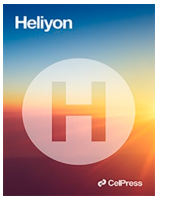
Heliyon 9 (2023) e20239

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon



A study of the purchase intention of insect protein food as alternative foods for fitness proteins

Longfei Ren [a], Fangfang Yang [a,*], Chao Gu [b]

[a] Academy of Physical Education and Health of Sanming University, Fujian, 365004, China
[b] Academy of Arts & Design, Tsinghua University, Beijing, 100084, China

ARTICLE INFO

Keywords:
Alternative foods
Fitness enthusiast
Purchase intention
Insect protein food

ABSTRACT

The purpose of this study is to investigate the influencing factors for fitness enthusiasts' willingness to purchase insect protein foods as fitness protein replacements. Using structural equation modeling, a model was developed to understand the factors influencing the purchase intention of insect alternative foods. We conducted an online survey of 968 fitness enthusiasts in China. In accordance with the data processing results, perceived value appears to be one of the most significant factors that contribute to consumers' purchase intention, attitude, and satisfaction with their purchase decisions. Furthermore, satisfaction has the potential to improve user attitudes and increase user purchase intentions. As a whole, this study extends research on insect protein alternatives as a potential alternative product for bodybuilding supplements. Moreover, make some recommendations to producers, designers, and promoters.

1. Introduction

1.1. Research background and purpose

By 2100, the world population will have grown by 4 billion, to a total of 11 billion, and will continue to grow [1]. Due to the continued growth of the world's population and the consumption of environmentally friendly foods, air, soil, and water resources are also experiencing a great deal of stress [2]. There is a prediction that 830 to 1.09 billion people in the world will suffer from hunger by 2050 as a result of food safety issues, and that the supply of food should increase by at least 50% and even as much as 75% [3]. It has been suggested by experts that the global food demand will increase in the first half of the 21st century, however the crops will be widely used in bioenergy and industry, thereby threatening the food security of the least developed and developing countries [4]. As the world's population grows, food availability is one way to ensure food security in the future [5]. A top priority in addressing food security is to find alternatives to animal products. The most important source of animal protein is dairy products. Milk substitutes that use insects as raw materials have similar nutritional properties and do not negatively impact the environment [6].

There are already two billion people in the world who consume insects [7]. The trend towards healthy and sustainable diets is currently underway around the world, with a shift towards seafood, dairy, poultry, and vegetable oils among the most prominent changes [8]. As alternative proteins gain more attention, plant-based meat alternatives, insects, and artificial meat have greater benefits for human health than animal-based meat, while improving animal welfare at the same time [9]. A number of scientists have

* Corresponding author.
E-mail address: 20218129@my.honam.ac.kr (F. Yang).

https://doi.org/10.1016/j.heliyon.2023.e20239
Received 11 January 2023; Received in revised form 31 August 2023; Accepted 14 September 2023
Available online 17 September 2023

argued that eating insects is a viable option to ensure food security. Insects have the advantages of high feed conversion rates, low greenhouse gas emissions, low water consumption, and good animal welfare [10]. Compared to traditional protein, insect protein is a good alternative because it has a high nutritional value, is easy to digest, and protects the environment [11]. Meanwhile, food must be safe, affordable, convenient, and delicious [12], and alternative foods are favored by urban sustainable development planners in order to both protect the environment and attract wealthy residents to the urban core for consumption [13].

Since people have become more aware of their health in recent years, the demand for protein supplements among fitness enthusiasts has risen dramatically. Combining insect food with supplements for bodybuilders is a very interesting and important research area. Protein supplements are beneficial to fitness enthusiasts for a variety of reasons, including the building of muscle and strength, the reduction of body fat, the increase in muscle mass, the improvement of athletic performance, and the improvement of overall health [14]. When exercising, 30%–70% of sports enthusiasts take dietary supplements, and 20% consume protein powder frequently on the advice of their coaches or doctors [15]. The use of edible insects could address human needs for animal protein and add new dietary components to food waste [16]. A growing population has created severe food shortages. Insect food has attracted the attention of many scholars in recent years, however there is no study that explores the effects of adding insect food to fitness enthusiasts. With fitness enthusiasts having a high protein requirement, this study fills the gap in research on alternative products for fitness enthusiasts with high protein requirements. Furthermore, this study examines the role and response of fitness enthusiasts to insect food as a protein substitute, which is the innovation of this study. It is therefore important to investigate the willingness of bodybuilders to purchase insect alternative foods.

According to a large number of literature studies, insect alternative foods are gradually becoming more accepted by consumers, and they offer more and more advantages such as high protein levels. In this paper, it is demonstrated that adding insect alternative foods to the supplements of bodybuilders can satisfy the desire for high protein levels, and that it will play a very important role in reducing environmental pressure and food shortages. The purpose of this study is to analyze the factors that influence fitness enthusiasts' intentions to purchase insect protein alternative foods. It is vital to identify the main factors that influence people's decision to choose alternative products, to develop new edible products and alternative products for the future population of the world, and to minimize the imbalance between supply and demand for food.

1.2. Research purposes

This study aims to investigate the factors influencing the purchase intention of insect protein products as fitness protein substitutes and fitness enthusiasts. We developed a structural equation model to examine the relationship between new product innovation, campaign commitment, perceived risk, perceived value, satisfaction, attitude, and purchase intention. Providing valuable insight to policymakers and industry stakeholders interested in incorporating insect alternative foods into the food supply in an environmentally friendly and socially acceptable manner.

2. Theoretical background and the research model

2.1. Alternative foods

The most common alternative foods are plant proteins, artificial meat proteins, and insect proteins [17]. As the production process of products consumes a large amount of resources, consumers are becoming more concerned about the sustainability of consumption patterns [18]. In order to meet the needs of users, we must also look for and develop better sustainable consumer products. It has been shown in numerous studies that flexible diets that replace protein and future foods can contribute to the sustainability of the food system [19]. Alternative foods are expected to play an important role as a good source of nutrition in the near future [20]. Food alternatives will play an important role [21], which indicates that they have significant development value. Alternative foods are developed for various reasons, including convenience, customization, improved nutritional needs, animal welfare, and others [22].

2.2. Innovation in products

A new product's development and promotion are highly dependent upon product innovation. According to the article on social media customer satisfaction research, SNS food service product innovation can have an impact on customer satisfaction [23]. In other words, product innovation can increase user satisfaction to a certain extent. By using five constructs, such as food innovation to explain user satisfaction and attitudes, open innovation can help the hotel industry better understand customer preferences and needs. The results show that the Logit model interpretation rate reaches more than 50% [24]. E-commerce product innovation is one of the focuses of businesses and consumers worldwide [25]. Among Indonesian Shopee users, the relationship between product innovation, satisfaction, and repurchase intention was not significant, but satisfaction significantly affected repurchase intention. Thus, when buyers recognize the innovation of a product, it can further influence their satisfaction, attitude, and purchase intention. There is, however, a question of whether such effects can still be achieved with special products such as insect alternative foods.

