

Review Article

Bibliometric analysis of Iranian research on resistance training and muscle hypertrophy

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Abstract

This study was designed to conduct a bibliometric analysis of Iranian research on the effects of various resistance training protocols on muscle hypertrophy. The analysis examined temporal publication trends, prolific authors, leading research institutions, and prominent journals in this field. All relevant articles published up to the year 1403 (2024) were retrieved from the MagIran database. Inclusion criteria were limited to original peer-reviewed research articles published in Persian, while conference abstracts and other non-journal sources were excluded. Data were analyzed using VOSviewer software to perform co-authorship and keyword co-occurrence analyses. Between 1390 and 1403 (2011–2024), a total of 31 articles were published in this domain. Most publications were authored by faculty members of public (state) universities. Approximately 65% of the articles appeared in journals affiliated with the Ministry of Science, Research and Technology, whereas 35% were published in medical sciences journals. Keyword analysis indicated that “resistance training” and “muscle hypertrophy” were the most frequent and central terms, with clustering results demonstrating strong interconnections among core research topics. Overall, the findings of this bibliometric analysis provide a structured overview of the research landscape and offer a roadmap for identifying research gaps, publication patterns, and future research priorities in the Iranian context.

Key Words: Resistance training, Muscle hypertrophy, Bibliometric analysis, VOS viewer software

Introduction

Strength training is a form of exercise that has now found its way into virtually all sports involving high-intensity efforts (Andersen & Aagaard, 2010). Previous studies have shown that muscles in rodents that have undergone prior training achieve gains in strength and volume more rapidly than untrained muscles. It has been proposed that this phenomenon is associated with an increased density of muscle nuclei (Psilander et al., 2019). Strength training represents one of the most common forms of structured physical activity. This type of exercise is frequently employed to enhance athletic performance, facilitate recovery from injury, counteract age- or disease-related loss of muscle mass and function, and improve aesthetic body composition (Roberts et al., 2015). Over the past decade, the role of skeletal muscle in maintaining overall health has received growing attention, to the extent that muscle tissue is now recognized as a secretory organ that releases hundreds of myokines involved in the regulation of other organs, including the brain, adipose tissue, bone, and liver (Iversen, Norum, Schoenfeld, & Fimland, 2021). Strength training increases muscular strength and hypertrophy while conferring numerous additional positive health benefits, including improved functional capacity, a more favorable cardiometabolic risk profile, and enhanced well-being. Concurrent training refers to the combination of aerobic and strength exercises performed within the same training programme to simultaneously develop aerobic capacity, muscular strength, and/or hypertrophy. Current physical activity guidelines recommend that all children, adolescents, and adults engage in concurrent training to promote substantial health benefits (Lundberg, Feuerbacher, Sünkeler, & Schumann, 2022). Alternatively, adaptations may be governed solely by the principle of specificity, meaning that improvements in strength, power, and hypertrophy are specific to the type of training performed. However, when strength and power are assessed using neutral tests and hypertrophy is evaluated based on the total muscle mass recruited, the magnitude of the effect appears comparable (Haugen et al., 2023).

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In recent years, Iranian researchers have conducted studies examining the effects of resistance training on muscle hypertrophy. Nevertheless, no study has yet provided a comprehensive and systematic scientometric analysis of previous research in this field. Therefore, a bibliometric study appears capable of offering a thorough analysis and evaluation of the existing literature in this domain. For this reason, the present study aims to conduct a knowledge mapping study of prior research—performed by Iranian investigators—on the effects of resistance training on muscle hypertrophy, with analysis based on publication year, authors, research institutions, and leading journals. Specifically, the current investigation focuses on the effects of different types of resistance training on muscle hypertrophy. The findings of this study will enable Iranian researchers to more effectively select and refine their research questions within the field of resistance training and muscle hypertrophy.

Materials and methods

Bibliometric search strategy

The present study investigates trends in research conducted on the effects of various types of resistance training on muscle hypertrophy. To this end, all relevant articles published up to the year 1403 (2024/2025 Gregorian calendar) were retrieved from the MagIran database, the national repository of Iranian scientific journals. MagIran is one of the most comprehensive domestic sources for Persian-language scholarly publications and provides structured bibliographic information suitable for scientometric analyses, including co-authorship and keyword co-occurrence mapping using VOSviewer software.

The use of MagIran was deliberately chosen to capture the domestic research output published in Persian-language journals and to ensure consistency in data extraction and analysis. However, this database selection represents an inherent limitation of the present study, as it excludes Iranian research published in international, English-language journals indexed in databases such as Scopus or Web of Science. Consequently, high-impact Iranian studies disseminated through international outlets were not included in the analysis. This methodological choice should be considered when interpreting the findings, as the results primarily reflect national publication patterns rather than the full global research output of Iranian scholars in this field. In this study, only full-length peer-reviewed research articles published in Persian were included. Other publication types—such as conference abstracts, editorials, letters to the editor, and commentaries—were excluded from the analysis. The search was performed using the exact phrase “resistance training on muscle hypertrophy”. A total of 31 articles that simultaneously investigated the effect of resistance training on muscle hypertrop-

-hy were ultimately selected. Data from these articles were exported in RIS format from the MagIran database and subsequently imported into VOSviewer software for bibliometric and visual network analysis.

Visualization and bibliometric mapping

In the present study, the free, open-source software VOSviewer, developed by the Centre for Science and Technology Studies (CWTS) at Leiden University, the Netherlands, was employed to construct and visualize the bibliometric networks (van Eck & Waltman, 2017). In VOSviewer, specific visualization parameters were deliberately configured to enhance the interpretability of the bibliometric networks. The size of each circle represents the frequency or weight of the corresponding item (e.g., number of publications by an author or occurrences of a keyword), while the size of the label font is scaled proportionally to the same metric. The thickness of connecting lines reflects the strength of co-occurrence or collaboration links; specifically, thicker lines indicate stronger collaborative relationships or higher co-occurrence frequency. In the co-authorship network, line thickness directly corresponds to the intensity of scientific collaboration between authors, thereby providing a clear visual representation of the relative strength of academic connections (WL., 2018). In the present study, VOSviewer software was utilized to perform co-authorship analysis and keyword co-occurrence analysis.

