measurement cm	30.10± 0.01	36.01± 0.01
Intensity of muscle soreness	Percentage	43.01± 0.01	15.11± 0.01

(P≤ 0.05)

The mean standard deviations levels of Muscle thickness of both biceps, Muscle strength, Muscle hypertrophy and Intensity of muscle soreness of both male and female participants of Group-A, in first weak and after six weak (34.10± 0.01, 64.02± 0.01, 34.10± 0.01, 53.01± 0.01) (46.12± 0.02, 94.11± 0.01, 47.01± 0.01, 09.11± 0.01), (31.10± 0.01, 37.02± 0.01, 30.10± 0.01, 43.01± 0.01) (39.21± 0.01, 49.01± 0.01, 36.01± 0.01, 15.11± 0.01) were seen respectively and represented in table-4 and table-5.

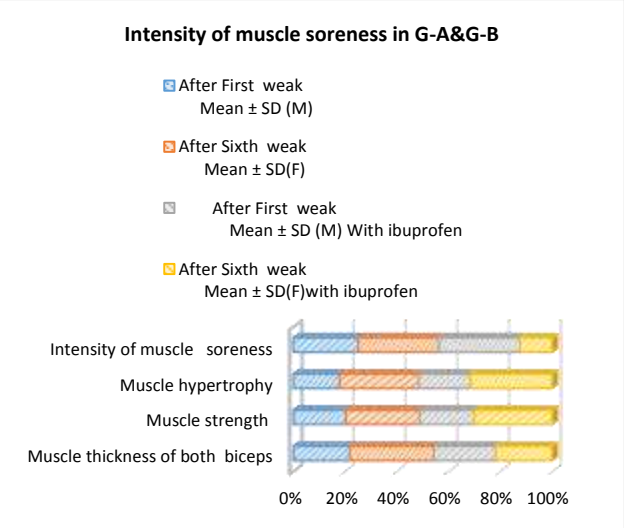

Fig-1: Intensity of muscle soreness in G-A&G-B

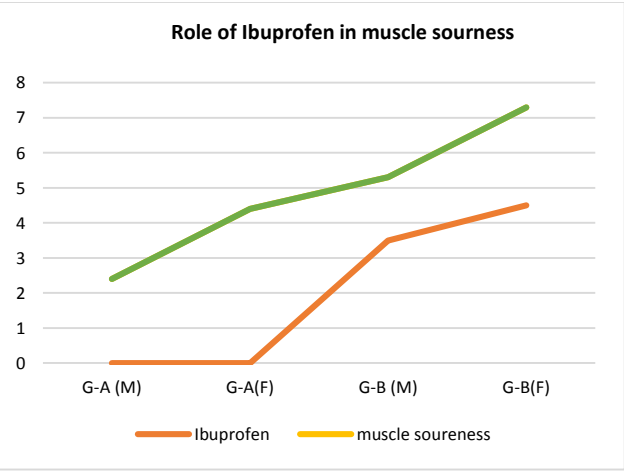

Fig-2: Role of Ibuprofen in muscle sourness

Current study was first to uncover the regular consumption of ibuprofen during the course of a resistance training program. It was observed that the mean standard deviations levels of Muscle hypertrophy and Intensity of muscle soreness of both male and female participants of Group-A, and Group-B in first weak and after six weak (34.10± 0.01, 51.01± 0.01) (30.10± 0.01, 42.01± 0.01), (34.10± 0.01, 53.01± 0.01)(30.10± 0.01, 43.01± 0.01) were significant (P≤ 0.05) .

DISCUSSION

This study was the first to look into long-term, daily ibuprofen use during a weight training regimen. Ibuprofen had significant (P≤ 0.05) effect on muscular hypertrophy and Intensity of muscle soreness[19]. This study's little dosage (400 mg) might have had a significant impact on the outcomes. In comparison to a higher dosage (i.e., 1200 mg), the dosage is equivalent to the usual recommended adult dose of over-the-counter ibuprofen, and as such, it may be safer when taken every day over a long period of time. However, it may be too small to inhibit the inflammatory response brought on by intense resistance training, and as a result, it has no effect on muscle soreness[20].

Ibuprofen at high doses has been found to prevent the production of muscle proteins following a session of resistance training. We examined the effects of daily use of a moderate dose of ibuprofen 400 mg/ day on muscular growth and strength following resistance exercise[21]. Only the first week of exercise saw an increase in muscle pain; nevertheless, there was no difference between the ibuprofen and placebo groups[22]. It was determined that taking a moderate amount of ibuprofen after several resistance training sessions did not influence muscle strength or hypertrophy, and it has positive effect on sore muscles[23].

Non-steroidal anti-inflammatory medicines (NSAIDs) may decrease the skeletal muscle's early reactions to exercise, according to earlier research in young people. Uncertainty exists on how long-term usage of NSAIDs impacts young people' skeletal muscle adaptations to resistance training[24]. The effects of high over-the-counter ibuprofen doses compared to low doses of acetylsalicylic acid on young adults' muscular responses and adaptations to acute and ongoing resistance training were examined in a randomized experimental trial. After 8 weeks of resistance training, the results revealed that taking ibuprofen reduced muscle volume, with ASA (7.5%) increasing more than IBU (3.7%)[25].

Athletes have utilized non-steroidal anti-inflammatory medicines (NSAIDs), such ibuprofen, to treat the pain and symptoms of muscular injury26. Our findings demonstrate that although ibuprofen use has some beneficial effects, there is no conclusive proof that it benefits muscular function or prevents muscle injury[27]. Activity first inhibits the expression of the MEK-ERK gene at the molecular level, which then prevents the production of protein in the human skeletal muscle[9]. NSAIDs are a class of pharmacological medications that have similar modes of action but differ in their structural and pharmacodynamics properties. Ibuprofen's ability to postpone the natural drop in muscle temperature that occurs during post-exercise recovery may also be a sign of a delayed anti-inflammatory response. Measurements of muscle thickness were taken 48 hours prior to the start of training. Post-training muscle thickness measurements were finished 48 hours after the last training session to ensure muscle recovery[28].

Medical resources, diagnosis, and treatment must improve in developing countries. There are limited resources: access to medical and health resources; knowledge about disease; awareness, trainings, and awareness about health. Health literacy is mandatory for any disease and facilitates the patients access to resources, databases, and trainings about the disease in print and electronic (hybrid) format.[31-38]

CONCLUSION

The findings of current study generally accepted that the most significant mechanism driving training-induced muscle hypertrophy is the recurrent increases in muscle protein synthesis following each exercise session. Ibuprofen low doze i.e. 400mg/day decreased the biosynthesis of prostaglandin, Intensity of muscle soreness, muscle protein synthetic response after each training

session. There is mounting evidence that prostaglandins and cyclooxygenase (COX) enzymes are key regulators of the molecular processes governing muscle hypertrophy.

Acknowledgment: The hard work and dedication of the authors are greatly appreciated in conducting this important research and contributing to the field of medicine.

Funding Status: It was self-funded study and no external funding was received for the present study.

Conflict of interest: No conflict of interest was faced during present study.

Authors Contribution: Every author devoted his time and knowledge sincerely in conducting the present study.

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