2.3. Commitment to sports

It is generally considered that commitment is displaying a sense of belonging and a spiritual desire for certain behaviors and persisting in carrying them out [26]. Having a strong commitment to sports will have an impact on the loyalty of bodybuilders. The

higher the loyalty, the higher the satisfaction and also the likelihood that bodybuilders will purchase fitness equipment [27]. An analysis of psychometric trait measures found that commitment to sports and satisfaction were positively associated [28]. According to Ref. [29], previous relevant literature has shown that sports commitment is positively related to satisfaction and attitude toward sports. A sports commitment will not only improve participation in sports, but will also have a direct or indirect effect on the purchase satisfaction, attitude, and purchase intention of sports-related products. This study further explores the relationship between these factors using the insect alternative food purchase intention model.

2.4. Perceived risk

A perceived risk is defined as the loss expectation that people perceive as a result of eating edible insects in restaurants, including the quality, psychology, health, environment, time loss, social risk, and other factors [30]. A consumer's perception of risk has a negative impact on his or her purchase intention when shopping online [31]. Users' perception of risk inhibits their willingness to make a purchase [32]. In addition, people's perception of risk will affect their behavior regarding preventative behavior to some extent [32]. In the food industry [33], noted that perceived risk negatively impacts customer satisfaction. In the case of new products or services that are associated with direct food consumption, there is a substantial increase in the perceived level of risk [34]. Despite the fact that eating insects is not a new concept, this article focuses on the addition of insects to protein supplements for bodybuilders. Since this is a new food product, the study of perceived risk is extremely significant.

2.5. Perceived value

Perceived value is defined by the most often cited definition, based on consumers' perceptions of what is received and given to them [35]. The perceived value of carpooling will positively affect passengers' willingness to participate [36]. People often choose the more cost-effective product or service if they have a more valuable choice. The perceived value of supermarket food contributes positively to customer satisfaction [37]. A participant's perception of value plays a critical role in predicting his or her purchase intention [38]. According to Kwun [39], perceived value has a positive impact on attitudes toward meal purchases. Thus, a positive value perception can improve consumers' satisfaction and attitudes, which will increase their willingness to make a purchase. We investigate whether this relationship is still valid for insect alternative foods in this study.

2.6. Attitude

An individual's attitude is their level of positive or negative evaluation of a behavior [40]. Attitudes have a significant impact on consumer purchase intentions [41]. A brand commitment helps consumers form a positive attitude towards the brand, which increases their likelihood of making a purchase [42]. In addition, a positive attitude will increase consumer willingness to purchase [43]. Thus, personal attitudes are an important predictor of participants' willingness to purchase [44].

2.7. Satisfaction

It has been demonstrated that consumer satisfaction has a positive effect on the purchasing attitude of consumers [45]. Purchase attitudes of consumers are positively influenced by their satisfaction with online purchases [46]. Purchasing intentions and food choices are mediated by attitude and satisfaction [47]. Participants' increased trust in the robot restaurant reduces perceived risk and enhances satisfaction [48]. In general, the higher the customer satisfaction, the more likely they are to consume on the website again [49].

2.8. Consumer purchase intentions and behaviors

A consumer's purchase intention is defined as their willingness to make a purchase [50]. As a result of attitude, customers' purchase intention is positively influenced, whereas perceived risk inhibits customers' purchase intentions [41]. Attitudes and satisfaction moderated participants' motivations and intentions for making food choices [47]. Consumers' purchase intentions are influenced primarily by their attitude [18]. With a positive attitude towards green clothing, Indian consumers intend to purchase green clothing with the aim of protecting the environment [51]. Consumer behavior evolves continuously over time as a result of the previous purchase experience of the participant and the information provided by the surrounding people, such as marketing personnel [52]. There is great potential for new research in marketing strategy, consumer behavior, and marketing analytics. Among the most important factors that motivate consumers to purchase products are factors that affect their behavior [53].

3. Research method

In this study, we surveyed respondents' opinions online and obtained their consent without interacting with them or encountering medical ethical concerns. Due to this, there is no statement applicable to the institutional review board. Our experiments informed consent was obtained from all participants and all methods were performed per relevant guidelines and regulations.

3.1. The survey object

A structural equation modeling approach was used to analyze the willingness of fitness enthusiasts to purchase insect alternative foods as fitness alternative products. Following the combination of the pictures of insect alternative foods and the deletion of the questionnaires with invalid responses, 634 valid data were obtained. The purpose of this study is to explore the purchase intention of fitness enthusiasts for insect alternative foods. Protein products are most frequently used by fitness enthusiasts, and they have a great deal of knowledge about them. It was conducted on subjects who had consumed insect food or insect-related protein products. Further, given their long-term purchasing pattern for protein supplement products, a new product that can reduce fitness costs and contribute to sustainable food development is of greater importance to them. Therefore, we selected them as the research objects.

3.2. Questionnaires design

This questionnaire has been based on the original questionnaire of relevant dimensions, supplemented with relevant structures appropriate to this study, and the relevant questionnaires have been modified in accordance with this theme. In this model, we only used items that passed the reliability and validity tests because the reliability and validity test results for some items did not meet the standard. As shown in Table 1, the reference sources, codes, items, and source information for latent variables relate to the theme of this article and relevant literature.

3.3. Collection of data

Data collection for this study was conducted online from October to December 2022 using online questionnaires. The respondents who received the survey were instructed to click on the link to the questionnaire to complete it. Participants viewed the description of

Table 1
Measurement scale.

LatentVariable	Coding	Item	Source
Innovation in products	NI1	Innovations in insect alternative foods are based on food materials that are completely different from those used in the past.	(Cheng & Huizingh, 2014)
	NI2	Creating insect alternative foods requires the development of new products that replace the existing ones.	
	NI3	A leap in effectiveness and value of new ingredients is possible through the innovative use of insect alternative foods.	
	NI4	Insect alternative foods that use innovative raw materials and have had a significant impact on the industry.	
Commitment to sports	NC1	Exercise is an activity that is worth pursuing.	(Zhang et al., 2021)
	NC2	If I did not continue working out, I would feel guilty.	
	NC3	In order to fulfill my responsibilities, I insist on fitness.	
Perceived risk	PR1	It concerns me that consuming supplements containing insect alternative foods products could result in physical harm or injury.	(Abbasi, Kumaravelu, Goh, & Singh, 2021)
	PR2	My concern is that insect alternative food products supplements will not be worth the money I spend.	
	PR3	My concern is that supplementing with insect alternative foods may cause hygiene or health issues.	
	PR4	My concern would be that insect alternative foods products would disappoint me.	
Perceived value	PV1	By using insect alternative foods product supplements, I am able to save money on fitness.	
	PV2	It is possible to accelerate my muscle growth and save me time by using supplements made from insect alternative foods.	
	PV3	The insect alternative foods product supplements are worth the effort I have put into them.	
	PV4	The value of supplements containing insect alternative foods products is generally excellent.	
Attitude	ATTD1	My preference for insect alternative foods is based on their ability to contribute to the sustainable development of food.	(Al-Swidi, Huque, Hafeez, & Shariff, 2014)
	ATTD2	It is my preference to use insect alternative food products because they are more nutritious than traditional dietary supplements.	
	ATTD3	Due to its environmental friendliness, I prefer insect alternative foods.	
	ATTD4	In my opinion, insect alternative food products are quite reasonably priced.	
	ATTD5	Insect alternative foods are of great interest to me.	
Satisfaction	US1	I am very satisfied with the insect alternative food supplement products that I have used.	(Y.-Y. Wang, Wang, Lin, & Tsai, 2019)
	US2	There is high quality in these insect alternative foods.	
	US3	I am satisfied with this insect alternative food supplement.	
Purchase intention	PI1	Due to their high protein content, I am inclined to purchase insect alternative foods products.	(Paul, Modi, Patel, & services, 2016)
	PI2	In order to protect the environment, I would consider switching to insect alternative foods.	
	PI3	Instead of conventional foods, I will spend more money on insect alternative foods.	
	PI4	Due to the positive impact on the environment, I intend to purchase insect alternative foods in the future.	
	PI5	It is certain that I will purchase insect alternative foods in the near future.	

