A cross-sectional study on chronic disease in the middle-aged after COVID-19 fortified edible cosmeceuticals for improving health functionality

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Abstract. *Introduction:* This paper used big data based on the previous H1N1 influenza that was prevalent worldwide in 2012. *Objectives*: We are aiming to develop elderly-friendly functional foods according to the domestic influenza epidemic and to understand the importance of sustainable and healthy beauty. Using big data as a research method, prognostic evaluation of coronavirus infection-19 (COVID-19) was performed. *Methods*: Statistical data were collected from the 5th National Health and Nutrition Survey (KNHANES V-3, 2012) conducted by the Ministry of Health and Welfare of the Republic of Korea. Of the 7,214 survey respondents on the entire KNHANES V-3 Big Data, 3,150 participants belonged to the senior group aged 50-65 years or older. *Results:* The intake of health functional foods within one year of the elderly over 50 is as follows. Daily intakes of vitamin A, thiamine, riboflavin, and niacin were shown to be sufficient, and intake of vitamin C was significantly higher at 100–143% of the recommended intake. The foundation of this study was based on big data of the Korean population in Korea at the time of the H1N1 influenza epidemic. *Conclusions*: The results of this study are expected to help improve the diet of the senior population, the elderly, and develop customized edible cosmeceuticals through sustainable and safe dietary supplements in the context of the global pandemic COVID-19.

Key words: chronic disease, COVID-19, safety, H1N1 influenza epidemic, edible cosmeceutical, health functionality

Introduction

The number of flu deaths in Korea in 2012 was estimated to have increased more than nine times compared to 2009–2010, when the swine flu epidemic was prevalent. The three deadly global epidemics associated with the novel coronavirus - namely, SARS, Middle East Respiratory Syndrome (MERS) and coronavirus disease-19 (COVID-19) - are ongoing. It is highly contagious and causes acute respiratory infections with a high mortality rate. Recently, it was reported that an average of 2,900 people die from influenza every year in Korea. Also, with the recent outbreak of COVID-19, also called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), all these viruses are highly contagious viral infections. The COVID-19 pandemic has not yet ended herd immunity. Social distancing is a key public health tool to mitigate the COVID-19 pandemic. During the COVID-19 crisis, food consumption has shifted to the home and is changing into a new form of consumption. Visits to grocery stores and food centers have greatly decreased as gatherings are prohibited by the government's quarantine guidelines. These social changes have changed the eating habits of

the population due to the restrictions of the restaurant industry. Likewise, health-related lifestyles have also changed (1–4).

Everyone wants a long life despite the deterioration of life in old age due to chronic diseases, which affects medical expenses and national insurance programs, depending on the condition. The prevalence of diabetes among chronically ill patients in 2013, according to Statistics Korea (5). Metabolic syndromes such as hypertension, hyper-lipidemia, and hypercholesterolemia, which occur frequently in middle-aged people, also had the following changes in 2012. Hypertension increased from 24.60% in 2007 to 29.00% in 2012. Also, the prevalence of hypercholesterolemia significantly increased from 8.00% in 2005 to 14.50% in 2012. Moreover, the rate of increase in chronic diseases among the elderly over 65 is much faster than in 2012 (5,6). In addition, the aging population can be defined in various ways depending on the purpose and content of studies on people aged 50 to 65 years (7). Bartors (1980) (7) lowered the minimum age of older consumers to 50 or less (8).

Nutricosmetics are products and ingredients that act as nutritional supplements that maintain the natural beauty of the skin, nails, and hair. They promote skin health and beauty from the inside out. This recent trend in the beauty industry is melting into consumers in line with modern culture. Today, consumers are conscientious of the foods they put into their bodies. At the same time, their awareness of safety is in-creasing. Thus, they tend to focus on customized inner beauty, which can improve health and beauty without side effects (9).

Therefore, this study defines the population over 50 as a new aging population based on previous studies on the improvement of eating habits of this population in the future for a healthy life. This study also analyzes the specific attributes of consumers on optional factors and requirements. This study aimed to find a functional, nutritionally fortified diet for each disease by considering various nutrients that can be used to make healthy and convenient meals. Accordingly, we propose the development of customized meals using edible cosmeceutical for sustainable healthy beauty and customized inner beauty.

