A study on the knowledge and attitudes of dietitians and their clients about collagen

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ABSTRACT

This study aimed to assess the opinions of dietitians and their clients regarding their knowledge and use of collagen and to determine their level of knowledge regarding the use of collagen supplements. It was conducted on 30 dietitians and 125 clients in Istanbul, Balıkesir, Antalya and Hatay provinces between March and April 2023. Online data was collected from participants via Google Forms. 56.7% (n=17) of dietitians and 54.4% (n=68) of their clients use collagen (P>0.05). While 36.7% (n=11) of dietitians said, it was beneficial for the skin, 23.3% (n=7) used it for weight control and digestive regulation, 38.4% (n=48) said it was beneficial for the skin and 34.4% (n=43) for joint density and pain relief. There was also no statistically significant difference (P>0.05) between dietitians' and clients' information about collagen use. However, while 17.5% (n=3) of dietitians were concerned about the reliability, certification, and brand of collagen, 22.1% (n=15) of consumers were concerned about its reliability. In addition, the opinions of the dietitians and clients participating in the study regarding the use of collagen were not found to be statistically significant (P>0.05).

Keywords: Collagen, Collagen knowledge level, Collagen use

Introduction

Collagen is the main structural protein in connective tissues such as skin, tendons, cartilage and bone. It accounts for 25-30% of all proteins in the body. Collagen is a component of the extracellular matrix of skin tissue, accounting for 75% of its total weight, and its main function is to provide mechanical support. Together with other extracellular matrix fibres, hyaluronic acid, reticulin and elastin, collagen forms a support network for fibroblasts, keratinocytes, melanocytes and specialised cells of the skin's immune system (de Miranda et al., 2021).

Ageing is a natural process that causes physiological changes in organs, tissues, and cells over time. Ageing leads to a decrease in the synthesis and changes in the arrangement of proteoglycans and collagen in the skin and cartilage, as well as the loss of glycosaminoglycans, which are responsible for the integrity and health of these tissues. Daily oral supplementation with a liquid nutraceutical containing hydrolysed collagen, vitamins, antioxidants and other active ingredients can improve skin texture and elasticity. It may also have a protective effect on joints (Czajka et al., 2018).

Collagen is characterised by a high concentration of three amino acids (glycine, proline and hydroxyproline) that form its characteristic triple helix structure. Therefore, collagen is enzymatically hydrolysed and broken down into smaller bioactive peptides that are easily absorbed in the digestive tract before entering the circulation. Due to hydrolysis, collagen peptides do not have the gelling properties of gelatin and are soluble in cold water (Khatri et al., 2021). Collagen is mostly found in animal tissues, and the amount of collagen naturally present in plant foods is usually limited. Foods rich in collagen are meat, fish, bone broth, seafood, cowhide, milk and dairy products, soy products, egg whites, citrus fruits (orange, tangerine, grapefruit, etc.), red fruits, green leafy vegetables and almonds are foods that support collagen synthesis. As the amount of collagen in food is often insufficient, people prefer to use collagen supplements or cosmetic products containing collagen (Avila Rodríguez et al., 2018). As a source of collagen, bovine collagen has properties such as biocompatibility and low immunogenicity; it is generally well tolerated and does not cause an immune response in most people, except for those with collagen allergy (Davison-Kotler et al., 2019). Porcine collagen is used in industrial applications because of its similarity to human collagen and low antigenicity, but it carries a risk of zoonotic disease. In Middle Eastern countries, the use of porcine collagen is restricted for religious reasons. In East Asian countries such as China and Japan, the use of porcine collagen is an important part of the diet (bone broth, confectionery, etc.) due to the health and beauty benefits of porcine collagen peptides (Bhadra et al., 2021). Marine-derived collagen has attracted attention due to its different chemical, biological and mechanical properties compared to animal-derived collagen (Davison-Kotler et al., 2019). Marine-derived collagen has attracted attention due to its different chemical, biological, and mechanical properties compared to animal-derived collagen (Davison-Kotler et al., 2019). Marine collagen is reported to have no risk of infectious disease, is generally recognised as safe by the US Food and Drug Administration (FDA), and is inexpensive to produce (Avila Rodríguez et al., 2018). Collagen has been produced from fish since 1957 (Eastoe, 1957). To date, collagen has been produced from carp, catfish, sardines, perch and sargo scum, snails, perch skin and bones. It has been reported that puffer fish and fish offal have a good potential as a source of collagen and can be used in functional foods. In cosmetics and pharmacology, obtaining collagen from fish offal has important advantages in terms of economic contribution and prevention of environmental pollution (Nagai et al., 2004; Liu et al., 2007; Huang et al., 2011; Duan et al., 2018).