the survey via the link to the questionnaire, and were fully informed of their voluntary responses. The Likert scale was used, ranging from 1 for strongly disagree to 5 for strongly agree.

This study collected a total of 968 questionnaires, of which 334 were invalid. The remaining 634 valid questionnaires were then analyzed, and the effective recovery rate was 65.5%. As shown in Table 2, the data is based on the final valid sample.

4. Results

4.1. Description of the test results

Hypothesis testing is required for the returned questionnaires, since this paper makes assumptions about normality and linearity in the distribution of the returned questionnaires. Test the normality of the distribution using the skewness and kurtosis of each construct. Based on the results, the skewness of each construct was between 0.684(HT) and 0.838 (PE) and the kurtosis was between 0.033(HT) and 1.067 (PE). Table 3 illustrates that the distribution of the data collected formally conforms to univariate normality [54], as indicated by the absolute values of skewness and kurtosis.

4.2. Reliability analysis

Cronbach's Alpha and the corrected total correlation coefficient (CITC) were used to validate the questionnaire in this study. According to Table 4, the CITC of all constructs is greater than 0.5, and Cronbach's Alpha reliability coefficient is greater than 0.7. It can be concluded from this that the questionnaires and scales employed in this study possess a high degree of internal consistency.

4.3. Analyses of exploratory factors

Using exploratory factor analysis, each construct was validated, as shown in Table 5. All constructs have KMO values greater than 0.6, and the significance of the Bartlett sphericity test is less than 0.05, which allows exploratory factor analysis to be conducted [55]. A commonality of greater than 0.6 between each construct item indicates that there is a good degree of convergence [56]. An eigenvalue greater than 1 can only be extracted from one new factor if the factor loading exceeds 0.7, indicating that it obeys one construct and is suitable for analysis.

4.4. Analyses of confirmatory factors

4.4.1. Validation of convergence

As shown in Table 6, confirmatory factor analysis was used in this study. The standardized factor loading is greater than 0.6 [57], the SMC value is greater than 0.4, the t value is greater than 2.58, and the P value is less than 0.05, which is significant. The combination reliability is greater than 0.7, and the average variance extraction (AVE) is greater than 0.4, so this structure is considered to have good convergent validity [58].

As shown in Table 7, the model fitting index meets the recommended index, indicating that the first-order CFA model has a better

Table 2
Demographic characteristics of the respondents.

Sample	Category	Number	Percentage
Gender	Male	293	46.2
	Female	341	53.8
Age	1	154	24.3
	2	195	30.8
	3	187	29.5
	4	49	7.7
	5	49	7.7
Experience in fitness	1	156	24.6
	2	217	34.2
	3	200	31.5
	4	61	9.6
Frequency of fitness	1	178	28.1
	2	228	36.0
	3	146	23.0
	4	82	12.9
Experience with insect alternative foods	1	303	47.8
	2	331	52.2
Hometown	Eastern Region	353	55.7
	Middle Region	175	27.6
	western region	90	14.2
	Northeast Region	15	2.4
	Hong Kong, Macao and Taiwan regions	1	0.2

Table 3
Description of the test results.

Constructs	Mean	S.D.	Skewness	Kurtosis
NI	3.722	.793	−.689	.625
NC	4.072	.701	−.771	1.067
PR	3.623	.832	−.689	.545
PV	3.645	.776	−.788	.962
AT	3.527	.839	−.753	.366
SAT	3.610	.831	−.838	.730
PI	3.438	.895	−.684	−.033

Table 4
Results of the reliability analysis.

Item	Corrected Item Total Correlation	Cronbach's Alpha If Item Deleted	Cronbach's Alpha	Item	Corrected Item Total Correlation	Cronbach's Alpha If Item Deleted	Cronbach's Alpha
NI1	.587	.684	.761	AT2	.607	.702	.775
NI3	.621	.648		AT4	.626	.685	
NI4	.569	.707		AT5	.613	.705	
NC1	.546	.674	.739	SAT1	.646	.746	.808
NC2	.535	.689		SAT2	.671	.721	
NC3	.613	.598		SAT3	.650	.743	
PR1	.647	.690	.788	PI3	.661	.681	.788
PR2	.666	.669		PI4	.595	.749	
PR3	.574	.767		PI5	.642	.706	
PV2	.564	.700	.756				
PV3	.641	.609					
PV4	.554	.709					

Table 5
Results of an exploratory factor analysis.

Construct	KMO	Bartlett's Sphere Test	Item	Commonality	Factor Loading	Eigenvalue	Total Variation Explained
NI	.693	.000	NI1	.674	.821	2.033	67.762%
			NI3	.709	.842		
			NI4	.650	.806		
NC	.678	.000	NC1	.640	.800	1.976	65.872%
			NC2	.624	.790		
			NC3	.712	.844		
PR	.694	.000	PR1	.723	.850	2.106	70.202%
			PR2	.742	.862		
			PR3	.641	.800		
PV	.680	.000	PV2	.648	.805	2.019	67.302%
			PV3	.733	.856		
			PV4	.638	.799		
AT	.703	.000	AT2	.685	.828	2.081	69.381%
			AT4	.706	.840		
			AT5	.691	.831		
SAT	.814	.000	SAT1	.712	.844	2.167	72.230%
			SAT2	.738	.859		
			SAT3	.716	.846		
PI	.702	.000	PI3	.734	.857	2.116	70.547%
			PI4	.665	.816		
			PI5	.717	.847		

ability to fit the data [59]. A computational latent factor method (CCLFM) is used in this paper to assess the common method bias of the data. Results indicate that the common method bias fitness index is not significantly improved when compared with the CFA index, and that RMSEA and SRMR have been reduced by less than 0.05, and that GFI, AGFI, CFI, NFI, and TLI have been increased by less than 0.1, indicating that there is no common method bias present in the study.

