Review

The impact of taurine on healthy nutrition and Overall health

Onur Oral[1, *], Naima Badid[2], Iyanuloluwa Ojo[3], PramilaThapa[4], Mumtaz Enser[5]

[1]*Ege University, Faculty of Sports Sciences, Department of Health Sciences and Sports, Izmir, Turkey.*
**Corresponding Author: Assoc. Prof. Onur Oral : onur.oral@ege.edu.tr*
[2]*University Abou Bakr Belkaid, Faculty of Natural Sciences and Life, Sciences of the Earth and the Universe, Department of Biology, Tlemcen, Algeria. badidnaima@gmail.com, naima.badid @univ-tlemcen.dz*
[3]*University College Hospital, Ibadan, Oyo State, Nigeria.*
[4]*Life Skill Education Institutes/Yeti Health Science Academy, Katmandu, Nepal.*
[5]*Dokuz Eylul University, Institute of Social Sciences, Department of Philosophy, Izmir, Turkey*

Abstract

Background: This review article aims to provide a comprehensive overview of the diverse effects of taurine on human health. It seeks to synthesize the existing research findings and explore the potential therapeutic applications of taurine in addressing various medical conditions.
Materials and Methods: A comprehensive search of the literature was conducted using various databases and a range of keywords, including "taurine," "nutrition," "health," "metabolism," "physical activity," and "overall health." It was intended to ensure that the search was as inclusive as possible, and therefore several different terms have been included. The review included a variety of study types, such as randomized controlled trials, cohort studies, and systematic reviews, to ensure a comprehensive and diverse range of evidence, in line with the best practice for such a review. To ensure a comprehensive and diverse range of evidence, the inclusion criteria for this review were established to filter studies that assess the relationship among "taurine," "nutrition," "health," "metabolism," "physical activity," and "overall health." After careful consideration, a total of 26 studies were selected for inclusion in this review. This review aims to shed light on the relationship among eating disorders, wellness, physical activity, and overall health. To ensure the quality and relevance of the selected studies, we limited the search to peer-reviewed articles published in English between 2001 and 2024.
Results: Taurine has the potential to offer a range of benefits for athletes, both in terms of supporting their performance and promoting overall health and well-being. While its effects on endurance and strength performance may vary from one individual to another, and there is much to be learned about how it can be most effectively used, the antioxidant properties, hydration benefits, and positive impacts on muscle recovery and cardiovascular health remain consistent across different athletic populations.
Conclusion: There is considerable potential for taurine to play a role in nutritional and therapeutic strategies targeting diabetes, cardiovascular diseases, and oxidative stress-related conditions. Given its diverse beneficial properties, it seems prudent to include taurine in public health discussions and clinical practice. There is a clear need for continued exploration to fully harness taurine's capabilities in promoting holistic health.

Keywords: Taurine – Nutrition – Health – Metabolism - Physical activity - Overall health.

Introduction

Taurine, a sulfur-containing amino acid, has recently received a great deal of attention for its potential health benefits, particularly in the context of nutrition and athletic performance. While taurine is classified as a non-essential amino acid, meaning that the body can synthesize it, it is found in high concentrations in various tissues, including the brain, heart, and skeletal muscles (Schaffer et al., 2010; Seidel et al., 2019).
It is widely acknowledged that taurine plays an integral role in metabolic regulation. Pérez-Hernández et al. (2022) have suggested that taurine may act as an important metabolic regulator, with the potential to affect bone and cartilage health. There is also some evidence that it could offer therapeutic benefits in osteoporosis and arthritis (Marcinkiewicz & Kontny, 2014). It is also worth noting that taurine plays a role in regulating pancreatic β-cell function, which is crucial for insulin production and secretion (Cuttitta et al., 2013). It seems reasonable to suggest that taurine supplementation may have potential in the management of type 2 diabetes by increasing insulin secretion and sensitivity (Hansen, 2001).

Moreover, taurine has been shown to have a significant impact on cardiovascular health. Schaffer et al., (2014) put forth the possibility that the amino acid may have the potential to regulate cardiovascular function, suggesting that it could play a protective role against coronary heart disease by reducing arterial stiffness and hypertension. These potential effects are further developed and complemented by the findings of Wójcik et al., (2010), which suggest that taurine may have cardioprotective effects through its antioxidant properties, which could help to reduce oxidative stress and inflammation associated with cardiovascular diseases.