Collagen hydrolysate is a water-soluble protein hydrolysate produced by enzymatic or acid hydrolysis of collagen protein from animal skin and bone. Collagen hydrolysate, or collagen peptides, contains high levels of type 1 and 2 collagen from bovine, porcine, and fish hides. The average molecular weight of collagen is between 2000 and 5000 Daltons. As a result, its digestibility and bioavailability are very high. Collagen hydrolysate, or collagen peptides, is made from type 1 collagen from bovine, porcine, fish bones, tendons, skin, and ligaments. The molecular weight of collagen hydrolysate is broken down by acid and enzymatic hydrolysis and is commonly used as a protein. They are additives for food supplements and cosmetic applications (Edward, 1987).

The aim of this study was to assess and compare the opinions of dietitians and their clients about their knowledge and frequency of collagen use and to determine the level of knowledge about the use of collagen supplements.

Materials and Methods

Type of Research

This descriptive study was conducted between March and April 2023 with 30 dietitians and 125 clients in private clinics in Istanbul, Balıkesir, Antalya and Hatay provinces using Google Form. Based on the literature, it has been reported

that individuals are familiar with the term 'dietary supplements', but they have difficulty classifying these products into appropriate categories. More than 55% consider dietary supplements as food (Yetim, 2011). Considering the perception of collagen consumption, known as dietary supplements, at 70%, it was calculated that a total of 155 dietitians and clients should be included in the R (software/programming - version 3.6.2 - CRAN) programme according to 90% power (Wierzejska et al., 2014). This investigation was conducted in the private clinics that agreed to participate in the current study in the Istanbul, Balıkesir, Antalya and Hatay provinces.

Study population, exclusion criteria

Data were collected from the following clinics using Google Forms for the study. The forms, which were prepared for purposes such as data collection, recording, grouping, and transfer, were preferred because the clinics are located in different cities, some clients are served online, and the participants can be reached in a short time and with less cost. Istanbul, Balıkesir, Antalya, and Hatay were identified as the clinics that could reach the sample size for the study.

Children and adolescents under the age of 18, people with chronic kidney or liver failure, pregnant or breastfeeding women, vegans or vegetarians, as collagen supplements, are usually derived from animal sources, and people with allergies, as they may contain allergens such as fish, were not included in the study.

Data Collection Method

This descriptive study collected online data from dietitians and their clients. The data collection form administered to the participants asked questions to determine demographic characteristics, knowledge and usage status of collagen, purpose of use, purchase preferences and feelings of trust in these products.

Data Collection Form

The demographic characteristics of the participants were collected using a 6-item 'socio-demographic data form'. Based on the literature, the researchers developed a 13-item 'Collagen Use Information Data Form' and a 27-item 'Collagen Information Form'.

In the 'Collagen Use Information Form', participants were asked if they had used collagen before, in what form, what they looked for when obtaining it, and if they experienced any side effects after using it. The researchers developed these questions to collect data. In the 'Collagen Information Data Form', the participants were asked questions in the form of a

5-point Likert scale about the structure of collagen, its form, and who is recommended to use it and when. A previous study conducted at Necmettin Erbakan University Institute of Science and Technology was used as an example in the design of this form (Avcı C, 2022). These forms were administered to the participants via Google Forms.