4.4.2. Validity test for discriminant analysis

The discriminant validity of the data was tested using the Fornell-Larcker criterion method in this study. Table 8 shows that the square root of the AVE for each construct is greater than the correlation coefficient between the constructs, indicating that the constructs have good discriminant validity [60].

Table 6
Results of a confirmatory factor analysis.

	Items	Factor loading	t value	p value	SMC	AVE	CR
NI	NI1	.736	19.705	.001	.542	.518	.762
	NI3	.756	20.425	.001	.572		
	NI4	.663	17.271	.001	.440		
NC	NC1	.650	15.897	.001	.423	.492	.743
	NC2	.682	16.776	.002	.465		
	NC3	.767	19.041	.001	.588		
PR	PR1	.774	19.749	.001	.599	.558	.790
	PR2	.807	20.649	.001	.651		
	PR3	.652	16.482	.001	.425		
PV	PV2	.657	17.488	.001	.432	.510	.757
	PV3	.745	20.584	.001	.555		
	PV4	.737	20.291	.001	.543		
AT	AT2	.720	20.155	.001	.518	.541	.779
	AT4	.767	21.923	.002	.588		
	AT5	.718	20.096	.001	.513		
SAT	SAT1	.777	22.594	.001	.604	.583	.807
	SAT2	.764	22.032	.001	.584		
	SAT3	.749	21.465	.001	.561		
PI	PI3	.768	21.677	.001	.590	.560	.792
	PI4	.699	19.066	.001	.489		
	PI5	.776	21.988	.001	.602		

Table 7
Model fitting index comparison results of CFA and CCLFM.

Common indices	χ^2/df	RMSEA	GFI	IFI	CFI	TLI	SRMR
Judgment criteria	<3	<0.08	>0.9	>0.9	>0.9	>0.9	<0.08
CFA Value	2.504	.049	.940	.959	.958	.948	.047
CCLFM Value	2.278	.045	.965	.965	.965	.956	.050

4.5. Results of structural equation modeling

Fig. 1 illustrates the model path relationship. Table 9 indicates that the model has good fitting indicators, and all of these indicators are higher than recommended standard values CFI = 0.958, RMSEA = 0.049, indicating that the model is reasonably constructed and has reached the standard fitting degree [60].

The maximum probability similarity method is used in this paper to estimate the direct and indirect effects of each construct path. According to Table 10, perceived value significantly predicts satisfaction (β = 0.819, P = .020), attitude (β = 0.870, P = .016), and purchase intention (β = 0.798, P = .005). The study indicates that the perceived value of insect protein alternatives for fitness enthusiasts is positively correlated with their satisfaction, attitude, and purchase intention.

Insect protein alternative foods' customers' satisfaction significantly predicted their purchase intention (β = 0.874, P = .008) and attitude (β = 0.955, P = .016), indicating that fitness enthusiasts' satisfaction had a positive relationship with their purchase intention and attitude.

However, product innovation (β = .075, P = .455), (β = 0.046, P = .713), sport commitment (β = -0.042, P = .181), (β = 0.120, P = .112), perceived risk (β = -0.008, P = .745), (β = -0.051, P = .196), did not demonstrate a significant route relationship with attitude or satisfaction. The findings of this study demonstrate that there is no positive relationship between fitness enthusiasts' attitudes and satisfaction with insect alternative food innovation, sports commitment, perceived risk, and their use of insect protein alternative foods.

A significant route relationship was not observed between product innovation (β = .069, P = .668), sport commitment (β = −0.042, P = .605), perceived risk (β = −0.007, P = .992), or attitude (β = 0.939, P = .115). It shows that fitness enthusiasts' product

Table 8
Validity test for discriminant analysis.

	NI	NC	PR	PV	AT	SAT	PI
NI	.873						
NC	.403**	.862					
PR	.241**	.106**	.889				
PV	.585**	.286**	.176**	.870			
AT	.539**	.250**	.166**	.699**	.883		
SAT	.577**	.364**	.115**	.696**	.785**	.898	
PI	.548**	.242**	.119**	.652**	.706**	.736**	.890

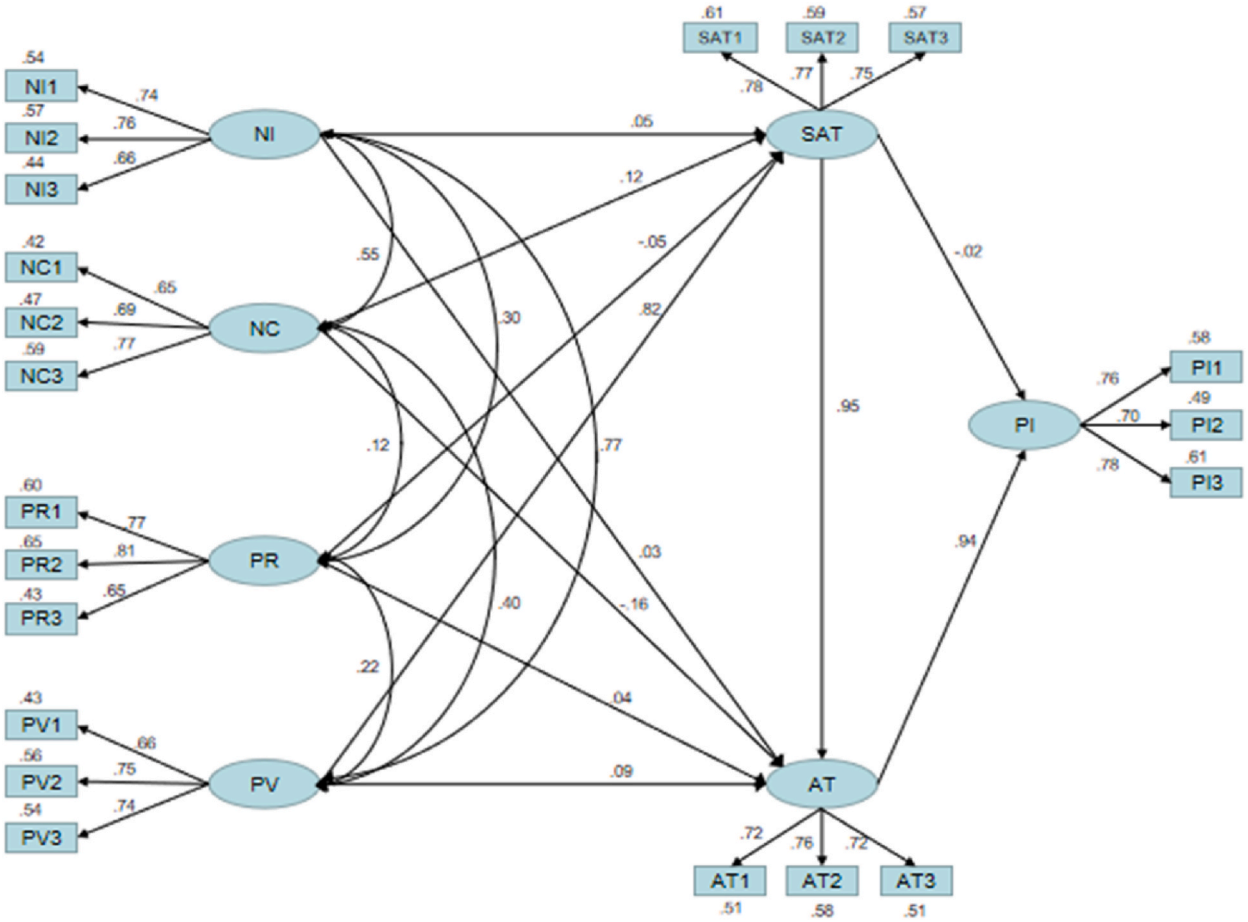


Fig. 1. Structural equation model.

