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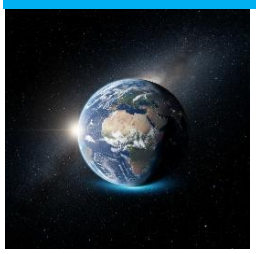

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Oral Collagen Peptide Supplementation and Skin Health: Evidence from Human Studies and Implications for Connective Tissue

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Conceptualization, methodology, investigation, and writing – original draft preparation were performed by the authors. All authors have read and agreed to the published version of the manuscript.

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Oral Collagen Peptide Supplementation and Skin Health: Evidence from Human Studies and Implications for Connective Tissue Function

Running title: Collagen Peptides and Skin Health
Keywords: collagen peptides; collagen supplementation; skin health; skin hydration; skin elasticity; connective tissue; exercise

Abstract
Collagen is the main structural protein of connective tissues and plays an important role in maintaining skin structure, elasticity, and hydration. In recent years, oral collagen peptide supplementation has attracted considerable scientific interest as a nutritional strategy aimed at supporting skin health and connective tissue metabolism. The aim of this review was to summarize current evidence from human clinical studies investigating the effects of oral collagen peptide supplementation on skin-related outcomes and to discuss its potential implications for connective tissue in the context of physical activity. A literature search was

conducted in the PubMed database focusing on human studies evaluating oral collagen supplementation and its effects on skin physiology. Studies assessing skin hydration, elasticity, wrinkle depth, and dermal matrix structure were included in the analysis. The reviewed clinical trials generally report improvements in skin hydration and elasticity following several weeks of collagen peptide supplementation. Some studies also indicate reductions in wrinkle depth and improvements in dermal structure. In addition, evidence suggests that collagen supplementation combined with physical activity may support connective tissue adaptation. Overall, oral collagen peptide supplementation may represent a promising nutritional strategy supporting skin health and potentially connective tissue function.

1. Introduction

Collagen is the most abundant structural protein in the human body and constitutes a fundamental component of connective tissues such as skin, tendons, ligaments, cartilage, and bone, where it plays a key role in maintaining structural stability and mechanical strength (Shaw et al., 2017; Shoulders & Raines, 2009). It is essential for maintaining tissue strength, elasticity, and structural integrity. In the skin, collagen fibers form a complex network within the dermis that provides mechanical support and contributes to maintaining skin firmness and elasticity (Frantz et al., 2010). Because collagen is also a key structural component of tendons and ligaments, nutritional strategies supporting collagen metabolism are increasingly discussed in the context of sports science and physical activity.

The extracellular matrix of the dermis consists primarily of collagen fibers, elastin, proteoglycans, and other structural proteins that regulate tissue architecture and mechanical properties. Fibroblasts are responsible for the synthesis and remodeling of collagen within the dermal layer and play a central role in maintaining extracellular matrix homeostasis in the skin (Arseni et al., 2018; Cole et al., 2018). Under normal physiological conditions, collagen metabolism involves a dynamic balance between synthesis and degradation. Disturbances in this balance may lead to structural alterations in connective tissues and contribute to visible signs of skin aging (Schagen et al., 2012).

With increasing age, collagen production gradually declines while collagen degradation processes become more pronounced. These changes are associated with reduced skin elasticity, decreased hydration, and the formation of wrinkles (Zhang & Duan, 2018). In addition to intrinsic aging, environmental factors such as ultraviolet radiation, pollution, smoking, and lifestyle-related influences may further accelerate collagen degradation and negatively affect skin structure (León-López et al., 2019). As a result, strategies aimed at supporting collagen metabolism have gained increasing attention in dermatology, nutrition science, and preventive health research, particularly in the field of nutraceutical approaches to skin health (Pérez-Sánchez et al., 2018).

In recent years, oral collagen peptide supplementation has attracted considerable scientific interest as a nutritional strategy aimed at supporting connective tissue health and improving skin physiology (Wang, 2021; Zague et al., 2025).Collagen peptides are produced through enzymatic hydrolysis of collagen, which results in smaller bioactive peptides characterized by improved digestibility and bioavailability compared with native collagen (León-López et al., 2019)After ingestion, collagen-derived peptides may be absorbed through the gastrointestinal tract and transported via the bloodstream to various connective tissues (Wang, 2021). Experimental studies suggest that these peptides may stimulate fibroblast activity and promote the synthesis of extracellular matrix components such as collagen and elastin.