Statistical Analysis

After all the data were collected, SPSS (Statistical Package for Social Science) Statistics 15.0 was used in a Windows environment for statistical evaluation. In the statistical data analysis, percentage ratio was used for qualitative variables; mean, standard deviation and minimum-maximum parameters were used for quantitative parametric variables; median, lower and upper-value parameters were used for quantitative non-parametric variables. Chi-square analyses were used to examine relationships between categorical variables using cross-tabulations. This study was approved by the Biruni University Non-Interventional Studies Ethics Committee (decision no: 2023/76-01).

Results and Discussion

The study was conducted with 155 dietitians and their clients, 104 women and 51 men. When the educational status of the individuals was examined, it was found that 11% (n=17) were primary school graduates, 17.4% (n=27) were high school graduates, 45.8% (n=71) were undergraduate graduates, and 25.8% (n=40) were postgraduate graduates. The occupations of the individuals were 38.1% (n=59) workers, 18.7% (n=29) students, 6.5% (n=10) academics, 17.4% (n=27) health professionals and 19.4% (n=30) dietitians. Individuals spent most on food (34.8% (n=54) and clothing (22.6% (n=35)), education (7.1% (n=11), health (9% (n=14), care (9% (n=14), entertainment (8.4% (n=13) and other (9% (n=14)). When the difference between the collagen knowledge of all participants in the study was evaluated, it was found that while there was a statistically significant difference according to gender and educational status ($P<0.05$), there was no significant difference according to occupation ($P>0.05$). The study found that while there was a statistically significant difference ($P<0.05$) between the knowledge level of individuals using collagen according to gender, educational status and collagen use status, there was no significant difference ($P>0.05$) according to the occupations of the individuals. It was found that there was a statistically significant difference ($P<0.05$) in the opinions of individuals about collagen use according to gender, educational status, occupation and collagen use status. As a result of comparing the descriptive characteristics of individuals according to their collagen use status, it was found that there was no statistically significant difference in any parameter

(P>0.05) (Table 1). It was found that there was no statistically significant difference between the collagen knowledge levels of the dietitians and their clients included in the study (P>0.05) (Table 2).

When comparing the descriptive characteristics of the dietitians and their clients (Table 1), a statistically significant difference in educational status was found (P<0.05). While 40.8% (n=51) of the clients were university graduates, 13.6% (n=17) were primary school graduates. While 66.7% (n=20) of the dietitians were undergraduate graduates, 33.3% (n=10) were postgraduate graduates.

When comparing the collagen knowledge of dietitians and their clients (Table 2), there was no statistically significant difference (P>0.05). 56.7% (n=17) of the dietitians and 54.4% (n=68) of their clients used collagen. While 36.7% (n=11) of the dietitians used collagen for skin benefits and 23.3% (n=7) for weight control and digestive system regulation, 38.4% (n=48) of the clients used collagen for skin benefits and 34.4% (n=43) for joint density and pain relief.

In the present study, 38.1% of participants reported using collagen for its effects on the skin (Table 2). A systematic review of the dermatologic effects of oral collagen use evaluated 11 studies and 805 patients. According to two studies, 3 g/day of collagen tripeptide for 4-12 weeks improved skin elasticity and hydration. One study suggested that the anti-ageing effect of collagen is proportional to the collagen dipeptide content (Choi et al., 2019). Additionally, 31.6% of participants reported using collagen for its effects on joint health (Table 2). In a randomised controlled trial of the efficacy and tolerability of undenatured type II collagen supplementation in knee osteoarthritis symptoms, 191 subjects were divided into three groups. One of the three groups received 40 mg/day of undenatured collagen for 180 days, one received glucosamine hydroxide plus chondroitin sulfate, and the other received placebo. The results showed that participants using undenatured type II collagen were effective and well-tolerated for knee joint symptoms (Lugo et al., 2016).