Results

Distribution of articles by year of publication

The first finding of this study revealed that a total of 31 research articles investigating the effect of resistance training interventions on muscle hypertrophy have been published in scientific-research journals affiliated with the Ministry of Science, Research and Technology and the Ministry of Health and Medical Education of Iran. These articles were published over the period from 1390 to 1403 (2011–2024/2025). The temporal trend of publication is illustrated in Figure 1.

Authorship pattern, collaboration, most productive authors and institutions

A total of 83 authors contributed to the 31 articles, yielding a mean of 3.23 ± 1.16 authors per article. Only one article was single-authored. The number of authors per article ranged from 1 to 6. Eight articles (26%) were co-authored by two authors, whereas the majority were multi-authored (≥ 3 authors). Specifically: 10 articles (32%) had 3 authors, 9 articles (29%) had 4 authors, 1 article (3%) had 5 authors, and 2 articles (6%) had 6 authors. Given that articles derived from PhD dissertations in Iran typically include at least three authors (the student, supervisor,

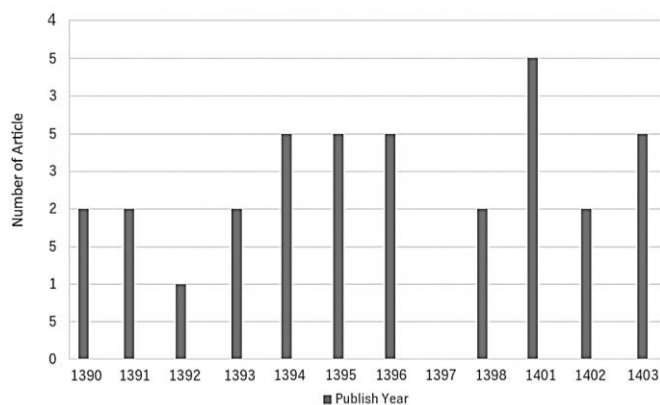


Figure 1. Temporal trend of published articles on the effect of resistance training on muscle hypertrophy by Iranian researchers (1390–1403 / 2011–2024).

and co-supervisor), the presence of two-authored papers and one single-authored paper indicates that not all publications in this field originated from doctoral theses. Fourteen authors published two articles each as corresponding author, representing the highest individual contribution to the literature on the effect of resistance training on muscle hypertrophy. Regarding institutional affiliation of the corresponding author: 27 articles (87%) were published by faculty member of public (state)

universities, with Guilan University leading among public institutions with 3 articles (9% of the total in this category). The remaining 4 articles (13%) were published by faculty members of Islamic Azad University. These findings highlight a predominance of collaborative, multi-author research and a clear dominance of public universities particularly in the corresponding authorship role—within this research domain in Iran.

Preferred journals

Of the 31 published articles, 11 (35%) appeared in scientific-research journals affiliated with universities of medical sciences and accredited by the Ministry of Health and Medical Education. The remaining 20 articles (65%) were published in journals affiliated with the Ministry of Science, Research and Technology. The complete list of journals that published these articles is presented in Table 1.

Trends in research and most frequent keywords

The keyword co-occurrence network visualization consisted of 88 keywords forming 21 clusters, with 217 links and a total link strength of 233. This means that 217 pairs of keywords co-occurred within the same articles. For example, the terms “resistance training”, “hypertrophy”, and “muscle hypertrophy”

Table 1. List of journals publishing articles on the effect of resistance training on muscle hypertrophy.

Journal Name	Publisher	Number of Articles	Accreditation Type
Journal of Qom University of Medical Sciences	Qom University of Medical Sciences	1	Scientific-Research (Ministry of Health and Medical Education)
Journal of Applied Studies in Sport Biosciences	University of Birjand	2	Scientific-Research (Ministry of Science, Research and Technology)
Complementary Medicine Journal	Arak University of Medical Sciences	1	Scientific-Research (Ministry of Health and Medical Education)
Journal of Arak University of Medical Sciences	Research Institute of Physical Education and Sport Sciences (SSRC)	1	Scientific-Research (Ministry of Health and Medical Education)
Journal of Sport Physiology (Quarterly)	University of Tehran	4	Scientific-Research (Ministry of Science, Research and Technology)
Journal of Sport Biosciences (Quarterly)	Shahrekord University of Medical Sciences	3	Scientific-Research (Ministry of Science, Research and Technology)
Journal of Shahrekord University of Medical Sciences	National Nutrition and Food Technology Research Institute (NNFTRI)	1	Scientific-Research (Ministry of Health and Medical Education)
Iranian Journal of Nutrition Sciences & Food Technology (Quarterly)	Shahid Beheshti University	2	Scientific-Research (Ministry of Health and Medical Education)
Journal of Exercise Physiology and Physical Activity	University of Guilan	4	Ministry of Science, Research and Technology
Journal of Metabolism and Exercise	Academic Center for Education, Culture and Research (ACECR)	1	Ministry of Science, Research and Technology
Research in Sport Physiology and Management	Mashhad University of Medical Sciences	1	Ministry of Science, Research and Technology
Journal of Paramedical Sciences and Rehabilitation (Quarterly)	University of Mazandaran	1	Scientific-Research (Ministry of Health and Medical Education)
Applied Sport Physiology Research Journal	Ilam University of Medical Sciences	1	Ministry of Science, Research and Technology
Elderly Nursing Journal	Shahid Beheshti University of Medical Sciences	1	Scientific-Research (Ministry of Health and Medical Education)
Journal of Rehabilitation Medicine (Quarterly)	Isfahan University of Medical Sciences	2	Ministry of Science, Research and Technology
Journal of Isfahan Medical School	Azarbajjan Shahid Madani University	1	Scientific-Research (Ministry of Health and Medical Education)
Journal of Applied Health Studies in Sport Physiology	Qom University of Medical Sciences	1	Scientific-Research (Ministry of Health and Medical Education)
Journal of Knowledge & Health in Basic Medical Sciences	University of Birjand	1	Ministry of Science, Research and Technology