In recent years, an increasing number of human clinical studies have investigated the effects of collagen peptide supplementation on skin-related outcomes. These studies have primarily focused on parameters such as skin hydration, elasticity, wrinkle depth, and dermal matrix quality (Bolke et al., 2019; Kim et al., 2018; Lee et al., 2025; Maia Campos et al., 2021; Morakul et al., 2024; Nomoto & Iizaka, 2020). Several randomized controlled trials have reported improvements in skin hydration and elasticity following regular collagen peptide intake, suggesting that supplementation may have beneficial effects on skin physiology.

Beyond dermatological outcomes, collagen supplementation has also attracted attention in the context of physical activity and sports nutrition. Connective tissues such as tendons and ligaments rely heavily on collagen structure to maintain their mechanical strength and resistance to mechanical loading. During physical activity, these tissues are exposed to repetitive stress and require continuous remodeling and regeneration (Shaw et al., 2017). Therefore, nutritional strategies that may support collagen synthesis and connective tissue metabolism are of particular interest in sports science.

Some studies investigating collagen supplementation in combination with resistance training have reported improvements in body composition and muscle strength in physically active individuals (Jendricke et al., 2019; Zdzieblik et al., 2015). In addition, research suggests that collagen intake combined with vitamin C prior to exercise may stimulate collagen synthesis and contribute to connective tissue adaptation (Shaw et al., 2017). These findings highlight the potential relevance of collagen supplementation not only for skin health but also for connective tissue function in physically active populations.

Despite increasing scientific interest in collagen supplementation, the available evidence remains heterogeneous with respect to study design, supplementation protocols, and outcome measures. Therefore, a comprehensive synthesis of current human studies is necessary to better understand the potential role of oral collagen peptide supplementation in skin physiology and connective tissue metabolism.

The aim of the present review was to summarize current evidence from human clinical studies examining the effects of oral collagen peptide supplementation on skin health and to discuss the potential implications of these findings for connective tissue in the context of physical activity and sports science.

In the context of sports science, collagen supplementation has gained increasing attention due to its potential role in supporting tendon and ligament health. These connective tissues are exposed to repetitive mechanical loading during exercise, and their capacity for adaptation depends largely on collagen turnover and extracellular matrix remodeling. Therefore, nutritional strategies that may enhance collagen synthesis are of particular interest for physically active individuals and athletes.

2. Materials and Methods

2.1 Study design

This study was conducted as a narrative review of human clinical studies aimed at summarizing current evidence on the effects of oral collagen peptide supplementation on skin health and discussing its potential implications for connective tissue in the context of physical activity and sports science.

2.2 Literature search strategy

The literature search was conducted using the PubMed database and focused on human studies investigating oral collagen peptide supplementation and its effects on skin-related outcomes and connective tissue physiology. The search was performed between January and March 2026 and included studies published up to March 2026.

The search strategy included combinations of the following terms:

("collagen peptides" OR "collagen hydrolysate" OR "hydrolyzed collagen")
AND ("skin hydration" OR "skin elasticity" OR "wrinkles" OR "dermal matrix" OR "connective tissue") AND ("exercise" OR "physical activity" OR "sports nutrition")

Boolean operators (AND, OR) were used to combine search terms in order to identify relevant publications.

Only articles published in English and available in full text were considered.

2.3 Eligibility criteria

Studies were included if they met the following criteria:

- involved human participants
- investigated oral collagen peptide or collagen hydrolysate supplementation
- assessed outcomes related to skin physiology, including hydration, elasticity, wrinkle depth, or dermal structure
- were published in peer-reviewed journals
- were available as full-text articles in English

Studies were excluded if they:

- involved animal or in vitro studies
- investigated topical collagen application
- did not assess outcomes related to skin physiology or connective tissue

Table 1. Inclusion and exclusion criteria for studies included in the review

Criteria type	Description
Inclusion criteria	• Human studies investigating oral collagen peptide supplementation • Studies evaluating skin-related outcomes (hydration, elasticity, wrinkle depth) • Articles published in peer-reviewed journals • Full-text articles available in English
Exclusion criteria	• Animal studies • In vitro experiments • Studies investigating topical collagen application • Articles not related to skin physiology or connective tissue

2.4 Study selection

The initial database search identified 128 records. After removal of duplicates, 112 articles remained for screening.