It is worth mentioning that taurine is involved in many physiological processes, including bile salt formation, osmoregulation, and modulation of calcium signaling. It seems reasonable to suggest that this property of taurine may be of great importance in emphasizing its potential importance in maintaining general health (Cuttitta et al., 2013). It may be of interest to observe that during the extensive literature review on this topic, there has been a considerable amount of interest expressed in the potential impact of taurine on healthy nutrition and health. Because of that reason, it is important to highlight that this interest has particularly focused on taurine's ergogenic properties, antioxidant effects, and crucial effects on various populations, including athletes and individuals with certain health conditions.

The physiological effects of taurine are subject to influence by many individual factors, including genetics, age, sex, and training status. For example, research indicates that genetic variations can affect taurine metabolism, resulting in differences in baseline levels among individuals (Manna et al., 2013). Some individuals may possess higher endogenous taurine levels, which could diminish the need for supplementation. Conversely, others may experience significant performance enhancements from taurine intake due to lower baseline levels (Szymański & Winiarska, 2008). This variability underscores the necessity of personalized approaches to taurine supplementation, particularly in athletic populations where performance optimization is of paramount importance.

It is also worth noting that the timing of taurine supplementation can have a significant impact on its effectiveness. It seems that short-term supplementation, especially when taken before exercise, may have the potential to enhance endurance and overall exercise performance (Waldron et al., 2018; Wójcik et al., 2010). On the other hand, the long-term effects of taurine supplementation are not yet fully understood. Some studies have indicated that continuous use may lead to adaptations that either enhance or plateau performance over time (Pérez-Hernández et al., 2022). This distinction is important for athletes to consider when integrating taurine into their training regimens, as they may need to adapt their approach based on their specific performance goals.

Materials and methods

A comprehensive search of the literature was conducted using a range of databases, including the US National Library of Medicine (PubMed), Scopus, EBSCO, MEDLINE, DRJI (Directory of Research Journal Indexing), Embase, Web of Science, Google Scholar, and SportDiscus. To gain a comprehensive understanding of the subject matter, some key search terms were selected for the search, including "taurine," "nutrition," "health," "metabolism," "physical activity," and "overall health." In addition, further relevant literature was identified through the examination of reference lists derived from the data searches. To focus on the most relevant results, the search was limited to peer-reviewed articles published in English between 2001 and 2024. To gain a comprehensive understanding of the relationship among eating disorders, wellness, physical activity, and overall health, it was necessary to meet certain criteria. Firstly, the relationship among eating disorders, wellness, physical activity, and overall health had to be examined. Secondly, the studies had to be published in a peer-reviewed journal. Thirdly, the studies had to be in English. Following a rigorous selection process, 26 studies were chosen to be included in this review.

Results and discussion

Through a process of careful review and analysis of current literature, we have gained valuable insights into the potential benefits of taurine in enhancing nutritional health and managing chronic diseases. When all the findings are evaluated together, it may be possible to integrate the positive contributions of taurine to nutritional health, consider their implications, and identify areas requiring further research in the context of public health and clinical practice (Lourenco & Camilo, 2002; Yamori et al., 2010) It seems that taurine may play an important role in regulating glucose metabolism, particularly in studies that emphasize its potential to increase insulin secretion and reduce insulin resistance (Brøns et al., 2004). This could be a promising avenue for addressing the growing prevalence of type 2 diabetes. These results are in line with those previously demonstrated by Cuttitta et al. (2013) and De la Puerta et al. (2010), who described the ability of taurine to improve pancreatic β-cell function. In light of the growing prevalence of diabetes worldwide, these findings underscore the potential value

of exploring taurine as a possible adjunct in diabetes management protocols, particularly for individuals with metabolic syndrome. It seems reasonable to suggest that taurine supplementation may offer cardiovascular benefits. Some studies, such as those by Schaffer et al., (2014) and Qaradakhi et al., (2020), suggest that taurine may have the potential to improve hypertension and arterial health. It is of great importance to consider these findings highlighting the cardiovascular benefits associated with taurine supplementation, particularly given that cardiovascular disease remains a leading cause of death worldwide.