appeared together in a highly interconnected cluster with strong, multifaceted links. The most frequent and dominant keywords identified in this study were “resistance training”, “hypertrophy”, and “muscle hypertrophy”.

Less frequently occurring keywords included creatine, ethanol, myostatin, and aerobic training. The blue-colored clusters exhibited the strongest connections and highest link strength, indicating that these keywords frequently appeared together in the analyzed articles. As clearly shown in the figure, “resistance training”, “hypertrophy”, and “muscle hypertrophy” displayed the strongest association (total link strength: 17; number of links: 10). The green clusters (total link strength: 21; number of links: 20) primarily revolved around follistatin and myostatin in relation to muscle hypertrophy. The red clusters highlighted the association of muscle thickness (total link strength: 8; number of links: 8) with the keyword's muscular strength and cortisol. Overall, “resistance training” achieved the highest total link strength of 59, followed by “hypertrophy” with 41 and “muscle hypertrophy” with 21, resulting in a combined link strength of 121 – the highest in the entire network. Resistance training was employed as the intervention in all included articles. Five studies investigated the effects of resistance training on hypertrophy in animal models (rats), four studies focused on older adults, one study examined individuals with overweight/obesity, and one study addressed alcoholic cardiomyopathy (Abbasi & Moghadasi, 2023; Afsharne-

-zhad & Ramezani, 2018; Albajalan, Rostamzadeh, & Sheikholeslamivatani, 2023; Banitalebi, Gharakhanlou, Ghatreh-Samani, Mohammad-Amoli, & Teimori, 2012; Ebrahim Banitalebi et al., 2012; Bassami, Ebrahim, & Kolahduzy, 2013; Cheragh-Birjandi & Farhadpoor, 2024; Eghbali & Arazi, 2024; Gardashkhani & Farzaneh, 2019; Hajivand & Arazi, 2024; Hatami, Nikooie, & Enhesari, 2019; Irani, Afroundeh, & Birar, 2022; Karimi, Fakhrpour, & Zarneshan, 2022; Khodaei, Hamedinia, Kakhk, & Damavandi, 2016; Masoudian, Jazi, Faramarzi, & Talebi, 2019; Moghadam, Askari, Hamedinia, & Haghghi, 2020; Moghadasi, Fashi, & Ahmadizad, 2020; A. Mohammadi, Khodayi, & Abbasi, 2016; M. Mohammadi & Chafy, 2023; Rasoul Mohammadi, Homaee, Azarbayjani, & Baesi, 2017; Robabeh Mohammadi, Afroundeh, Khajehlandi, & Mohammadian, 2020; Moqimi, Rajabi, & Amani-Shalamzari, 2022; Mostafalou, Kakhak, & Haghghi, 2020; Nava, Biniiaz, Heidarianpour, & Mehrialvar, 2021; Negaresh, Ranjbar, Habibi, & Gharibvand, 2016; Negaresh, Ranjbar, Gharibvand, Habibi, & Moktarzade, 2017; Nourshahi, Rostami, & Nazari, 2024; Rohani, Asjodi, Safarimosavi, & Bahmanzadeh, 2017; Roudsari & Amani, 2019; Sadegh, Rashidlamir, Rizeh, & Soukhtanloo, 2018; Zahabi, 2015). Muscle hypertrophy was measured as an outcome variable in all of the included studies (See Figures 2, 3, and 4 for the corresponding visualisations).