Following title and abstract screening, 68 studies were excluded as they did not meet the inclusion criteria.

A total of 44 full-text articles were assessed for eligibility. After full-text evaluation, 21 studies met the inclusion criteria and were included in the final analysis.

Study selection and data extraction were performed by the author.

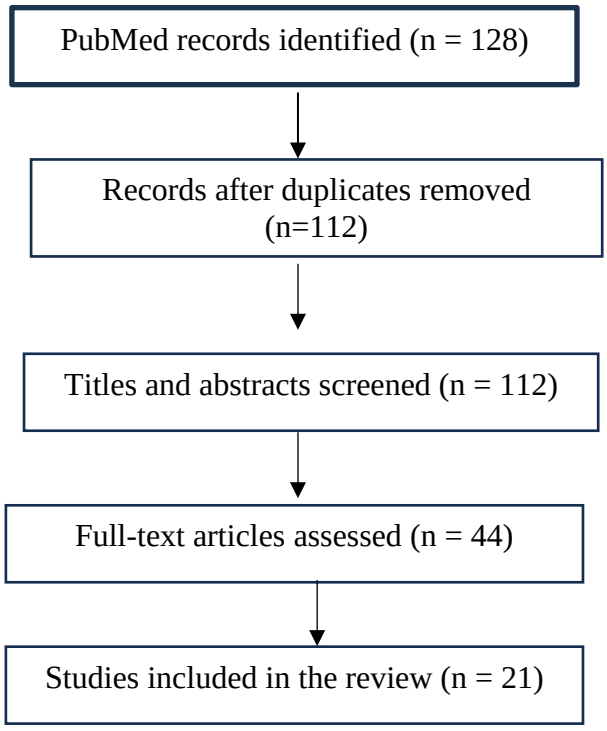

Figure 1. Flow diagram of the literature search and study selection process.

2.5 Data extraction and analysis

Relevant data were extracted from each included study, including:

- study design
- participant characteristics
- collagen supplementation protocol (dose, duration, type)
- outcome measures related to skin physiology or connective tissue

Due to heterogeneity in study design, supplementation protocols, and outcome measures, a **quantitative meta-analysis was not performed**. Instead, a qualitative synthesis of the evidence was conducted.

The included studies were grouped into the following thematic categories:

1. collagen biology and connective tissue physiology
2. mechanisms of collagen peptide supplementation
3. human clinical trials evaluating skin-related outcomes
4. evidence related to connective tissue and physical activity

3. Results

3.1 Overview of included studies

A total of 21 publications met the eligibility criteria and were included in the qualitative synthesis. The selected studies consisted of randomized controlled trials, clinical intervention studies, and systematic reviews focusing on oral collagen peptide supplementation and its effects on skin physiology and connective tissue metabolism. In most of the included clinical trials, collagen peptide supplementation ranged from approximately 2.5 g to 10 g per day, with intervention durations typically lasting between 4 and 12 weeks.

Most clinical trials evaluated the effects of collagen supplementation on parameters associated with skin aging, including skin hydration, elasticity, wrinkle depth, and dermal matrix structure. The majority of studies investigated hydrolyzed collagen or specific collagen peptides administered orally over intervention periods ranging from several weeks to several months.

The included studies differed with respect to participant characteristics, collagen source, dosage, and study duration. Nevertheless, several consistent patterns emerged regarding the effects of collagen supplementation on skin-related outcomes.

Table 2. Summary of human clinical studies investigating oral collagen peptide supplementation and skin-related outcomes

Study	Study design	Participants	Dose	Duration	Outcomes	Collagen source
Bolke et al., 2019	Randomized placebo-controlled trial	Adults	2.5 g/day	12 weeks	Improved skin hydration, elasticity, roughness, and dermal density	Collagen peptides (bovine)
Kim et al., 2018	Double-blind randomized	Adults	1 g/day	8 weeks	Reduced wrinkle depth	Low-molecular-