Table 9
Adaptability of SEM

Common indices	χ^2	df	χ^2/df	RMSEA	GFI	IFI	CFI	TLI	SRMR
Judgment criteria			<3	<0.08	>0.9	>0.9	>0.9	>0.9	<0.08
Value	430.684	173	2.490	.049	.938	.958	.958	.949	.047

innovation, sports commitment, perceived risk, and attitude towards insect alternative foods and their willingness to consume insect protein alternatives do not have a positive causal relationship with their willingness to consume insect protein alternatives.

5. Discussion

The purpose of this study is to examine fitness enthusiasts' purchase intentions for insect alternative foods. We analyzed seven explanatory variables derived from NI, NC, PV, PR, AT, SAT, and PI. These results provide a valuable reference for insect alternative foods as an alternative product to relieve pressure on the environment and food supplies.

Fitness enthusiasts' perceived value of adopting insect alternative foods products is associated with their satisfaction in a positive manner. This implies that fitness enthusiasts' perception of the value of insect alternative foods products directly affects their satisfaction with those products, which is consistent with the findings of [61]. The perception of value tends to have a positive effect on the satisfaction of customers [62]. A positive correlation exists between customers' perception of organic food's value and their satisfaction [63]. This may be due to fitness enthusiasts' perception that insect alternative foods are useful as a substitute for supplements, and can easily be recognized to some extent in terms of their quality, value, and utility, which reflects a high degree of satisfaction.

An association exists between fitness enthusiasts' perceptions of the value of adopting insect alternative foods and their attitudes toward them. The perceived worth of the subjects played a significant role in influencing their attitudes toward insect alternative foods [64]. also noted that perceived value and attitude affect consumer behavior, and fitness enthusiasts place great emphasis on these

Table 10
Direct and indirect effects.

Path	Direct effect		Indirect effect		Total effect	
	β	B–C Sig.	β	B–C Sig.	β	B–S Sig.
NI→SAT	.046	.713	/	/	.046	.713
NI→AT	.031	.661	.044	.732	.075	.455
NC→SAT	.120	.112	/	/	.120	.112
NC→AT	−.157	.025*	.114	.066	−.042	.181
PR→SAT	−.051	.196	/	/	−.051	.196
PR→AT	.041	.430	−.049	.187	−.008	.745
PV→SAT	.819	.020*	/	/	.819	.020*
PV→AT	.088	.479	.782	.023*	.870	.016*
NI→PI	/	/	.069	.668	.069	.668
NC→PI	/	/	−.042	.605	−.042	.605
PR→PI	/	/	−.007	.992	−.007	.992
PV→PI	/	/	.798	.005**	.798	.005**
SAT→PI	.939	.115	/	/	.874	.008**
SAT→AT	.955	.016*	.896	.103	.955	.016*
AT→PI	−.022	.905	/	/	.939	.115

concepts when choosing fitness products. According to Ref. [65], Zimbabwean insect users' positive attitudes toward insect alternative foods were positively influenced by their nutritional and therapeutic benefits. The producers and operators should further examine their value positioning in order to improve the perception of value among consumers and create promotional strategies that maximize product quality and value awareness.

A positive relationship exists between fitness enthusiasts' perceived value of insect alternative foods and their intention to make a purchase. It was found that the results of this study were in agreement with the previous studies [38]. An important measure of participant willingness to purchase is their perceived value [66]. The perceived value of a product has a positive impact on the purchase intention of customers [67]. There is evidence that insect protein alternative foods have high nutritional value as well as environmental protection value. When fitness enthusiasts are made aware of the value of insect protein alternative foods, they will actively promote their willingness to purchase insect alternative foods for fitness purposes. Additionally, product developers should fully consider different user needs, both in terms of material selection and nutritional composition, in order to create products that are more valuable to users, thereby increasing their willingness to purchase them.

The satisfaction with insect alternative food products and the intention to purchase them are positively correlated. According to the research results of [68] satisfaction is the most important factor in determining purchase intentions. It is well known that satisfaction has a significant impact on people's purchase intentions [69]. Fitness enthusiasts have a high degree of satisfaction with insect protein alternative foods due to their comprehensive understanding of these foods, which leads to their willingness to purchase these foods. Therefore, customer satisfaction is closely related to the likelihood of making a purchase.

Fitness enthusiasts' satisfaction with insect alternative foods products and attitudes are positively related. By presenting insect alternative foods to the experiencers in the form of seminars [70], attempted to increase the satisfaction of the experiencers with their products. The results of the study significantly impacted the attitudes of the experiencers towards using insect alternative foods. The growth of the global population is driving a shift in the attitude toward insects as a source of dietary protein [71]. The meaning of this is that attitudes can also be improved through external factors such as marketing or promotional efforts. By introducing the benefits and positive aspects of a product or concept to people, it is possible to influence their attitudes more positively. Those interested in fitness believe insect protein alternative foods have significant advantages, such as high protein and environmental protection, are satisfied with the product itself, and then express a positive opinion of it.

Fitness enthusiast adoption of insect-based products was not significantly related to innovation, commitment to sports, perceived risk, or attitudes toward purchase intentions. In contrast to previous findings [31], found that perceived risk inhibits purchase intentions significantly [72]. found no significant relationship between innovation, perceived risk, and purchase intention for green products. The attitudes of Taiwan consumers toward organic food influence their purchase decisions [73]. In addition [74], found that sports commitment significantly impacts purchase intentions for products related to sports, which is also different from our findings.

Neither fitness enthusiasts' product innovation nor commitment to sports is positively correlated with their attitude toward and satisfaction with insect alternative foods. This may be due to the influence of other existing foods in the insect alternative food category, which reduces the subject's innovative recognition of insect alternative foods [75,76]. Thus, product innovation does not have a significant impact on satisfaction and attitude. The factors affecting commitment to sports are diverse and complex, and even without fitness supplements, fitness enthusiasts will participate in fitness activities [77,78]. Additionally, we considered the effect of the subjects' awareness of insect protein alternative foods, so market promoters may wish to emphasize the promotion of such products. The perception of risk does not significantly influence product satisfaction or user attitude, which may explain to some extent why insect alternative foods are likely to expand into new markets [79]. The majority of test subjects have no significant negative reactions to this type of product, despite some having a slight repulsion toward it. Furthermore, product packaging and designers face certain challenges, and designs that reduce users' psychological aversions should be easier to accept.