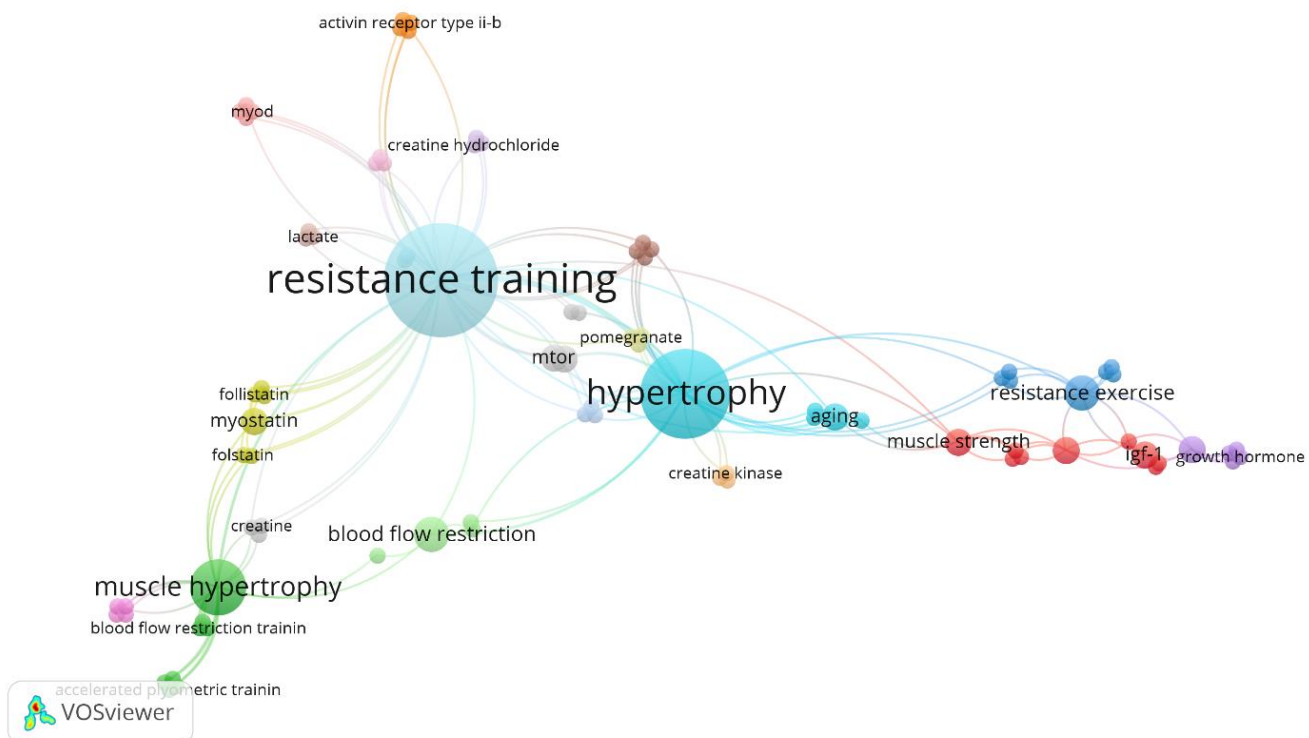


Figure 2. Most frequently used keywords by authors in studies on the effect of resistance training on muscle hypertrophy.

Discussion

The present study conducted a comprehensive bibliometric analysis of articles published by Iranian researchers on resistance training and muscle hypertrophy, with the primary aim of mapping the structural and thematic characteristics of the research landscape. Scientometric indicators, visual maps, and descriptive tables were used to address questions related to publication trends, authorship patterns, institutional affiliations, journal distribution, and dominant research themes.

The results showed that 31 articles were published between 2011 and 2024, with no consistent temporal growth trend. This irregular publication pattern suggests that research on resistance training-induced hypertrophy in Iran has developed intermittently rather than through a sustained and coordinated research agenda. Authorship analysis indicated that most studies were conducted by teams of three or more authors, which is consistent with the predominance of doctoral dissertations as the main source of scientific output in this field. In such cases, authorship order is typically determined by national academic regulations involving students, supervisors, and co-supervisors.

Institutional analysis revealed that the majority of publications originated from public (state) universities, while a smaller proportion (approximately 13%) was affiliated with Islamic Azad University. This distribution likely reflects differences in research capacity, access to graduate programs, and institutional research

priorities. In terms of journal placement, approximately 65% of the articles were published in sport physiology and exercise-related journals, whereas 35% appeared in medical sciences journals. This pattern may be explained by the higher concentration of graduate students in sport sciences within universities supervised by the Ministry of Science, Research and Technology.

Further examination of journal accreditation types and publishers demonstrated that the analyzed articles were dispersed across a wide range of nationally accredited scientific-research journals affiliated with both the Ministry of Science and the Ministry of Health and Medical Education. Journals published by institutions such as the University of Tehran, University of Guilan, and University of Birjand accounted for a notable share of publications within sport sciences, while several medical and health-related journals under the Ministry of Health hosted studies at the intersection of exercise physiology, rehabilitation, and clinical health. The absence of a dominant or specialized journal serving as a central publication outlet suggests a fragmented dissemination structure, which may limit thematic continuity and long-term visibility of this research domain.

Keyword co-occurrence and network analyses identified “muscle hypertrophy” as the central thematic node, strongly connected with terms related to resistance training modalities, muscular adaptations, supplementation, and specific study populations. In this network, node size reflects keyword frequency and link presence indicates co-occurrence within the same publications,