Table 1: Comparison of descriptive characteristics of dietitians and their clients

		Dietitian (n=30)		Client (n=125)		Total (n=155)		χ^2	*P*
		n	**%**	**n**	**%**	**n**	**%**		
Gender	**Female**	22	73.3	82	65.6	104	67.1	0.655	0.418
	Male	8	26.7	43	34.4	51	32.9		
Education Status	**Primary School**	-	-	17	13.6	17	11.0	14.911	**0.002**
	Highschool	-	-	27	21.6	27	17.4		
	Bachelor	20	66.7	51	40.8	71	45.8		
	Postgraduate	10	33.3	30	24.0	40	25.8		
Area with the highest monthly expenditure	**Food**	11	36.7	43	34.4	54	34.8	13.128	0.057
	Clothing	7	23.3	28	22.4	35	22.6		
	Education	6	20.0	5	4.0	11	7.1		
	Health	1	3.3	13	10.4	14	9.0		
	Care	3	10.0	11	8.8	14	9.0		
	Entertainment	1	3.3	12	9.6	13	8.4		
	Other	1	3.3	13	10.4	14	9.0		

χ^2: Chi-Square Analysis, *P* level of significance <0.05

According to the analysis, no statistically significant difference (*P*>0.05) was found when comparing the knowledge of collagen users between dietitians and clients (Table 3). While 23.5% (n=4) of the dietitians use collagen in liquid or tablet form, 35.3% (n=24) of their clients use collagen in powder form. While 17.5% (n=3) of dietitians are concerned about the reliability, certification and brand of collagen, 22.1% (n=15) of clients are concerned about its reliability.

It was found that there was no statistically significant difference in the opinions of dietitians and their clients regarding the use of collagen (*P*>0.05). As a result of this research, 33.3% (n=10) of the dietitians agreed with using collagen in ageing, while 23.2% (n=29) of their clients disagreed. A Japanese study investigated the effects of daily oral supplementation with collagen hydrolysate on UV-B-damaged skin. Using in vivo methods to measure water-holding capacity, collagen hydrolysate was shown to be nutritionally beneficial, improve skin defects caused by UV-B damage and photoaging, and increase skin water-holding capacity (Tanaka et al., 2009). Another study conducted in Japan found that women who consumed collagen hydrolysate in their diet increased collagen water retention compared to women who did not (Huang et al., 2011). In a study of rats, rats were given three different daily doses of collagen: 0.166 g/kg, 1.66 g/kg and 16.6 g/kg for 4 weeks. The effect of collagen on body weight and bone density was assessed. It was observed that collagen increased total body weight and bone density more than other ratios in the 16.6 g/kg daily collagen group (Eastoe, 1957).

Table 2: Comparison of Collagen Knowledge of Dietitians and Their Clients

		Dietitian (n=30)		Client (n=125)		Total (n=155)		χ^2	*P*
		n	%	n	%	n	%		
Collagen knowledge	**Yes**	22	73.3	81	64.8	103	66.5	0.791	0.374
	No	8	26.7	44	35.2	52	33.5		
Collagen use	**Yes**	17	56.7	68	54.4	85	54.8	0.051	0.823
	No	13	43.3	57	45.6	70	45.2		
Collagen prices	**Cheap**	6	20.0	25	20.0	31	20.0		
	Normal	12	40.0	47	37.6	59	38.1	0.071	0.966
	Expensive	12	40.0	53	42.4	65	41.9		
Reasons to use collagen	**Beneficial for skin health**	11	36.7	48	38.4	59	38.1		
	Beneficial for hair care	6	20.0	19	15.2	25	16.1		
	Joint density and pain relief	6	20.0	43	34.4	49	31.6	4.141	0.247
	Weight control and digestive system regulator	7	23.3	15	12.0	22	14.2		
Side effects of collagen	**Yes**	10	33.3	51	40.8	61	39.4	0.565	0.452
	No	20	66.7	74	59.2	94	60.6		
Benefits of collagen	**Yes**	23	76.7	89	71.2	112	72.3	0.361	0.548
	No	7	23.3	36	28.8	43	27.7		
How to obtain collagen	**Herbalist**	5	16.7	15	12.0	20	12.9		
	Television	1	3.3	7	5.6	8	5.2		
	Internet	5	16.7	21	16.8	26	16.8	1.661	0.798
	Apotheke	15	50.0	72	57.6	87	56.1		
	Market	4	13.3	10	8.0	14	9.0		