Product innovation, commitment to sports, perceived risk, and attitudes of fitness enthusiasts towards insect alternative foods products are not positively correlated with purchase intention. Unlike previous studies [80], found that perceived risk hindered

purchase intention, and the perceived environmental risk was different from the perceived risk in this study.

6. Conclusions

According to this study, perceived value is one of the most important factors affecting the willingness of fitness enthusiasts to purchase insect alternative foods such as protein products. As a result of the positive value cognition associated with such products, it helps to improve the attitude and satisfaction of the users, which then constitutes a significant influence on their purchase intention. An important finding of the study was that perceived value had a direct impact on purchase intentions. A second important construct is satisfaction. Improved satisfaction can significantly improve fitness enthusiasts' attitudes toward insect protein alternatives and their willingness to purchase them. There were, however, a few subjects who exhibited negative attitudes such as fear and rejection toward insect alternative foods, although the results were not statistically significant. Several strategies can be used to overcome this negative emotion, including effective contact with insects and the diversification of food processing techniques, the development of smaller molecules of insect alternative foods, and the optimization of packaging.

6.1. Theoretical contribution

A new structural equation model was developed in this study to verify the relationship path hypothesis of fitness enthusiasts' purchase intentions and influencing factors for insect alternative foods protein products as fitness alternative proteins. In this study, we analyze the purchase intention of fitness enthusiasts for insect alternative foods in order to assess the current level of acceptance for such products among the general population. The information presented in this paper extends the theoretical framework of the factors influencing the purchase intention of insect alternative foods, and makes several contributions to the future diversification of food nutrition, the development of sustainable food systems as well as protection of the environment. Additionally, the use of insects as a food source may have cultural and social implications, given that it is more prevalent in some regions of the world than in others. Research on insect alternative foods contributes to our understanding of insects' role in the food system and their potential benefits and challenges. Furthermore, this study contributes to the body of knowledge on the use of insects as a nutritional source of protein and may be used to inform future research.

6.2. Practical implication

Based on the results of this study, it provides a reference for high-protein supplements and offers suggestions for reducing food pressure. Two main conclusions can be drawn from this study: In the first place, fitness enthusiasts' perception of insect protein alternatives is positively correlated with satisfaction, attitude, and purchase intention. In the second place, this paper provides a link between product innovation and sports commitment.

Ultimately, insect food can be a very useful substitute for traditional products. It is also viewed as one of the most effective ways to alleviate the huge food gap caused by population growth, as well as the sustainability of the environment. Although insects can convert feed into protein quickly, promoting protein quickly remains a major challenge. In the future, more researchers need to study insect alternative foods to help people overcome bad emotions and accelerate the adoption of insect alternative foods in mainstream diets. Insect protein alternative foods play a very important role in maintaining global food security. Alternatively, the production and promotion of these products can also result in a greater diversification of protein products, which may reduce consumer purchase costs and increase the choice of products available to them. Furthermore, it can save fitness enthusiasts' fitness costs, which is also very valuable for improving fitness efficiency and reducing sports-related time commitments.

7. Future research and limitations

1. Limitations on the subject. It should be noted that the majority of respondents in this study are between the ages of 17 and 25 years of age, and it is possible to verify the effectiveness of the model in other areas. Further studies may be conducted in the future to determine the consistency of the causal relationship between the growth of age and experience with these findings.
2. Research limitations. This study focuses on the willingness of fitness enthusiasts to consume insect protein alternative foods, and analyzes it with NI, NC, PV, PR, AT, SAT, PI, 7 explanatory variables. In the future, more influencing factors can be examined.
3. Limitations of the product. There are few insect protein alternatives on the market at present, so many consumers have certain cognitive limitations. Since insect alternative foods have become increasingly popular in recent years, it is essential to revisit this model in the future with diversified products and full customer awareness.

Author contribution statement

Longfei Ren: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper. Fangfang Yang: Conceived and designed the experiments; Performed the experiments; Wrote the paper. Chao Gu: Performed the experiments; Contributed reagents, materials, analysis tools or data.

Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e20239.