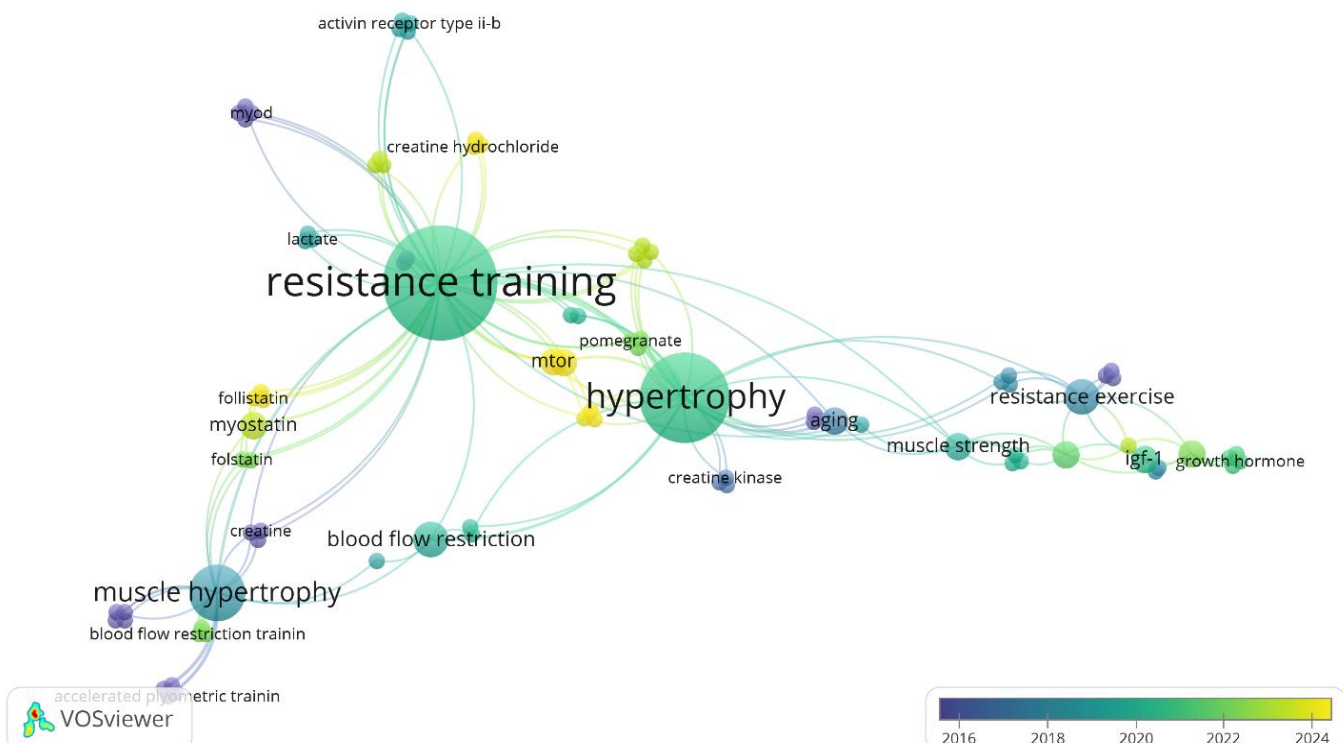


Figure 3. Overlay visualization of the most frequently used keywords by authors and their publication year.

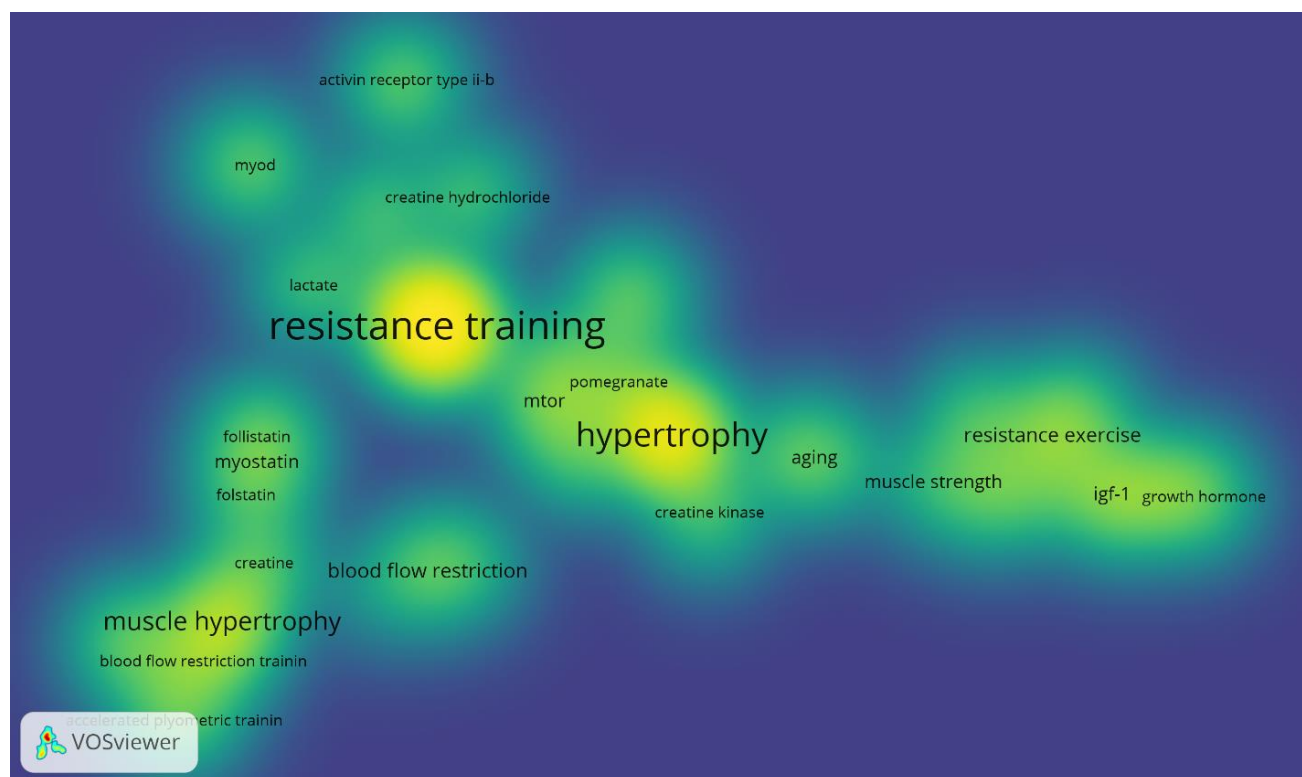


Figure 4. Density visualization of the most frequently used keywords by authors.

while color-coded clusters represent thematic groupings generated by the clustering algorithm. From a descriptive thematic perspective, these clusters broadly correspond to training-related concepts, outcome-related terms, and population-specific topics, rather than distinct or independent research streams. The visualization demonstrates substantial overlap among themes, suggesting that research topics in this field are closely interconnected. Importantly, the network is interpreted here as a structural representation of thematic distribution and co-occurrence patterns, rather than as a basis for inferring the relative strength or dominance of specific conceptual relationships.

From this descriptive thematic perspective, the reviewed literature most frequently addressed older adults (often in relation to sarcopenia), individuals with insulin resistance, overweight or obesity, and selected clinical conditions such as alcoholic cardiomyopathy. The prominence of ageing-related populations indicates that muscle hypertrophy has primarily been investigated within preventive and rehabilitative research contexts.