Materials and methods

Data collection

Using raw data completed by the 5th Korea National Health and Nutrition Examination Survey (KNHANES V-3) in 2012, we analyzed the daily intake trends of nutrients for 7,214 people older than 1 year old and the intake rates of dietary supplements less than a year for 3,150 people. In addition, this study used data from KNHANES V-3, which was conducted by Statistics Korea, to assess the health and nutritional status of Korean people per Article 16 of the National Health Promotion Act. After we obtained approval to use KNHANES V-3 raw data from the KNHANES headquarters, the raw data and the guidelines for analysis were provided and applied with its approval number (2012-01EXP-01-2C). Furthermore, to confirm and complement the results of this study, the survey was conducted on 400 males and females aged 50 years and older living in Seoul Metropolitan City, Gwangju Metropolitan City, Busan Metropolitan City, Jeju Special Self-Governing Province, and other provinces, ensuring a well-balanced geological distribution. A total of 400 questionnaires were distributed, and 383 were returned. We excluded questionnaires that were missing details. Ultimately, 374 valid questionnaires were used for the analysis.

The survey was conducted at participants' workplaces, public facilities, social welfare centers, senior welfare centers, county offices, senior citizens centers, catholic churches, and schools by random selection. The survey directly used self-administered questionnaires. However, for participants who needed help, we explained the contents and terms used in the survey. The first page of the questionnaire included statements from the Statistics Law of Republic of Korea indicating that "the information provided in this research will be remain confidential and will not be used for those other than stated purposes, in accordance with Article 13 and Article 14 of the Statistics Law" and that the responses would be kept anonymous and used only for statistical analysis. Participants gave verbal consent to participate. After the participants completed the questionnaires, they received a briefing about the purposes of the survey and how the statistical data would be

used. The self-administered questionnaire consisted of the choice factors of functional nutrient-fortified diets and their analysis by the age groups. For the questions on the informativity and reliability of diets, a cross-tabulation analysis and Chi-square test were conducted for the choice factors, including nutritional information, dis-ease-specific diets depending on the participant's health condition, the necessity of nutritional reinforcement, the usage of domestic food ingredients, labeling of calorie, labeling of sodium amounts, the necessity of MSG labeling, sanitation, freshness, product packaging, and the necessity of information for brands and foods. An ANOVA was performed on ordinal five-point scale questions to determine any differences in responses between age groups. In the case of significant differences, Duncan's new multiple range test was conducted for *post–hoc* analysis.

The survey questions

Regarding the survey questions on the levels of interest and necessity for the development of functional diets and cooking methods, a frequency analysis was per-formed to determine the following factors: health status (with or without diseases), essential nutrient requirements, preferred types of nutrients and health information of each individual and its interested fields, intention to purchase nutrient-fortified diets, the necessity of recipes and cooking programs, preferred cooking methods, preferred types of foods, preferred flavors, preferred textures, and purchase expenses. The frequency analysis was conducted for general status, including gender, age, family relations, academic background, occupation, income, and residence.

Analyses

The frequency analysis was conducted on survey data collected for this study using the IBM SPSS Statistics 19 program to identify the choice factors of target respondents. In addition, Cronbach's alpha, scaled from one to five points, was performed. Furthermore, a cross-analysis and Chi-square test were performed for categorical questions to detect any differences in responses among the age groups. DUNCAN verification was employed in the *post–hoc* analysis to identify

significant results after the ANOVA for ordinal questions (five-point scale questions), thus indicating differences in the responses among the age groups.

Results

Investigations of health information, interest and necessity for developing functional diet by age group

Table 1 shows the comparisons of nutrients necessary for different age groups. The data indicate that 188 people (55.30%) require vitamin, 62 people (16.60%) require other nutrients, and 52 people (13.90%) require proteins. Moreover, the answering distribution of nutrients that are necessary in all age groups showed that vitamin at most; there was no significant difference in statistics in this regard. By gender, 144 respondents were male (38.50%), whereas the remaining 230 respondents were female (61.50%). By occupation, 57 (15.20%) respondents were professionals; 21 (5.60%) people engaged in technical posts; 29 (7.80%) people were office workers; 47 (12.60%) people were service-sector workers; 12 (3.20%) people were salespersons; 34 (9.10%) people were public officials; 103 (27.50%) people were housewives; 44 (11.80%) people belong to other occupational categories, and the remaining 27 (7.20%) people were unemployed.

