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## Analysis of frozen food adoption by the consumer in Uttarakhand, a state of India: an inferential statistics approach

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**Abstract:** The aim of paper is to outline socio-economic profile of consumer readily adopting frozen food products and to identify relevant factors influencing consumer adoption. The paper attempts to analyse the influence of identified factors on frozen food product adoption and thus understand the level of consumer adoption towards frozen food products. Chi-square test for independence has been employed to examine the relationships and determine the degree of association between the adoption and demographic variables/factors. The binary logistic regression model permits evaluation of dependence of the dichotomous variable on the identified factors. Chi-square test of independence revealed significant association between demographic variables and the dependent variable, consumer adoption. The analysis carried out has shown that all the variables have significant impact on consumer adoption. Analysis carried out could be indicative of a shift in consumer perception related to frozen food products. The study will help manufacturers and marketers to focus their efforts towards increasing consumer adoption of frozen food.

**Keywords:** consumer perception; unhealthy; frozen food; consumer adoption; consumer convenience; India.

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## **1 Introduction**

Today, convenient food products like canned, packaged and frozen food are generally available in supermarkets and hypermarkets in closer proximity to consumers. Thus, the conventional methods of cooking have been replaced with methods that are fast, convenient and hassle-free. Factors that may exert influence on the consumption of convenient food are time factor, health consciousness, food nutritious value and price consideration (Osman et al, 2014).

With increased levels of disposable income, exposure to western culture, increased urbanisation, increasing consumerism, transformation in family structures with increased number of working women, changing age profile, and above all reduced availability of time, one can observe a considerable transformation in patterns related to food consumption [Goldammer and Mishra (as cited in Joshi et al., 2010)]. Consumers consume a food product in order to meet their needs and wants with respect to certain aspects like availability, quality, affordability and convenience. Owing to increase in working urban population and student population, demand for frozen food products has been increasing. Also, the surge in numbers of retail outlets is giving consumers the ease of accessibility and convenience for purchasing of such food products. With increase in disposable income, consumer is ready to experience wider variety of frozen food products. There is high level of innovation leading to new varieties of frozen food products appearing in the retail outlets. However, frozen food products being perishable in nature need appropriate refrigeration to maintain quality and safety of such food products. Processes and equipment used to maintain perishable products in a suitably-monitored environment is referred to as “Cold Chain” (Bogataj et al., 2005; Kumar and Kansara, 2018).

Quality, health and safety are some of the factors that can affect consumer adoption. It is consumer perception towards a food product which decides the purchase behaviour of a consumer. If the consumer has a positive perception towards a food product, then the consumption of that product will increase whereas if the perception of the consumer towards a food product is negative then the consumption will reduce. However, people's intention to consume a food product not only depends upon its pros and cons but it also

depends upon the accessibility, visibility and availability of the food product in the retail stores.

Consumer adoption of frozen food product in Uttarakhand, a state of India is extremely limited owing to readiness towards adoption of such products. Enhancing the adoption of the frozen food products by improving upon the factors which impact the adoption will not only result in more consumers adopting frozen food products but it will also help in reducing the wastage and losses of food. Keeping this in focus, the present study has been carried out.

Basis detailed literature review and the survey conducted this study aims at analysing the adoption of frozen food products by consumers of Uttarakhand region of India. A good understanding of the perception of consumers is a pre-requisite for ready-adoption of frozen food products by consumers in the present and in future. This will help the cold chain and sales and marketing professionals to have a better understanding of the level of consumer adoption in India. Keeping this in mind, the study has following objectives:

- 1 Analyse the association between demographic profile and consumer adoption of FFP (frozen food product)
- 2 Analyse the influence of various factors on FFP adoption
- 3 Understand the level of consumer adoption towards FFP

To achieve the above objectives, chi square test of independence and Binary logistic regression have been employed.

The remaining paper is organised as follows: Section 2 discusses the important studies and deals with the identification of factors from the literature review and their explanation. In Section 3 the methodology used and the tools applied for obtaining results are depicted. Section 4 presents data analysis. Section 5 presents Results. Discussion pertaining to the results and the study is presented in Section 6 and finally Section 7 discusses conclusion and future research scope.

## **2 Literature review**

Frozen food is a sector that is heterogeneous in nature, and so comprises of a wide range of products varying in profitability and growth rates (McKinnon and Campbell, 1998). The frozen food industry is marked with high fragmentation owing to different types of products requiring varying conditions. Though the industry is dominated by large manufacturers, however, since the last few years, there is an emergence of retailer brand or local brand products. Super markets and grocery discount retail outlets now handle a major percentage of frozen food sales. According to McKinnon and Campbell (1998), there are five forms with respect to primary distribution of frozen food: Delivery from the factory to distribution centre; Collection from the factory by the retailer; Dedicated cold store, contracted or owned by manufacturer; Shared cold store, contracted by the manufacturer and Retailer-nominated primary consolidation centre.