χ^2: Chi-Square Analysis, *P* level of significance <0.05

Table 3: Comparison of Dietitians' and Clients' Knowledge of Collagen Users

		Dietitian (n=30)		Client (n=125)		Total (n=155)		χ^2	*P*
		n	**%**	**n**	**%**	**n**	**%**		
Preferred form of collagen use	Liquid	4	23.5	13	19.1	17	20.0	0.724	0.868
	Dust	7	41.2	24	35.3	31	36.5		
	Sachet	2	11.8	13	19.1	15	17.6		
	Tablet	4	23.5	18	26.5	22	25.9		
Attention to the source of collagen	Yes	14	82.4	52	76.5	66	77.6	0.271	0.603
	No	3	17.6	16	23.5	19	22.4		
Frequency of collagen use	Once a day	5	29.4	28	41.2	33	38.8	2.655	0.618
	2 times a day	2	11.8	10	14.7	12	14.1		
	3 times a day	3	17.6	7	10.3	10	11.8		
	1 times a week	4	23.5	8	11.8	12	14.1		
	Other	3	17.6	15	22.1	18	21.2		
Factors considered in the procurement of collagen	Being local	2	11.8	2	2.9	4	4.7	7.333	0.501
	Halal	-	-	6	8.8	6	7.1		
	Reliable	3	17.6	15	22.1	18	21.2		
	Being cheap	-	-	4	5.9	4	4.7		
	Certified	3	17.6	14	20.6	17	20.0		
	Brand	3	17.6	5	7.4	8	9.4		
	Source from which it was obtained	2	11.8	11	16.2	13	15.3		
	Easy accessibility	2	11.8	4	5.9	6	7.1		
	Other	2	11.8	7	10.3	9	10.6		
Problems after collagen use	Yes	5	29.4	21	30.9	26	30.6	0.014	0.906
	No	12	70.6	47	69.1	59	69.4		
Paying attention to the expiry date of collagen	Yes	13	76.5	56	82.4	69	81.2	0.308	0.579
	No	4	23.5	12	17.6	16	18.8		

χ^2: Chi-Square Analysis, *P* level of significance <0.05

According to the study's results, 36.7% (n=11) of the dietitians who agreed that 'the collagen content of the supplement should be 10 g or at least 5 g' in the collagen knowledge survey were undecided. In comparison, 41.6% (n=52) of their clients were undecided. In a study investigating the effects of collagen hydrolysate on osteoarthritis and osteoporosis, 10 g of collagen hydrolysate per day for sixty days was effective in treating osteoarthritis and osteoporosis. Collagen hydrolysate increases protein synthesis in cartilage tissue. It has an anabolic effect that stimulates tissue growth, so it can improve joint structure and integrity in athletes to reduce joint pain (Moskowitz, 2000). In a study on adult athletes at the German Olympic Centre, 79% showed improved joint mobility and flexibility after taking 10g of collagen hydrolysate daily for 12 weeks of training (Clark et al., 2008).

In a post-study article about the benefits of collagen, 40% (n=12) of the dietitians who agreed that 'collagen is only good for the skin' disagreed, while 20% (n=25) of their clients were undecided. A study conducted in Thailand on 36 postmenopausal women aged 50-60 years evaluated the effect of oral intake of 5g of collagen hydrolysate for 4 weeks on skin elasticity. In addition, the effects of collagen hydrolysate supplementation on skin elasticity were compared between sun-exposed and sun-protected areas. Participants were assessed for skin elasticity using a cutometer at baseline, after 2 and 4 weeks of collagen hydrolysate supplementation, and 4 weeks after collagen hydrolysate supplementation was discontinued. An increase in skin elasticity measured on the left and right cheeks was observed in participants using collagen hydrolysate compared to placebo. In addition, skin elasticity