References

[1] W.W. Murdoch, F.-I. Chu, A. Stewart-Oaten, M.Q. Wilber, Improving wellbeing and reducing future world population, PLoS One 13 (9) (2018), e0202851.
[2] E. Schmitt, W. de Vries, Potential benefits of using Hermetia illucens frass as a soil amendment on food production and for environmental impact reduction, Curr. Opin. Green Sustainable Chem. 25 (2020), 100335.
[3] A.Y. Prosekov, S.A. Ivanova, Food security: the challenge of the present, Geoforum 91 (2018) 73–77.
[4] L. Kopteva, L. Shabalina, E. Kashirina, Ecological aspects of the world food security, in: E3S Web of Conferences, vol. 91, EDP Sciences, 2019, 06011.
[5] A.D. Tripathi, R. Mishra, K.K. Maurya, R.B. Singh, D.W. Wilson, Estimates for world population and global food availability for global health, in: The Role of Functional Food Security in Global Health, Elsevier, 2019, pp. 3–24.
[6] A. Tello, K. Aganovic, O. Parniakov, A. Carter, V. Heinz, S. Smetana, Product development and environmental impact of an insect-based milk alternative, Future Foods 4 (2021), 100080.
[7] C.M. Collins, P. Vaskou, Y. Kountouris, Insect food products in the western world: assessing the potential of a new 'green'market, Ann. Entomol. Soc. Am. 112 (6) (2019) 518–528.
[8] M. Tuninetti, L. Ridolfi, F. Laio, Compliance with EAT–Lancet dietary guidelines would reduce global water footprint but increase it for 40% of the world population, Nature Food 3 (2) (2022) 143–151.
[9] R. Tso, A.J. Lim, C.G. Forde, A critical appraisal of the evidence supporting consumer motivations for alternative proteins, Foods 10 (1) (2020) 24.
[10] A. Van Huis, et al., *Edible Insects: Future Prospects for Food and Feed Security* (No. 171), Food and agriculture organization of the United Nations, 2013.
[11] A. Gravel, A. Doyen, The use of edible insect proteins in food: challenges and issues related to their functional properties, Innovat. Food Sci. Emerg. Technol. 59 (2020), 102272.
[12] F. Liu, et al., "Future foods: alternative proteins, food architecture, sustainable packaging, and precision nutrition,", Crit. Rev. Food Sci. Nutr. (2022) 1–22.
[13] V. Ong, "" Feeling out of place suddenly, and you haven't even moved", in: Food Gentrification, Alternative Foods, and Sociospatial Justice in Downtown Kitchener, University of Waterloo, Ontario, 2020.
[14] R. Shrestha, Current trends of dietary supplements among fitness enthusiasts, Indian Journal of Health Sciences and Care 8 (spl) (2021), 90-90.
[15] A. Kiss, L. Pfeiffer, J. Popp, J. Oláh, Z. Lakner, A blind man leads a blind man? Personalised nutrition-related attitudes, knowledge and behaviours of fitness trainers in Hungary, Nutrients 12 (3) (2020) 663.
[16] V. Varelas, Food wastes as a potential new source for edible insect mass production for food and feed: a review, Fermentation 5 (3) (2019) 81.
[17] C.A. Gómez-Luciano, L.K. de Aguiar, F. Vriesekoop, B. Urbano, Consumers' willingness to purchase three alternatives to meat proteins in the United Kingdom, Spain, Brazil and the Dominican Republic, Food Qual. Prefer. 78 (2019), 103732.
[18] T.M. Rausch, C.S. Kopplin, Bridge the gap: consumers' purchase intention and behavior regarding sustainable clothing, J. Clean. Prod. 278 (2021), 123882.
[19] A. Green, C. Blattmann, C. Chen, A. Mathys, The role of alternative proteins and future foods in sustainable and contextually-adapted flexitarian diets, Trends Food Sci. Technol. 124 (2022) 250–258.
[20] A.B. Suwardi, N.Z. Indriaty, Z. Navia, Nutritional evaluation of some wild edible tuberous plants as an alternative foods, Innovare J Food Sci 6 (2) (2018) 9–12.
[21] M. Al Mijan, B.O. Lim, Diets, functional foods, and nutraceuticals as alternative therapies for inflammatory bowel disease: present status and future trends, World J. Gastroenterol. 24 (25) (2018) 2673.
[22] H. Seo, J. Hwang, Analysis of decisive elements in the purchase of alternative foods using bivariate probit model, Sustainability 14 (7) (2022) 3822.
[23] P.T. Mahendra, Improve customer satisfaction through product innovation in social media, Budapest International Research and Critics Institute-Journal (BIRCI-Journal) 4 (3) (2021) 3719–3729.
[24] S.-H. Lee, J.J. Yun, M.M. Díaz, C.M. Duque, Open innovation through customer satisfaction: a logit model to explain customer recommendations in the hotel sector, Journal of Open Innovation: Technology, Market, and Complexity 7 (3) (2021) 180.
[25] A. Ibrahim, A. Hidayat, Application quality, product innovation, and popularity in influencing shopee consumer satisfaction and repurchase intentions in Indonesia, Jurnal Mantik 6 (3) (2022) 2931–2937.
[26] S. Karimi, J. Ghahramani, A. Ghasemzadeh, Structural Relationships between Mental Health, Organizational Health, Motivation to Participate and Sports Commitment Among Employees, 2021.
[27] A.S. Williams, Examining the Role of Brand Associations in Multipurpose Fitness Facilities: the Relationship between Service Quality, Exercise Commitment, Brand Associations, and Brand Loyalty, Indiana University, 2010.
[28] A. Granero-Gallegos, A. Baena-Extremera, M. Gómez-López, J. Abraldes, Psychometric properties of the "Sport Satisfaction Instrument (SSI)" in female athletes: predictive model of sport commitment, Psychol. Rep. 115 (1) (2014) 148–164.
[29] B. Hundito, The relationship between sports commitment and athlete satisfaction in sports activities: review of related literature, International Journal Of Research Pedagogy And Technology In Education And Movement Sciences 11 (1) (2022) 1–10.
[30] J. Hwang, J.Y. Choe, How to enhance the image of edible insect restaurants: focusing on perceived risk theory, Int. J. Hospit. Manag. 87 (2020), 102464.
[31] S.K. Ariffin, T. Mohan, Y.-N. Goh, Influence of consumers' perceived risk on consumers' online purchase intention, J. Res. Indian Med. 12 (3) (2018) 309–327.
[32] G. Lăzăroiu, O. Neguriță, I. Grecu, G. Grecu, P.C. Mitran, Consumers' decision-making process on social commerce platforms: online trust, perceived risk, and purchase intentions, Front. Psychol. 11 (2020) 890.
[33] N. Jin, N.D. Line, J. Merkebu, The impact of brand prestige on trust, perceived risk, satisfaction, and loyalty in upscale restaurants, J. Hospit. Market. Manag. 25 (5) (2016) 523–546.
[34] J.W. Taylor, The role of risk in consumer behavior: a comprehensive and operational theory of risk taking in consumer behavior, J. Market. 38 (2) (1974) 54–60.
[35] V.A. Zeithaml, Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence, J. Market. 52 (3) (1988) 2–22.
[36] Y. Wang, J. Gu, S. Wang, J. Wang, Understanding consumers' willingness to use ride-sharing services: the roles of perceived value and perceived risk, Transport. Res. C Emerg. Technol. 105 (2019) 504–519.