Preferred cooking methods of patients with specific diseases (high blood pressure) by age group

Tables 2 and 3 show comparisons between high blood pressure patients in the 55–60 and 60–65 age groups regarding their preferred cooking methods and flavors. In the 55–60 age group, boiling was the preferred cooking method, followed by soups/stews and steaming. This age group preferred a savory flavor, followed by spicy and salty flavors (7).

Investigation of edible cosmeceutical for diseases and the preferred diet information by age group

Table 4 compares necessary nutrients for diseases and knowledge of required diet information for different age groups. Overall, 207 people (55.30%) had

Table 1. Comparison of age-specific needs for nutrients in consideration of a well-balanced geological distribution (n=374).

		Protein[a]	Carbohyd rate	Fat	Calcium	Vitamins[b]	Other nutrients[c]	Total	X²	p
Age (years)	Freq	17	2	2	25	82	24	152		
50-55	%	11.20	1.30	1.30	16.40	53.90	15.80	100.00		
55-60	Freq	15	5	1	18	51	18	108		
	%	13.90	4.60	0.90	16.70	47.20	16.70	100.00		
60-65	Freq	13	4	0	8	31	16	72		
	%	18.10	5.60	0.00	11.10	43.10	22.20	100.00	18.63	0.55
65-70	Freq	3	1	0	4	11	3	22		
	%	13.60	4.50	0.00	18.20	50.00	13.60	100.00		
>70 under	Freq	4	0	1	1	13	1	20		
	%	20.00	0.00	5.00	5.00	65.00	5.00	100.00		
Overall	Freq	52	12	4	56	188	62	374		
	%	13.90	3.20	1.10	15.00	50.30	16.60	100.00		

[a]Protein: 52 (13.90%) people
[b]Comparison of age-specific needs for; vitamins: 188 (50.30%) people
[c]Other nutrients: 62 (16.60%) people

Table 2. Frequency analysis of preferred cooking methods (n = 28)

	Which of the following cooking methods do you prefer?				
		Freq.	Percent	Effective Percent	Cumulative Percent
Effective	Roast	4	14.30	14.30	14.30
	Boiling	11	39.30	39.30	53.60
	Steaming	2	7.10	7.10	60.70
	Soups/stew	6	21.40	21.40	82.10
	Stir-fry	4	14.30	14.30	96.40
	Deep-fry	1	3.60	3.60	100.00
Total		28	100.00	100.00	

Table 3. Frequency analysis of preferred flavors (n = 28)

	Preferred cooking flavors				
		Freq.	Percent	Effective Percent	Cumulative Percent
Effective	Spicy	5	17.90	17.90	17.90
	Salty	2	7.10	7.10	25.00
	Savory	21	75.00	75.00	100.00
Total		28	100.00	100.00	

Table 4. Comparison of age-specific differences between knowledge and available information (n = 374)

Types of nutrients and diets required for chronic diseases						X²	p
		I know	**I don't know**	**Not interested**			
Age (years)	Freq	88	59	5	152		
50-55	%	57.90	38.80	3.30	100.00		
55-60	Freq	58	43	7	108		
	%	53.7	39.80	6.50	100.00		
60-65	Freq	41	25	6	72		
	%	56.90	34.70	8.30	100.00	8.38	0.40
65-70	Freq	13	9	0	22		
	%	59.10	40.90	0.00	100.00		
>70 under	Freq	7	12	1	20		
	%	35.00	60.00	5.00	100.00		
Overall	Freq	207	148	19	374		
	%	55.30	39.60	5.10	100.00		

Table 5. Daily nutrient-specific intake based on data from 2012 based on raw data of the 5th Korea National Health and Nutrition Examination survey (n = 3,147)

Daily Recommended Intake	Mean ± (Standard deviation)	mg
Vitamin A intake (μgRE)	822.98 ± (28.02)	700~900 mcg
Thiamine intake (mg)	1.18 ± (0.01)	1.2 mg
Riboflavin intake (mg)	1.06 ± (0.01)	1.2~1.5 mg
Niacin intake (mg)	15.25 ± (0.16)	1.4~1.6 mg
Vitamin C intake (mg)	106.85 ± (1.95)	100 mg

this knowledge, 148 (39.60%) people did not, and 19 people (5.10%) were not interested. As for participants aged 50–70 years, the most frequent answer was that they were aware, followed by "not knowing" and "not interested." However, among those 70 years old or older, the distribution was different: "I do not know," followed by "I am well aware of" and "I am not interested." Statistical verifications showed no significant differences.