It seems that taurine may have the potential to play a role in cardiovascular health interventions, particularly given its antioxidant capacity and ability to reduce oxidative stress and inflammation. These factors are often implicated in cardiovascular pathology, so it is possible that taurine could be a beneficial addition to dietary supplements aimed at reducing cardiac risk (Tzang,et al., 2024).There is a growing body of evidence pointing to the potential role of taurine in diabetes management. For instance, Manna et al., (2013) and Surai et al., (2021) have highlighted its preventive potential against a range of metabolic complications associated with diabetes. In addition to these research studies, the antioxidant properties of taurine have been investigated by Kim et al. (2007) and Vassort & Turan (2010). It is worth noting that taurine plays a significant role in reducing oxidative stress-induced damage in diabetic conditions. Upon closer examination of these protective mechanisms, it can be argued that the incorporation of taurine into comprehensive diabetes management strategies and its potential to enhance patient outcomes by reducing antioxidant stress is a valuable contribution to public health (Schaffer & Kim, 2018; Sirdah, 2015).

Research on athlete nutritional health suggests that taurine supplementation may potentially contribute to increased exercise capacity, particularly in the context of endurance sports. For example, studies have indicated that taurine may potentially contribute to reducing oxidative stress and inflammation (De Carvalho et al., 2017), which could be beneficial for recovery after intense training. In addition to these findings, taurine may also play a role in maintaining proper hydration and electrolyte balance, which could be particularly beneficial for endurance athletes who require optimum hydration levels (Meyer et al., 2019).

It seems reasonable to suggest that the antioxidant properties of taurine may also play an important role in muscle recovery. In a study conducted by Ra et al., (2015) and Kurtz et al., (2021), athletes who supplemented with taurine reported reduced muscle soreness and faster recovery times, which could be indicative of its potential benefits. These findings also offer valuable scientific insights into the potential role of taurine as an ergogenic supplement for maintaining consistent training programs and preventing injuries. In addition to these insights, Pérez-Hernández et al., (2022) also explored the potential role of taurine as a metabolic regulator in bone and cartilage health. Their findings offer valuable insights into how taurine may affect bone density and strength through its effects on osteoblast and osteoclast activity. The authors consider the possibility that taurine supplementation might have therapeutic effects in the prevention of bone-related disorders, particularly in populations at risk for osteoporosis. This could help clarify the implications of taurine consumption as an ergogenic supplement. As this research continues to evolve, it will become increasingly important for athletes to gain a deeper understanding of these dynamics in order to optimize their training and recovery regimens (Larrosa et al., 2024).

Conclusion

Taurine, an amino acid that is widely distributed in a variety of food sources, has been linked to a multitude of health benefits across a range of physiological functions. Taurine has been shown to have beneficial effects on a number of physiological systems, including cardiovascular health, brain function, exercise performance, metabolic health, and eye health. These findings have emerged from a body of scientific studies. It is important to note that while the research suggests potential health benefits of taurine, further studies are needed to fully understand its mechanisms of action and establish optimal dosage recommendations for different populations. As with any dietary supplement or dietary change, it is recommended that individuals consult with healthcare professionals before incorporating taurine supplementation into their routine. By understanding the potential health benefits of taurine, individuals can make informed decisions about incorporating taurine-rich foods or supplements into their diet to support overall wellness and improve specific aspects of their health. A number of studies have explored the potential role of taurine in metabolic health, particularly in relation to diabetes and obesity. Taurine has been shown to improve insulin sensitivity, which is crucial for maintaining healthy blood sugar levels and preventing the development of type 2 diabetes. Furthermore, taurine has been found to regulate lipid metabolism, which may help to reduce the accumulation of fat in the liver and prevent the development of non-alcoholic fatty liver disease (NAFLD). Additionally, taurine has been suggested to promote weight loss by increasing fat oxidation and suppressing appetite. For those interested in physical fitness and exercise, taurine may offer potential benefits in enhancing performance. Taurine has been found to have the potential to improve