Study	Study design	Participants	Dose	Duration	Outcomes	Collagen source
	placebo-controlled trial				and improved skin hydration and elasticity	weight collagen peptides (marine)
Lee et al., 2025	Randomized double-blind placebo-controlled clinical trial	Healthy adults	1 g/day	12 weeks	Improved skin hydration and elasticity	Collagen peptides (marine)
Maia Campos et al., 2021	Double-blind placebo-controlled clinical trial	Adults	10 g/day	8 weeks	Improved dermal structure and skin elasticity	Hydrolyzed fish cartilage collagen
Morakul et al., 2024	Randomized double-blind placebo-controlled clinical trial	Healthy adults	2.5 g/day	12 weeks	Increased skin hydration and elasticity	Tuna-derived collagen peptides (marine)
Nomoto & Iizaka, 2020	Open-label randomized controlled study	Hospitalized older adults	5 g/day	6 weeks	Improved stratum corneum hydration and skin elasticity	Collagen peptides (not specified)
Zdzieblik et al., 2015	Randomized controlled trial	Elderly sarcopenic men	15 g/day	12 weeks	Improved body composition and muscle strength	Collagen peptides (bovine)
Jendricke et al., 2019	Randomized controlled trial	Premenopausal women	15 g/day	12 weeks	Increased muscle strength and improved body composition	Specific collagen peptides (bovine)

3.2 Effects of collagen supplementation on skin hydration

Several randomized controlled trials have reported improvements in skin hydration following oral collagen peptide supplementation. These studies typically involved adult participants receiving daily collagen peptide supplementation for periods ranging from 4 to 12 weeks. Improvements in skin hydration were measured using objective dermatological assessment methods such as corneometry.

Clinical studies indicate that regular collagen intake may be associated with increased moisture content in the stratum corneum and contribute to improved skin barrier function. Increased skin hydration may also enhance overall skin appearance and contribute to a reduction in visible signs of skin aging.

The positive effects of collagen supplementation on skin hydration were consistently reported across several independent clinical trials evaluating hydrolyzed collagen and collagen peptide formulations (Bolke et al., 2019; Kim et al., 2018; Lee et al., 2025; Pu et al., 2023).

3.3 Effects of collagen supplementation on skin elasticity

In addition to hydration, several studies reported improvements in skin elasticity following collagen peptide supplementation. Skin elasticity is an important indicator of dermal structural integrity and reflects the mechanical properties of the extracellular matrix.

Randomized clinical trials have shown that collagen supplementation may lead to measurable improvements in skin elasticity after several weeks of regular intake. These improvements may be associated with increased collagen synthesis and improved organization of collagen fibers within the dermis.

Improved skin elasticity may also be associated with enhanced dermal density and structural support provided by the extracellular matrix (Bolke et al., 2019; Kim et al., 2018; Lee et al., 2025; Maia Campos et al., 2021; Morakul et al., 2024).

3.4 Effects on wrinkle formation and dermal structure

Several studies also investigated the impact of collagen supplementation on wrinkle depth and dermal matrix structure. Reductions in wrinkle appearance were reported following collagen supplementation in adult participants.

These effects may be related to structural improvements within the dermal matrix, including increased collagen density and improved extracellular matrix organization. Some studies have reported measurable improvements in dermal density and reductions in wrinkle depth following supplementation.

Although the magnitude of these effects varied between studies, the majority of clinical trials suggested that collagen supplementation may contribute to improvements in visible signs of skin aging (Kim et al., 2018; Lee et al., 2025; Maia Campos et al., 2021; Morakul et al., 2024).

Table 3. Summary of evidence from human studies on collagen peptide supplementation

Outcome	Evidence from human studies	Supporting references
Skin hydration	Oral collagen peptide supplementation was associated with increased hydration of the stratum corneum in several randomized clinical trials.	(Bolke et al., 2019; Kim et al., 2018; Lee et al., 2025; Pu et al., 2023)
Skin elasticity	Multiple studies reported improvements in skin elasticity following several weeks of collagen peptide intake.	(Bolke et al., 2019; Kim et al., 2018; Lee et al., 2025; Maia Campos et al., 2021; Morakul et al., 2024)
Wrinkle reduction	Collagen supplementation was associated with reduced wrinkle depth and improved skin appearance in adult participants.	(Kim et al., 2018; Lee et al., 2025; Maia Campos et al., 2021; Morakul et al., 2024)
Dermal structure	Improvements in dermal matrix organization and skin density were observed in clinical studies.	(Maia Campos et al., 2021; Morakul et al., 2024)