Content classification further showed that Iranian studies in this field have predominantly focused on muscular, neuromuscular, and molecular dimensions of hypertrophy, as well as on training–nutrition interactions. These aspects are reported here solely as recurring topics and categories of investigation, rather than as evidence of physiological effectiveness or mechanistic conclusions. The thematic concentration and relative homogeneity of research topics suggest limited diversification in

study designs, populations, and conceptual frameworks.

Conclusion

In summary, the bibliometric profile of Iranian research on resistance training and muscle hypertrophy depicts a field characterized by modest publication volume, irregular temporal output, reliance on postgraduate research, dispersed journal placement, and thematic concentration on a narrow range of populations and outcomes. Addressing these structural characteristics—particularly through enhanced inter-institutional collaboration, broader population coverage, and more coherent publication strategies—may contribute to the more systematic development and international visibility of this research area in the future.

What is already known on this subject?

Previous bibliometric and narrative reviews indicate that research on resistance training frequently focuses on muscle hypertrophy and related adaptations, particularly within sport sciences and clinical exercise contexts. Existing evidence shows that publications in this field are commonly distributed across exercise physiology and medical journals and often originate from postgraduate research projects. However, the publication patterns, institutional contributions, journal accreditation characteristics, and thematic distribution of resistance training–related hypertrophy research within Iran have not been systematically examined.

What this study adds?

This study provides the first comprehensive bibliometric mapping of Iranian research on resistance training and muscle hypertrophy. It identifies publication trends, authorship structures, institutional contributions, journal accreditation patterns, and dominant research themes over a 15-year period. By highlighting the fragmented dissemination structure, limited temporal continuity, and thematic concentration of existing studies, the findings offer a structured overview that can inform future research planning, collaboration strategies, and journal targeting within this field.

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Data availability

Review article.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval Not applicable.

Informed consent Not applicable.

Author contributions

Conceptualization: SH.R.M.; Methodology: SH.R.M.; Software: SH.R.M.; Validation: SH.R.M.; Formal analysis: SH.R.M.; Investigation: SH.R.M.; Resources: SH.R.M.; Data curation: SH.R.M.; Writing - original draft: SH.R.M.; Writing - review & editing: SH.R.M.; Visualization: SH.R.M.; Supervision: SH.R.M.; Project administration: SH.R.M.; Funding acquisition: SH.R.M.;

References

Abbasi, Tanaz, & Moghadasi, Mehrzad. (2023). Comparison the effect of very short vs. short rest period between the sets in resistance training on hormonal adaptations and thigh muscles hypertrophy. *Sport Physiology & Management Investigations*, 15(3), 57-70. doi: <https://doi.org/10.22034/spmi.2023.191098>

Afsharnezhad, Taher, & Ramezani, Elham. (2018). Local Muscle Cooling (LMC) as A New Blood Flow Restriction Technique: The Effect of 8-Weeks Resistance Training with LMC on Knee Extensor Muscle Thickness, Strength and Activation. *Sport Physiology*, 10(39), 165-184. doi: <https://doi.org/10.22089/spj.2018.5534.1728>

Albajalan, Diyar MohammedAli, Rostamzadeh, Naser, & Sheikholeslamivatani, Daruush. (2023). Hypertrophic and hormonal responses to one session of resistance training with two different protocols in men's sprint runner. *Journal of Sport and Exercise Physiology*, 16(2), 1-13. doi: <https://doi.org/10.48308/joeppa.2023.103402>

Andersen, J. L., & Aagaard, P. (2010). Effects of strength training on muscle fiber types and size; consequences for athletes training for high-intensity sport. *Scand J Med Sci Sports*, 20 Suppl 2, 32-38. doi: <https://doi.org/10.1111/j.1600-0838.2010.01196.x>

Banitalebi, Ebrahiem, Gharakhanlou, Reza, Ghatreh-Samani, Kyehan, Mohammad-Amoli, Mahsa, & Teimori, Hosin. (2012). The effect of resistance training on plasma and skeletal muscles sphingosine-1-phosphate levels of male Wistar rat. *Journal of Shahrekord University of Medical Sciences*, 14(1), 1-. URL: <https://www.sid.ir/paper/58361/en>

Banitalebi, Ebrahim, Gharekhanlo, Reza, Samani, Kahan Ghatre, Parnow, Abdilhossain, Ameli, Mahsa Mohammad, & Teimori, Hossain. (2012). Sphingosine-1-Phosphate: a Growth Factor in Hypertrophy following Resistance Training. *Sport Biosciences*, 4(12), 111-. doi: <https://doi.org/10.22059/jsb.2012.28981>

Bassami, Dr Mino, Ebrahim, Dr Khosro, & Kolahduzy, Ba Sarkawt. (2013). The comparison between effects of circuit and hypertrophy resistance exercise on fat and carbohydrate metabolism during endurance exercise in overweight men. *Sport Physiology*, 5(17), 29-. URL: <https://www.sid.ir/paper/228288/en>

Cheragh-Birjandi, Sadegh, & Farhadpoor, Mojtaba. (2024). Comparison of the effects of two types of resistance training on the serum levels of factors involved in muscular hypertrophy in healthy young men. *Journal of Sport and Exercise Physiology*, 17(2), 67-79. doi: <https://doi.org/10.48308/joeppa.2024.235785.1256>

Eghbali, Ehsan, & Arazi, Hamid. (2024). Can creatine hydrochloride combined with resistance training affect testosterone and cortisol levels, strength, muscle hypertrophy and body composition in young men? *Journal of practical studies of Biosciences in Sport*, 12(31), 34-46. doi: <https://doi.org/10.22077/jpsbs.2023.6484.1803>