[37] N. Slack, G. Singh, S. Sharma, Impact of perceived value on the satisfaction of supermarket customers: developing country perspective, Int. J. Retail Distrib. Manag. 48 (11) (2020) 1235–1254.
[38] E.A.d.M. Watanabe, S. Alfinito, I.C.G. Curvelo, K.M. Hamza, Perceived value, trust and purchase intention of organic food: a study with Brazilian consumers, Br. Food J. 122 (4) (2020) 1070–1184.
[39] D.J.-W. Kwun, Effects of campus foodservice attributes on perceived value, satisfaction, and consumer attitude: a gender-difference approach, Int. J. Hospit. Manag. 30 (2) (2011) 252–261.
[40] M. Fishbein, I. Ajzen, Belief, Attitude, Intention, and Behavior: an Introduction to Theory and Research, 1977.
[41] D. Singhal, S.K. Jena, S. Tripathy, Factors influencing the purchase intention of consumers towards remanufactured products: a systematic review and meta-analysis, Int. J. Prod. Res. 57 (23) (2019) 7289–7299.
[42] X.-W. Wang, Y.-M. Cao, C. Park, The relationships among community experience, community commitment, brand attitude, and purchase intention in social media, Int. J. Inf. Manag. 49 (2019) 475–488.
[43] N. Peña-García, I. Gil-Saura, A. Rodríguez-Orejuela, J.R. Siqueira-Junior, Purchase intention and purchase behavior online: a cross-cultural approach, Heliyon 6 (6) (2020).
[44] R.M. Shri, S.V. Raj, Machine learning models for predicting customer willingness to buy electric vehicles, in: Computational Methods and Data Engineering: Proceedings of ICCMDE 2021, Springer, 2022, pp. 413–424.
[45] G. Zarei, B. Asgarnezhad Nuri, N. Noroozi, The effect of Internet service quality on consumers' purchase behavior: the role of satisfaction, attitude, and purchase intention, J. Internet Commer. 18 (2) (2019) 197–220.
[46] A.G. Abdul-Muhmin, Repeat purchase intentions in online shopping: the role of satisfaction, attitude, and online retailers' performance, J. Int. Consum. Market. 23 (1) (2010) 5–20.
[47] S.-A. Kim, W.-S. Hong, The Effect of Food Choice Motive on Consumption Attitude, Satisfaction, and Purchase Intention for Traditional Fermented Foods in the Twenties (Mediating Effect of Attitude and Satisfaction), 2019.
[48] K.H. Seo, J.H. Lee, The emergence of service robots at restaurants: integrating trust, perceived risk, and satisfaction, Sustainability 13 (8) (2021) 4431.
[49] T. Chi, Mobile commerce website success: antecedents of consumer satisfaction and purchase intention, J. Internet Commer. 17 (3) (2018) 189–215.
[50] P.A. Pavlou, Consumer acceptance of electronic commerce: integrating trust and risk with the technology acceptance model, Int. J. Electron. Commer. 7 (3) (2003) 101–134.
[51] A. Kumar, G. Prakash, G. Kumar, Does environmentally responsible purchase intention matter for consumers? A predictive sustainable model developed through an empirical study, J. Retailing Consum. Serv. 58 (2021), 102270.
[52] J. Sheth, New areas of research in marketing strategy, consumer behavior, and marketing analytics: the future is bright, J. Market. Theor. Pract. 29 (1) (2021) 3–12.
[53] B. Shen, W. Tan, J. Guo, L. Zhao, P. Qin, How to promote user purchase in metaverse? A systematic literature review on consumer behavior research and virtual commerce application design, Appl. Sci. 11 (23) (2021), 11087.
[54] P. Kline, A Handbook of Test Construction (Psychology Revivals): Introduction to Psychometric Design, Routledge, 2015.
[55] M.J. Norusis, SPSS for Windows: Base System User's Guide, Release 5.0, SPSS Incorporated, 1992.
[56] J.F. Hair, W.C. Black, B.J. Babin, R.E. Anderson, R.L. Tatham, in: Multivariate Data Analysis (Vol. 5, No. 3, Pp. 207-219), Prentice hall, Upper Saddle River, NJ, 1998.
[57] W. Wei, C. Gu, C. Yang, Examining the influence of moral norms on Dockless shared bicycle users' parking behavior—an exploratory study based on the theory of planned behavior, Systems 10 (1) (2022) 11.
[58] C. Fornell, D.F. Larcker, Structural Equation Models with Unobservable Variables and Measurement Error: Algebra and Statistics, Sage Publications Sage CA, Los Angeles, CA, 1981.
[59] D. Baik, J. Liu, H. Cho, R. Schnall, Factors related to biological sex differences in engagement with healthcare providers in persons living with HIV, AIDS Behav. 24 (2020) 2656–2665.
[60] C. Fornell, D.F. Larcker, Evaluating structural equation models with unobservable variables and measurement error, J. Market. Res. 18 (1) (1981) 39–50.
[61] A. Jaleel, M. Yajid, A. Khatibi, S. Azam, Assessing the interrelationships between customer satisfaction, perceived value and behavioral intention among Maldivians seeking medical care within medical tourism services: empirical evidence from the Maldives, Management Science Letters 11 (6) (2021) 1845–1854.
[62] H. Moon, H. Han, Tourist experience quality and loyalty to an island destination: the moderating impact of destination image, J. Trav. Tourism Market. 36 (1) (2019) 43–59.
[63] F.A. Konuk, The influence of perceived food quality, price fairness, perceived value and satisfaction on customers' revisit and word-of-mouth intentions towards organic food restaurants, J. Retailing Consum. Serv. 50 (2019) 103–110.
[64] S. Yu, J. Lee, The effects of consumers' perceived values on intention to purchase upcycled products, Sustainability 11 (4) (2019) 1034.
[65] F.A. Manditsera, C.M. Lakemond, V. Fogliano, C.J. Zvidzai, P.A. Luning, Consumption patterns of edible insects in rural and urban areas of Zimbabwe: taste, nutritional value and availability are key elements for keeping the insect eating habit, Food Secur. 10 (2018) 561–570.
[66] D. Jiménez-Castillo, R. Sánchez-Fernández, The role of digital influencers in brand recommendation: examining their impact on engagement, expected value and purchase intention, Int. J. Inf. Manag. 49 (2019) 366–376.
[67] J.R. Hanaysha, An examination of the factors affecting consumer's purchase decision in the Malaysian retail market, PSU Research Review 2 (1) (2018) 7–23.
[68] G. Dash, K. Kiefer, J. Paul, Marketing-to-Millennials: marketing 4.0, customer satisfaction and purchase intention, J. Bus. Res. 122 (2021) 608–620.
[69] A. Ali, G. Xiaoling, M. Sherwani, A. Ali, Antecedents of consumers' Halal brand purchase intention: an integrated approach, Manag. Decis. 56 (4) (2018) 715–735.
[70] S. Mancini, et al., Factors predicting the intention of eating an insect-based product, Foods 8 (7) (2019) 270.
[71] T. Pantuso, Attitudes among individuals following vegan, vegetarian, and omnivore diets and entomophagy (insect eating), Integrative Medicine Alert 22 (6) (2019).
[72] S.-I. Wu, J.-Y. Chen, A model of green consumption behavior constructed by the theory of planned behavior, Int. J. Market. Stud. 6 (5) (2014) 119.
[73] M.-F.J. Chen, Consumer attitudes and purchase intentions in relation to organic foods in Taiwan: Moderating effects of food-related personality traits 18 (7) (2007) 1008–1021.
[74] J.M. Casper, D.P. Gray, M.B. Stellino, A sport commitment model perspective on adult tennis players' participation frequency and purchase intention, Sport Manag. Rev. 10 (3) (2007) 253–278.
[75] R.P. Guiné, S.G. Florença, O. Anjos, P.M. Correia, B.M. Ferreira, C.A. Costa, An insight into the level of information about sustainability of edible insects in a traditionally non-insect-eating country: exploratory study, Sustainability 13 (21) (2021), 12014.
[76] M. Shelomi, Why we still don't eat insects: assessing entomophagy promotion through a diffusion of innovations framework, Trends Food Sci. Technol. 45 (2) (2015) 311–318.
[77] B. Desbrow, et al., Sports Dietitians Australia position statement: sports nutrition for the adolescent athlete, Int. J. Sport Nutr. Exerc. Metabol. 24 (5) (2014) 570–584.
[78] T.K. Scanlan, G.M. Chow, C. Sousa, L.A. Scanlan, C.A. Knifsend, The development of the sport commitment questionnaire-2 (English version), Psychol. Sport Exerc. 22 (2016) 233–246.
[79] A. Fischer, Eating Insects–From Acceptable to Desirable Consumer Products, 7, Wageningen Academic Publishers, 2021, pp. 1061–1063.
[80] G.A. Kusi, M.Z.A. Rumki, F.H. Quarcoo, E. Otchere, G. Fu, The role of information overload on consumers' online shopping behavior, Journal of Business and Management Studies 4 (4) (2022) 162–178.