Outcome	Evidence from human studies	Supporting references
Connective tissue adaptation	Collagen supplementation combined with resistance training improved body composition and muscle strength in physically active individuals.	(Jendricke et al., 2019; Zdzieblik et al., 2015)
Collagen synthesis	Vitamin C–enriched collagen or gelatin intake before exercise increased markers of collagen synthesis.	(Shaw et al., 2017)

3.5 Evidence from systematic reviews and meta-analyses

Systematic reviews and meta-analyses included in the analyzed material also support the beneficial effects of collagen peptide supplementation on skin parameters. These analyses summarized results from multiple clinical trials and reported statistically significant improvements in skin hydration, elasticity, and wrinkle-related outcomes.
However, the authors of these analyses also emphasized the heterogeneity of available studies, particularly with respect to collagen source, supplementation protocols, and study populations(Pu et al., 2023)

3.6 Relevance of collagen supplementation for connective tissue and physical activity

Although most of the analyzed studies focused on dermatological outcomes, several publications addressed the role of collagen supplementation in connective tissue metabolism and physical activity.
Collagen is a major structural component of tendons, ligaments, and other connective tissues exposed to mechanical loading during exercise. Research investigating collagen supplementation in combination with resistance training suggests that collagen peptides may support connective tissue adaptation and improvements in body composition and muscle strength.
Furthermore, collagen supplementation combined with vitamin C intake prior to exercise has been shown to stimulate collagen synthesis and may support connective tissue remodeling during physical activity (Jendricke et al., 2019; Shaw et al., 2017; Zdzieblik et al., 2015).

4. Discussion

The present review summarizes current evidence from human studies investigating the effects of oral collagen peptide supplementation on skin physiology and its potential implications for connective tissue in the context of physical activity. The analyzed studies suggest that collagen supplementation may positively influence several parameters associated with skin aging, including hydration, elasticity, and wrinkle appearance.
One of the most consistently reported findings across clinical studies is the improvement in skin hydration following collagen peptide supplementation. Increased hydration of the stratum corneum has been observed in several randomized controlled trials evaluating collagen peptide intake in adult populations. Improved skin hydration may be related to enhanced extracellular matrix metabolism and improved dermal structural integrity. Collagen peptides are rich in amino acids such as glycine, proline, and hydroxyproline, which are essential for collagen

synthesis and play an important role in maintaining the structural integrity of connective tissues (Bolke et al., 2019; Kim et al., 2018; Lee et al., 2025; León-López et al., 2019).

Another frequently reported outcome in clinical studies is the improvement of skin elasticity. Skin elasticity reflects the mechanical properties of the dermal extracellular matrix and is closely related to collagen fiber organization and dermal density. Several intervention studies have demonstrated that collagen peptide supplementation may lead to measurable improvements in skin elasticity after several weeks of intake. These effects may result from stimulation of fibroblast activity and increased synthesis of extracellular matrix components such as collagen and elastin (Kim et al., 2018; Lee et al., 2025; Maia Campos et al., 2021; Morakul et al., 2024).

The reviewed studies also suggest that collagen supplementation may contribute to improvements in visible signs of skin aging, including reductions in wrinkle depth. These improvements may be associated with structural changes in the dermal matrix and increased collagen density within the skin. Although the magnitude of these effects varies across studies, most clinical trials report positive trends in wrinkle-related outcomes following collagen peptide supplementation (Kim et al., 2018; Lee et al., 2025; Maia Campos et al., 2021; Morakul et al., 2024).

In addition to individual clinical trials, systematic reviews and meta-analyses have also reported beneficial effects of collagen supplementation on skin parameters. These analyses summarize results from multiple studies and generally confirm improvements in skin hydration, elasticity, and wrinkle appearance associated with collagen peptide intake. However, these studies also highlight the heterogeneity of the available evidence, including differences in collagen source, peptide composition, supplementation dosage, and duration of interventions (Pu et al., 2023).

Beyond dermatological outcomes, collagen supplementation may also have relevance for connective tissue metabolism and functional outcomes in physically active individuals (Kviatkovsky et al., 2023). Collagen is the primary structural protein in tendons, ligaments, and other connective tissues exposed to mechanical loading during exercise. These tissues require continuous remodeling and repair in response to repetitive mechanical stress. Nutritional strategies that support collagen synthesis may therefore play a role in connective tissue adaptation and injury prevention in physically active populations.