Gardashkhani, Shiam, & Farzaneh, Amin. (2019). The Comparison of Combination of 8 Weeks of Resistance Training with Blood Flow Restriction and Traditional Resistance Training Based on Linear and Undulating Periodization on Hypertrophy, Strength, Muscular Endurance and Explosive Power in Active Girls. *Sport Biosciences*, 11(41), 209-224. doi: <https://doi.org/10.22059/jsb.2019.257801.1274>

Hajivand, Elham, & Arazi, Hamid. (2024). Comparison of the effects of modified German volume resistance training versus the traditional method on muscle volume, strength and body composition of active women. *Journal of Sport and Exercise Physiology*, 17(3), 107-123. doi: <https://doi.org/10.48308/joeppa.2024.236200.1275>

Hatami, Mohsen, Nikoie, Rohollah, & Enhesari, Ahmad. (2019). Presentation of Lacto-Resistance Training Method and Comparing Its Effect on Muscle Hypertrophy with Traditional Resistance Training In Professional Bodybuilders. *Journal of Applied Exercise Physiology*, 15(29), 169-181. doi: <https://doi.org/10.22080/jaep.2019.15120.1821>

Haugen, M. E., Vårvik, F. T., Larsen, S., Haugen, A. S., van den Tillaar, R., & Bjørnsen, T. (2023). Effect of free-weight vs. machine-based strength training on maximal strength, hypertrophy and jump performance - a systematic review and meta-analysis. *BMC Sports Sci Med Rehabil*, 15(1), 103. doi:10.1186/s13102-023-00713-4. doi: <https://doi.org/10.1186/s13102-023-00713-4>