Harmful and harmful ingredients from the viewpoint of sustainable safety KNHANES V-3

To confirm and complement the results of this study, we used the raw data from KNHANES V-3 for the year 2012 (Tables 5 and 6) to analyze the daily nutrient-specific intake levels and the experience rates

Table 6. Age-specific experience with dietary supplements according to 2012 raw data from the 5th Korea National Health and Nutrition Examination survey (n = 3,150)

Age	N	Percentage
50–64	1.564	52.10%
65 and older	1.586	44.20%

of dietary supplements for less than one year for participants older than 50 years old. The daily intakes of vitamin A, thiamine, riboflavin, niacin, and vitamin C (compared with the recommended daily intakes) ranged from 100–143%, which is good. Meanwhile, the experience rates of dietary supplements for less than one year were 52.10% for participants aged 50–64 years and 44.20% for those older than 65 years, which are considerably high.

Discussions

Conflicting results were found on how the environment affects the survival, stability and transmission of SARS-CoV-2. Current evidence confirms that factors affecting the severity of COVID-19 require various measures, such as virus volume, stability, transmission, social interaction, host interaction, and environmental stability (10). As the global pandemic continues, various studies on public health response strategies are being conducted. A study was also conducted to determine the public health response of adults who surveyed COVID-19 infectious disease experts. Therefore, the study concluded that intensive protection strategies may be sufficient in low-level epidemic situations. However, he said that social distancing should be strengthened by switching to a strategy closer to continuous containment in the event of a rapid spread of the outbreak (11). As a result, studies on COVID-19, including studies addressing influenza, type A and MERS coronavirus outbreaks, have identified these diseases as risk factors affecting the severity of COVID-19 in infected people. SARS-CoV-2 causes many deaths and reduces people's health worldwide. Because of COVID-19, people's diets have gained increased importance. The number of reports of obesity and death associated with serious COVID-19 cases has also increased (12).

In recent years, the standard of living in Korea has improved significantly due to rapid economic development. Recent improvements in nutritional status, dietary lifestyle and state-of-the-art medical facilities have extended the lifespan of Koreans. As a result, the proportion of the elderly population is increasing (13,14). According to the Funeral Population Prospect (15,16) announced by the National Statistical Office in 2011, Korea has entered an aging society, as 7.20% of the population was aged 65 and over in 2000. The super-aging society increased by 14.30% in 2018 and is expected to exceed 20% in 2026. This growth has caused a serious social problem, and Korea has the fastest aging rate among OECD member countries (15,16).

Tables 5 and 6 show the hazardous ingredients noted in KNHANES V-3 from the viewpoint of sustainable safety. This is a dietary supplement for less than one year for seniors 50 and older. The daily intake of vitamin A, thiamine, riboflavin, niacin and vitamin C was good (100~143% of the recommended intake in East Asia and Korea). It is understood that the intake of more vitamin C due to flu prevention. However, the experience rate of dietary supplements appears to be lower than the recommended daily intake. A study has been published that the prevention and improvement of COVID-19 infection is effective for the immune-modulating effect of vitamin C, antioxidant and anti-inflammatory. It can also be used as an adjunct therapy for critically ill patients with COVID-19. It is believed that the low cost of vitamin C can be effective for sustainable safety. It may also be identified as vitamin C deficiency in respiratory infections. A study result showed that it would be effective to test the vitamin C status of patients in advance and treat them with intravenous administration in the intensive care unit and oral administration for hospitalized corona patients (17). Studies have shown that low levels of micronutrients during viral infection are associated with adverse clinical outcomes. This means that daily allowances of vitamins and trace elements for diagnosed malnourished patients can be beneficial and should be managed to maximize nutritional defense against infection. Additionally, a recent study of patients with COVID-19 found that vitamin D and selenium deficiency is evident in patients with acute respiratory infections. It is considered an antiviral agent, as vitamin C increases immunity. For this reason, a study showed that vitamin C administration could increase the survival rate of COVID-19 patients by weakening the excessive activation of the immune response. Thus, vitamin C increases the formation of antiviral cytokines and free radicals. This appears to decrease virus yield (18).