Several studies investigating collagen supplementation in combination with resistance training have reported improvements in body composition and muscle strength in physically active individuals. These findings suggest that collagen peptides may support connective tissue adaptation and musculoskeletal health when combined with exercise interventions (Jendricke et al., 2019; Zdzieblik et al., 2015). These observations are consistent with previous studies investigating collagen supplementation and its effects on skin and connective tissue health (Kaziród et al., 2023; Marzec et al., 2024). Furthermore, previous research indicates that collagen supplementation combined with vitamin C intake prior to exercise may stimulate collagen synthesis and support connective tissue remodeling during physical activity (Shaw et al., 2017).

Despite these promising findings, several limitations should be considered when interpreting the available evidence. Many of the analyzed studies involve relatively small sample sizes and short intervention periods. Additionally, considerable heterogeneity exists in terms of collagen sources, peptide formulations, supplementation dosages, and study populations. These methodological differences make direct comparisons between studies difficult and highlight the need for more standardized research protocols.

Future research should focus on well-designed randomized controlled trials investigating standardized collagen supplementation protocols and their effects on connective tissue physiology. In particular, further studies are needed to clarify optimal dosage, duration of supplementation, and the potential role of collagen peptides in supporting connective tissue

health in physically active individuals. It should also be noted that some studies investigating collagen supplementation were supported by industry funding, which may represent a potential source of bias and should be considered when interpreting the reported outcomes.
Several limitations of the present review should be acknowledged. The literature search was conducted using a single database (PubMed), which may have limited the identification of some relevant studies indexed in other scientific databases. In addition, the included studies differed with respect to collagen sources, supplementation protocols, participant characteristics, and outcome measures, which makes direct comparison between studies difficult.

5. Conclusions

The present review summarizes current evidence from human studies investigating the effects of oral collagen peptide supplementation on skin physiology and its potential relevance for connective tissue health. The analyzed studies suggest that collagen supplementation may positively influence several parameters associated with skin aging, particularly skin hydration, elasticity, and wrinkle appearance.
Randomized controlled trials and clinical studies consistently report improvements in skin hydration and elasticity following several weeks of collagen peptide supplementation. These effects are likely associated with increased availability of collagen-specific amino acids and stimulation of extracellular matrix synthesis within the dermis. Improvements in dermal structure and reductions in wrinkle appearance reported in several studies further support the potential role of collagen peptides in maintaining skin integrity.
Although most available research focuses on dermatological outcomes, current evidence suggests that collagen supplementation may improve several parameters also have broader implications for connective tissue metabolism. Because collagen is a major structural component of tendons, ligaments, and other load-bearing tissues, nutritional strategies supporting collagen synthesis may be relevant for physically active individuals and athletes. Evidence from studies combining collagen supplementation with resistance training suggests potential benefits for musculoskeletal health and connective tissue adaptation.
However, the current body of evidence remains heterogeneous with respect to study design, supplementation protocols, and participant characteristics. Differences in collagen source, peptide composition, dosage, and duration of supplementation make direct comparisons between studies challenging. Therefore, further well-designed randomized controlled trials are required to determine optimal supplementation strategies and to better understand the potential role of collagen peptides in connective tissue physiology and sports science.
Overall, oral collagen peptide supplementation appears to be a promising nutritional strategy supporting skin health and potentially connective tissue function. Future research should focus on standardized intervention protocols and investigate the long-term effects of collagen supplementation in both general and physically active populations.
These findings may have practical implications for sports nutrition strategies aimed at supporting connective tissue adaptation and reducing the risk of musculoskeletal injuries in physically active individuals.

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Ethical approval
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Conflict of interest
The authors declare no conflict of interest.

Author contributions

Conceptualization, [Dryl-Jarmoc]; methodology, [Dryl-Jarmoc]; investigation, [Dryl-Jarmoc] and [Kuliś], [Ślinko], [Zimowski]; writing – original draft preparation, [Dryl-Jarmoc]; writing – review and editing, all authors; supervision, [Kuliś]; project administration, [Kuliś]. All authors have read and agreed to the published version of the manuscript.

Disclosure

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AI Declaration

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) for language editing and improvement of text clarity. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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