measured on the left and right cheeks was found to be different between the collagen hydrolysate and placebo groups at week 4 after stopping collagen hydrolysate. In conclusion, a significant improvement in skin elasticity in sun-exposed areas was demonstrated after 4 weeks of use of marine-derived collagen hydrolysate. The improvement in elasticity was observed to continue for 4 weeks after cessation of collagen hydrolysate use. No serious adverse effects were observed during the study (Sangsuwan & Asawanonda, 2021). randomised controlled trial involved 60 healthy female participants. Participants were divided into groups of 20, including topical collagen users, oral collagen supplement users and oral placebo users. Stratum corneum water content, skin viscoelasticity, dermal echogenicity and skin pore parameters were assessed. The topical collagen group showed a significant increase in stratum corneum water content and skin elasticity at 28 days, and the peptide formulation was also effective on dermis echogenicity at 90 days. Oral collagen supplements effectively improved skin elasticity and showed a more pronounced effect on dermal echogenicity, reducing skin pores after 90 days (Maia Campos et al., 2019).

When asked about the ingredients in collagen supplements, 23.3% (n=7) of dietitians disagreed, were undecided or strongly agreed that the supplement should contain copper, zinc and vitamin C to support collagen synthesis. In comparison, 36.8% (n=46) of their clients agreed. In the study, 72 healthy female participants aged 35 and over living in Germany were given the test product for twelve weeks. The test product was a specially developed blend of 2.5 g collagen peptides, 666 mg acerola fruit extract, 80 mg vitamin C, 3 mg Zinc, 2.3 mg vitamin E and 50 µg biotin. Participants were dermatologically assessed at baseline, after 12 weeks of supplementation, and after a 4-week follow-up period without supplementation. In addition, tolerability and efficacy data were collected. The study's results showed that using the test product improved skin hydration, elasticity and density and reduced skin roughness. All test parameters differed between the intervention and placebo groups, which was also observed during follow-up (Bolke et al., 2019).

On a question related to the weight of collagen in collagen supplements, 46.7% (n=14) of the dietitians were undecided about the correct choice of low molecular weight collagens (around 3000 Daltons). In comparison, 53.6% (n=67) of their clients were undecided. A randomised controlled trial was conducted in Korea in 64 healthy women aged 40-60. Subjects received a placebo or 1000 mg of low molecular weight collagen peptide once daily for 12 weeks. Skin hydration, wrinkle and elasticity parameters were assessed at baseline and after 6 and 12 weeks. Compared to the placebo group,

skin hydration scores were significantly higher in the collagen group at 6 and 12 weeks. After 12 weeks, the visual assessment score and three parameters of skin wrinkles were significantly improved in the collagen group compared to the placebo group. In the intervention group, skin hydration scores improved at weeks 6 and 12. Significant improvements were seen in the intervention group's three parameters of skin wrinkles compared to placebo. These results suggest that collagen can be a healthy functional ingredient that provides hydration and elasticity and prevents wrinkles in human skin (Do-Un Kim, 2018).

Conclusion

Collagen is an essential protein for body structure and is very important for the health of bones, joints, skin and tendons. Individuals must know their collagen intake and where they may lack knowledge about supplements. As a result of the research, it is clear that people's opinions on the use of supplemental collagen vary, and there is no clear consensus. While male participants were generally undecided, female participants expressed an opinion. The study also found no significant difference in the knowledge of collagen users according to their occupation. It was observed that the use and knowledge of dietitians about supplemental collagen is insufficient and that dietitians should have more information about collagen through more studies. As the research was conducted on dietitians in private hospitals and clinics, the use of collagen was generally recommended, and most clients were observed to be using collagen supplements. These results are based on private hospitals and clinics partnering with food supplement companies. In contrast, a similar study should be conducted on dietitians and their clients working in public institutions to address the deficiencies. Different opinions and experiences were observed between dietitians and clients. The results of this study highlight the complexity of knowledge and individual differences in the use of collagen. Lack of scientific evidence and conflicting information make reaching a consistent consensus between dietitians and clients difficult. This situation highlights the importance of scientific research and reliable sources. It shows that dietitians and clients need more information and reliable research to make informed decisions about collagen consumption. At this stage, the scientific accuracy of health industry claims needs to be investigated and communicated. It is also important to assess the appropriateness of using collagen supplements, considering customers' needs and their body composition.

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