In addition, our studies on the effects of nutritional status and vitamin status, including trace elements, on disease course and outcome were also supported. The present study indicates that the COVID-19 pandemic is linked to obesity, mal-nutrition and trace element deficiencies. This conclusion confirms that the nutritional status abnormality for malnutrition is related to acute disease clinical outcomes. As a result, it is reported that vitamins and trace elements can modulate immune responses and inflammatory conditions.

These roles will be critical data recently. Overall, the patient's condition, nutritional status, course, severity, and responsiveness to therapy will play a pivotal role in tailored nutritional interventions and are integral to treating COVID-19 patients (19). A previous study confirmed changes in consumers' perceptions of take-out food before and after the outbreak of COVID-19 using big data. In 2019, the most common search term related to take-out food using text mining was "eat out." In addition, keywords such as "packaging," "famous restaurants," "family," and "delicious" were identified. In 2021, "dining out" was again a popular keyword. Also, "packaging," "famous restaurants," "delivery," "family," "delicious," "availability," and "corona" were used as search terms (20).

Other studies have been conducted to determine whether the COVID-19 pandemic has affected customers' behavior. The behaviors investigated in this study indicate increased awareness of the organic market. They confirmed the impact of the COVID-19 pandemic on consumer behavior in the Polish organic market. As a result, it was said that online sales should be developed. It was also important to indicate information on the ecological origin and to indicate that the product was manufactured in Poland. It identifies the consumer groups whose behavior changed and the direction of these changes (21). Following the rapid spread of COVID-19, a study conducted in Malaysia confirmed that older people with underlying medical conditions were most affected. This study was conducted to determine the impact of exercise during the COVID-19 pandemic on the quality of life and mental health of older people living in senior housing. This came out. It was also stated that the quality of life of people living in senior housing should be improved (22).

A cross-sectional study on the use of big data for the past H1N1 influenza epidemic in obese individuals after COVID-19 revealed that customized inner beauty and customized cosmetics should be studied using historical data (23). After the global COVID-19 pandemic broke out, new definitions of "safe health sustainability," "well-being" and "well-dying" related to beauty and healthy beauty were provided. Related studies utilized the direct-to-consumer (DTC) genetic testing market. It is a study on genetic testing that has

been rapidly emerging in recent years. These findings highlight the evolution of sustainable, safe and healthy beauty. The consumption of customized inner beauty formulations and customized foods could be effective.

In the global DTC genetic testing market, it is deemed necessary to study the combined effect of customized inner beauty products and food. In addition, research was conducted to develop a customized inner beauty app according to the use of nuclear factor erythroid 2-related factor 2 (NRF2), an important protein related to chronic diseases, e.g., inflammatory diseases and cancer. Such research represents a new what of thinking about rejuvenation and health and beauty. The results suggested the possibility of developing antioxidants as a means of customized inner beauty and regulating NRF2 in the COVID-19 era (24–26).

Therefore, the present study analyzed the dietary methods of middle-aged Koreans based on big data in 2012, when H1N1 influenza was prevalent worldwide. These data were utilized for the prognostic evaluation of COVID-19. This study is expected to aid the academic and corporate exploration of research plans to develop functional nutritional fortified foods and customized inner beauty contents for each chronic disease related to the ongoing COVID-19 pandemic. However, a limitation of this study is that it used historical data since COVID-19 is ongoing. Since new contagious diseases are continuously emerging, research on dietary methods and customized edible cosmeceutical for a healthy life and safe eating should be continuously conducted. Moreover, this study is based on the middle-aged and elderly in Korea, and there are some weak points, but it is considered that it can be used as basic data. Therefore, additional research according to the global inner beauty and edible cosmeceuticals market will be needed as an extension study.

Conclusions

Therefore, this study found that the daily intake of vitamin A, thiamine, riboflavin, and niacin within one year of the elderly 50 years or older was sufficient. In particular, the intake of vitamin C was significantly higher at 100~143% of the recommended intake. Vitamin C significantly inhibits the production of antiviral

and anti-inflammatory regulatory cytokines and free radicals, thereby reducing the level of inflammation and vi-ruses in the body, and it is judged to prevent influenza by increasing the intake rate. The basis of this study was based on big data of the Korean population at the time of the H1N1 influenza epidemic. The results of this study are expected to help improve the diet of the elderly and develop customized edible cosmeceutical through sustainable and safe health functional foods in the context of the global COVID-19 pandemic.

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Received: 17 March 2024
Accepted: 31 May 2024
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