- Irani, Meysam, Afroudeh, Roghayyeh, & Birar, Aylar. (2022). Effect of 8 Weeks of Resistance Training Combined With Pomegranate Extract Supplementation on Resting Metabolic Rate, Hypertrophy, and Muscle Strength of Inactive Male College Students. *Complementary Medicine Journal of faculty of Nursing & Midwifery*, 12(1), 56-68. doi: <https://doi.org/10.32598/cmja.12.1.1116.1>
- Iversen, V. M., Norum, M., Schoenfeld, B. J., & Fimland, M. S. (2021). No Time to Lift? Designing Time-Efficient Training Programs for Strength and Hypertrophy: A Narrative Review. *Sports Med*, 51(10), 2079-2095. doi: <https://doi.org/10.1007/s40279-021-01490-1>
- Karimi, Reza, Fakhrpour, Rogyehe, & Zarneshan, Azam. (2022). Effect of Resistance Training with Milk Protein Concentrate (MPC) Supplementation on serum levels of Follistatin and myostatin and Muscle Hypertrophy in Beginner Bodybuilders. *Biannual Journal of Applied Health Studies in Sport Physiology*, 9(1), 151-163. doi: <https://doi.org/10.1007/s40279-021-01490-1>
- Khodaei, Kazem, Hamedinia, Mohammad Reza, Kakhk, Seyed Alireza Hosseini, & Damavandi, Mohsen. (2016). The Effect of Six Weeks Plyometric Training with Nonlinear Periodization on Hormonal Changes, Muscle Hypertrophy and Leg Muscles Elastic Property in Male Athletes (Nonlinear Periodization of Plyometric Training and Hormonal Changes). *Sport Physiology*, 8(31), 45-. doi: <https://doi.org/10.22089/spj.2016.820>
- Lundberg, T. R., Feuerbacher, J. F., Sünkeler, M., & Schumann, M. (2022). The Effects of Concurrent Aerobic and Strength Training on Muscle Fiber Hypertrophy: A Systematic Review and Meta-Analysis. *Sports Med*, 52(10), 2391-2403. doi: <https://doi.org/10.1007/s40279-022-01688-x>
- Masoudian, Behnam, Jazi, Akbar Azamian, Faramarzi, Mohammad, & Talebi, Ardeshir. (2019). The Effect of Eight Weeks of Resistance Training on Activin Receptor type II-B and Plasma Levels of Growth Differentiation Factor 11 and 8 in Cardiac Physiological Hypertrophy in Male Wistar Rats. *Journal Of Isfahan Medical School*, 36(502), 1308-1313. URL: <http://eprints.mui.ac.ir/id/eprint/10798>
- Moghadam, A Sharifi, Askari, R, Hamedinia, M.R, & Haghghi, A.H. (2020). A Comparison of the Effects of Three Strength Training Programs with and without Blood Flow Restriction on Strength, Hypertrophy and Mobility Function in Elderly Women. *Journal of Paramedical Science and Rehabilitation*, 8(4), 26-35. doi: <https://doi.org/10.22038/jpsr.2020.33483.1828>
- Moghadasi, Ali, Fashi, Mohamad, & Ahmadizad, Sajad. (2020). The effect of four weeks of hypoxic resistance training on biceps hypertrophy and muscle function of healthy men's. *Sport Biosciences*, 12(45), 223-233.
- Mohammadi, Abas, Khodayi, Kazem, & Abbasi, Iman. (2016). A Comparison of the Effect of Accelerated Plyometric, Resisted Plyometric and Common Plyometric Training on Power Performance, Strength and Muscle Hypertrophy in Active Males. *Sport Physiology*, 8(30), 33-50. doi: <https://doi.org/10.22089/spj.2016.768>
- Mohammadi, Mohsen, & Chafy, MohammadReza Fadaei. (2023). The effect of resistance-aerobic training on the gene expression of FNDC5, myostatin and hypertrophy or hyperplasia in the gastrocnemius muscle of immature rats. *Journal of practical studies of Biosciences in Sport*, 11(28), 88-99. doi: <https://doi.org/10.22077/jpsbs.2023.5639.1740>
- Mohammadi, Rasoul, Homae, Hasan Matin, Azarbayjani, Mohammad Ali, & Baesi, Kazem. (2017). The Effect of 12-Week Resistance Training on Cardiac Hypertrophy, Glucose Level, Insulin, and Insulin Resistance Index in STZ-Induced Diabetic Rats. *Qom University of Medical Sciences Journal*, 11(2), 38-45. URL: <https://www.cabidigitallibrary.org/doi/full/10.5555/20173279384>
- Mohammadi, Robabeh, Afroudeh, Roghayyeh, Khajehlandi, Mojdeh, & Mohammadian, Mehrdad. (2020). Survey on the Acute Effect of Resistance Training with and without Blood Flow Restriction on Muscle Hypertrophy Indicators. *Scientific Journal of Rehabilitation Medicine*, 9(1), 147-155. doi: <https://doi.org/10.22037/jrm.2019.112040.2146>
- Moqimi, Reza, Rajabi, Hamid, & Amani-Shalamzari, Sadegh Sadegh. (2022). The effect of four weeks resistance training along with blood flow restriction on the cross-sectional area of non-restricted muscles in active men. *Journal of practical studies of Biosciences in Sport*, 10(23), 20-30. doi: <https://doi.org/10.22077/jpsbs.2021.4226.1625>
- Mostafalou, Ali, Kakhak, Seyed Alireza Hosseini, & Haghghi, Amir Hossein. (2020). The Effect of Low Intensity Eccentric Training with Blood Flow Restriction on Muscle Volume and Physical Function of Male Soccer Players. *Sport Physiology*, 12(46), 77-94. doi: <https://doi.org/10.22089/spj.2019.6652.1840>
- Nava, Majid Khanbabaii, Biniaz, Mohamad Mehdi, Heidarianpour, Ali, & Mehrialvar, Yaghoob. (2021). The role of Resistance Training on Hormones Involved in Muscle Hypertrophy. *Journal of Knowledge & Health*, 15(4), 2-11. URL: <https://www.sid.ir/paper/964843/en>
- Negaresh, Raof, Ranjbar, Dr. Roholah, Habibi, Dr. Abdolhamid, & Gharibvand, Dr. Mohammad Moemen. (2016). The effects of eight weeks of resistance training on some muscle hypertrophy and physiological parameters in elderly men. *Journal of Geriatric Nursing*, 3(1), 62-.
- Negaresh, Raof, Ranjbar, Roohollah, Gharibvand, Mohammad Mo'men, Habibi, Abdolhamid, & Moktarzade, Motahare. (2017). Effect of 8-Week Resistance Training on Hypertrophy, Strength, and Myostatin Concentration in Old and Young Men. *Salmand: Iranian Journal of Ageing*, 12(1), 56-67. doi: <https://doi.org/10.21859/sija-120154>
- Nourshahi, Maryam, Rostami, Samira, & Nazari, Nastaran. (2024). The impact of alcohol consumption on resistance training-induced muscle hypertrophy and alcohol-induced cardiomyopathy. *Journal of Sport and Exercise Physiology*, 17(2), 109-129. doi: <https://doi.org/10.48308/joeppa.2024.235366.1237>
- Psilander, N., Eftestøl, E., Cumming, K. T., Juvkam, I., Ekblom, M. M., Sunding, K., . . . Gundersen, K. (2019). Effects of training, detraining, and retraining on strength, hypertrophy, and myonuclear number in human skeletal muscle. *J Appl Physiol* (1985), 126(6), 1636-1645. doi: <https://doi.org/10.1152/jappphysiol.00917.2018>
- Roberts, L. A., Raastad, T., Markworth, J. F., Figueiredo, V. C., Egner, I. M., Shield, A., . . . Peake, J. M. (2015). Post-exercise cold water immersion attenuates acute anabolic signalling and long-term adaptations in muscle to strength training. *J Physiol*, 593(18), 4285-4301. doi: <https://doi.org/10.1113/jp270570>
- Rohani, H., Asjodi, F., Safarimosavi, S., & Bahmanzadeh, M. (2017). The Role of Resistance Training and Whey Protein Intake on Delayed Onset Muscle Soreness Indices after Eccentric Resistance Exercise in Untrained Men. *Iranian Journal of Nutrition Sciences & Food Technology*, 12(1), 11-20. doi: <http://nsf.sbmu.ac.ir/article-1-2210-en.pdf>
- Roudsari, Taher Afsharnezhad, & Amani, Alireza. (2019). The effects of resistance training on muscle strength, hypertrophy and myogenin protein level of gastrocnemius in elderly rats. *Journal of practical studies of Biosciences in Sport*, 7(14), 31-44. doi: <https://doi.org/10.22077/jpsbs.2018.1089.1349>
- Sadegh, Moein Rahimi, Rashidlamir, Amir, Rizeh, Ali Akbar Haddad Mashhad, & Soukhtanloo, Mohammad. (2018). Examining the Effect of Inhibition of Lysyl

oxidase on Involved Genes in Hypertrophy Following One Period of Resistance Training in Wistar Rats. *Journal of Arak University of Medical Sciences*, 20(12), 35-43. URL: <http://jams.arakmu.ac.ir/article-1-5319-en.html>

van Eck, N. J., & Waltman, L. (2017). Citation-based clustering of publications using CitNetExplorer and VOSviewer. *Scientometrics*, 111(2), 1053-1070. doi: <https://doi.org/10.1007/s11192-017-2300-7>

WL., van Eck N. J. (2018). Manual for VOSviewer version 1.6.9. Leiden, the Netherlands. Universiteit Leiden.

Zahabi, Gh. (2015). Effect of Whey Protein & Creatine Supplementation on the Fitness Indicators, Velocity and Muscle Hypertrophy of Untrained Men over a Period of Resistance Training. *Iranian Journal of Nutrition Sciences & Food Technology*, 10(2), 19-28. URL: <http://nsft.sbm.ac.ir/article-1-1622-en.html>