muscle endurance and reduce muscle damage caused by strenuous exercise. It may also have the ability to aid in post-exercise recovery by reducing inflammation and promoting the repair of muscle tissue. Furthermore, taurine has been shown to increase the availability of oxygen to muscles during exercise, which could result in improved exercise capacity and overall performance. These findings suggest that taurine supplementation may be a beneficial addition for athletes and individuals engaging in regular physical activity. Taurine has also been extensively studied for its potential effects on brain function. Research suggests that taurine may play a role in maintaining cognitive health and protecting against neurodegenerative diseases such as Alzheimer's and Parkinson's disease. Taurine acts as a neurotransmitter and has been shown to enhance memory and learning abilities in animal studies. Additionally, taurine has been found to possess neuroprotective properties, meaning it can help protect brain cells from damage caused by oxidative stress and inflammation. These properties make taurine a promising candidate for further research into the prevention and treatment of various neurological disorders. In light of the evidence presented, it seems reasonable to conclude that taurine offers a range of benefits for athletes, both in terms of performance enhancement and general health. It should be noted that the effects of taurine on endurance and strength performance can vary considerably from one individual to another. It seems, however, that the antioxidant properties, hydration benefits, and positive impacts on muscle recovery and cardiovascular health remain consistent across different athletic populations. As research progresses, it will be important for athletes to gain a deeper understanding of these dynamics in order to optimize their training and recovery regimens.

Acknowledgment

We would like to express our special thanks to Dr. George N. Nomikos for his very successful contribution to the literature research process and unique academic support in the publication during the process of this review article.

Conflict of interest

The author certifies that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Funding

The author certifies that there is no funding from any financial organization regarding the material discussed in the manuscript or contributions

Author contributions

All the authors read and approved the final version of the manuscript.

References

- Brøns C, Spohr C, Storgaard H, Dyerberg J, Vaag A (2004). Effect of taurine treatment on insulin secretion and action, and on serum lipid levels in overweight men with a genetic predisposition for type II diabetes mellitus. European journal of clinical nutrition 58(9): 1239-1247. https://doi.org/10.1038/sj.ejcn.1601955
- Cuttitta CM, Guariglia SR, Idrissi AE, L'Amoreaux WJ (2013). Taurine's effects on the neuroendocrine functions of pancreatic β cells. In Taurine 8: Volume 1: The Nervous System, Immune System, Diabetes and the Cardiovascular System: 299-310. https://doi.org/10.1007/978-1-4614-6130-2_25
- De Carvalho FG, Galan BS, Santos PC, Pritchett K, Pfrimer K, Ferriolli E et al., (2017). Taurine: a potential ergogenic aid for preventing muscle damage and protein catabolism and decreasing oxidative stress produced by endurance exercise. Frontiers in physiology (8): 710. https://doi.org/10.3389/fphys.2017.00710
- De la Puerta C, Arrieta FJ, Balsa JA, Botella-Carretero JI, Zamarrón I, Vázquez, C (2010). Taurine and glucose metabolism: a review. Nutrición Hospitalaria 25(6): 910-919. https://doi.org/10.3305/nh.2010.25.6.4815
- Hansen SH (2001). The role of taurine in diabetes and the development of diabetic complications. Diabetes/Metabolism Research and Reviews 17(5): 330-346. https://doi.org/10.1002/dmrr.229

- Kim SJ, Gupta RC, Lee HW (2007). Taurine-diabetes interaction: from involvement to protection. Current Diabetes Reviews 3(3): 165-175. https://doi.org/10.2174/157339907781368940
- Kurtz JA, Van Dusseldorp TA, Doyle JA, Otis JS (2021). Taurine in sports and exercise. Journal of the International Society of Sports Nutrition 18(1): 39. https://doi.org/10.1186/s12970-021-00438-0
- Larrosa M, Gil-Izquierdo A, González-Rodríguez LG, Alférez M, San Juan AF, Sánchez-Gómez Á et al., (2024). Nutritional strategies for optimizing health, sports performance, and recovery for female athletes and other physically active women: A systematic review. Nutrition Reviews, nuae082. https://doi.org/10.1093/nutrit/nuae082
- Lourenco R, Camilo ME (2002). Taurine: a conditionally essential amino acid in humans? An overview in health and disease. Nutr Hosp 17(6): 262-270.
- Manna P, Das JC, Sil P (2013). Role of sulfur containing amino acids as an adjuvant therapy in the prevention of diabetes and its associated complications. Current Diabetes Reviews 9(3): 237-248. https://doi.org/10.2174/1573399811309030005
- Marcinkiewicz J, Kontny E (2014). Taurine and inflammatory diseases. Amino acids 46: 7-20. https://doi.org/10.1007/s00726-012-1361-4
- Meyer F, Timmons BW, Wilk B, Leites GT (2019). Water: hydration and sports drink. In Nutrition and enhanced sports performance: 545-554. Academic Press. https://doi.org/10.1016/B978-0-12-813922-6.00046-1
- Pérez-Hernández E, Pastrana-Carballo JJ, Gómez-Chávez F, Gupta RC, Pérez-Hernández N (2022). A key metabolic regulator of bone and cartilage health. Endocrinology and Metabolism 37(4): 559-574. https://doi.org/10.3803/EnM.2022.1443
- Ra SG, Akazawa N, Choi Y, Matsubara T, Oikawa S, Kumagai H et al., (2015). Taurine supplementation reduces eccentric exercise-induced delayed onset muscle soreness in young men. In Taurine 9: 765-772. Springer International Publishing. https://doi.org/10.1007/978-3-319-15126-7_61
- Qaradakhi T, Gadanec LK, McSweeney KR, Abraham JR, Apostolopoulos V, Zulli A (2020). The anti-inflammatory effect of taurine on cardiovascular disease. Nutrients 12(9): 2847. https://doi.org/10.3390/nu12092847
- Schaffer SW, Ju Jong CKCR, Azuma J (2010). Physiological roles of taurine in heart and muscle. Journal of biomedical science 17: 1-8. https://doi.org/10.1186/1423-0127-17-S1-S2
- Schaffer SW, Shimada K, Jong CJ, Ito T, Azuma J, Takahashi K (2014). Effect of taurine and potential interactions with caffeine on cardiovascular function. Amino Acids 46(5): 1147-1157. https://doi.org/10.1007/s00726-014-1708-0
- Schaffer S, Kim HW (2018). Effects and mechanisms of taurine as a therapeutic agent. Biomolecules & therapeutics 26(3): 225. https://doi.org/10.1007/s00726-014-1708-0
- Seidel U, Huebbe P, Rimbach G (2019). Taurine: a regulator of cellular redox homeostasis and skeletal muscle function. Molecular nutrition & food research 63(16): 1800569. https://doi.org/10.1002/mnfr.201800569
- Sirdah MM (2015). Protective and therapeutic effectiveness of taurine in diabetes mellitus: a rationale for antioxidant supplementation. Diabetes & Metabolic Syndrome: Clinical Research & Reviews 9(1): 55-64. https://doi.org/10.1016/j.dsx.2014.05.001
- Surai PF, Earle-Payne K, Kidd MT (2021). Taurine as a natural antioxidant: From direct antioxidant effects to protective action in various toxicological models. Antioxidants 10(12): 1876. https://doi.org/10.3390/antiox10121876
- Szymański K, Winiarska K (2008). Tauryna i jej potencjalne wykorzystanie w terapii, Taurine and itspotentialtherapeuticapplication. *Postępy Higieny i Medycyny Doświadczalnej 62*: 75-86.
- Tzang CC, Lin WC, Lin LH, Lin TY, Chang KV, Wu WT, Özçakar L (2024). Insights into the cardiovascular benefits of taurine: a systematic review and meta-analysis. Nutrition journal 23(1): 93. https://doi.org/10.1186/s12937-024-00995-5
- Vassort G, Turan B (2010). Protective role of antioxidants in diabetes-induced cardiac dysfunction. Cardiovascular toxicology 10: 73-86. https://doi.org/10.1007/s12012-010-9064-0

- Waldron M, Patterson SD, Tallent J, Jeffries O (2018). The effects of an oral taurine dose and supplementation period on endurance exercise performance in humans: a meta-analysis. Sports Medicine 48: 1247-1253. https://doi.org/10.1007/s40279-018-0896-2
- Wójcik OP, Koenig KL, Zeleniuch-Jacquotte A, Costa M, Chen Y (2010). The potential protective effects of taurine on coronary heart disease. Atherosclerosis 208(1): 19-25. https://doi.org/10.1016/j.atherosclerosis.2009.06.002
- Yamori Y, Taguchi T, Hamada A, Kunimasa K, Mori H, Mori M (2010). Taurine in health and diseases: consistent evidence from experimental and epidemiological studies. Journal of biomedical science 17: 1-14. https://doi.org/10.1186/1423-0127-17-S1-S6