In today's dynamic and highly stressful times, convenience is considered as one of the most desirable and important characteristics of a food product. Changing lifestyles and evolving consumer trends, have significantly contributed to the production of ready meals (Reed et al., 2003). As a result, consumers are ready to experiment with buying, minimal cooking and eating rather than the conventional method of cooking while

keeping the sensory appeal intact. Consumer buying habits are also a result of regional trends, eating habits, household size, household income and the price perception that consumer has for the food product. The increase in demand of frozen food products is apparent by the presence of refrigerators, in the retail stores, dedicated for stocking such products. Food choices and the environment that is globally competitive triggers the need for innovation and help customer select better (Krishnamoorthy and Damle, 2017). The consideration for customer if integrated well in the processes related to product development will lead to a wonderful consumer experience (Isoherranen and Majava, 2018). perception of consumers certainly interests the food industry which would benefit considerably by the knowledge of what makes a consumer select and buy frozen food product(s). However, changing consumer tastes and demand, makes this process really difficult. Situational and personal factors also influence perceptions of a consumer with respect to quality (Fernqvist and Ekelund, 2014; Kumar et al, 2015).

Consumers today have become more demanding and more fragmented in their food choices (Grunert, 2005). Consumers, are ready to pay an additional cost for the ready-made frozen food product (Sen et al., 2019). Also, consumers have become very conscious towards selecting food products of good quality as well as considered safe foods for their consumption. Owing to the perception related to the quality and safety of food that influences the choice that a consumer demands, it can be emphasised that food safety and quality are undoubtedly consumer's most important concern (Vukasovic, 2015). Owing to increase in working urban population, young individuals staying away from their parents and increase in retail store outlets, there is increase in demand for food products that are easily available, easy to cook and less time consuming. The study uses Diffusion of innovation theory proposed by Rogers in 1962 (as cited in Di Benedetto, 2010) for examining consumer adoption. The theory will help investigate factors that can exert influence over consumer's decision of adopting a food product that is new and different as per their traditional eating habits.

It is generally agreed that Early adopters are vital to the success of a new product (McLean-Meynsse, 1997). Also, a retailer's performance can be influenced by the brand image, reputation, sales and profits, innovation and relationship with consumers and other stakeholders (Ganesan et al., 2009). The study by Bhatnagar et al. (2019) investigated the use of clustering for storage and transportation of fruits and vegetable to help reduce food wastage. Koen et al (2018) pointed out in their study that most of the times, it is only the price of a food product that was considered by the consumer while selecting a product and not much consideration was given on its nutritional value and its perceived quality. In a study by Shashi et al (2018), the focus is more on performance metrics and sustainability issues of the food cold chain. Alan et al (2017) has emphasised on influence of innovation characteristics on consumer innovation adoption. There is association between the awareness level related to organic food and the demographic characteristics (Krishnakumare and Niranjana, 2017). In a study done by Hoek et al. (2017), the consumer gave more impetus on health than the environmental attribute of a food product.

So knowing the consumer attitude towards frozen food products can help enhance performance or plan new strategies and exercise efforts in such areas, both by retailers and manufacturers. Attitude towards food consumption is made up of beliefs and awareness, external factors like backgrounds and socio-demographic profiles (Rezai et al., 2012). Attitude contributes to confidence and trust in the product which ultimately reflects as a positive attitude towards the product. Positive attitude will lead to increase in

consumer consumption of the product. Control factors that may result in inhibiting consumers from a particular behaviour are food safety, health consciousness and environmental friendliness (Rezai et al., 2012). Also, factors like degree of consumer involvement, consumer characteristics, product-oriented factors, perceived food quality, trust, product experience can influence consumer acceptance of new products (Sorenson and Henchion, 2011). According to a study by Yeh and Ickes (2008), family traditions, health perception, accessibility, cost, time, convenience, spoilage rate are some common facilitators of consumption. In a study done by Grunert (2005), when consumers were asked about what they regard as good quality with respect to food products, the answers revolved around taste, health, convenience and organic/natural production. Still another study by Joshi et al. (2010) portrayed that consumer demand high food quality, safety guarantee, and transparency.

There have been numerous studies on consumer adoption but their emphasis has been on convenience foods whereas the focus of the present study is on frozen food products. In a study done by Sen et al in 2019, some aspects have been considered for ready-made frozen food. Study by Koen et al (2018) concentrates on the consumer viewpoints. Certain studies are more theoretical in their approach. A number of studies lay emphasis on performance of cold chain however, consumer adoption is not much emphasised upon. Likewise, there are many studies conducted on cold chain management however the current study deals with a more exhaustive set of attributes for frozen food products especially considered during COVID-19 with empirical analysis of the same to arrive at the objective of the study. Table I presents some important research studies studied by the researchers. The researchers have explored various secondary sources like online databases (EBSCO, Pro-Quest, Google Scholar, etc.), conferences proceedings, etc. The relevant research papers were identified from year 1995 to 2020 using keywords like 'consumer purchase behaviour', 'consumer link', 'frozen products', 'chilled products', 'cold chain', and so on. Therefore, a clear relationship of certain factors with frozen food product adoption have been portrayed.

## *2.1 Influencing factors*

From further extensive literature review, 17 factors were identified, out of which two factors, namely, Unhealthy and Chemical content were negatively oriented. However, all the factors were considered for survey purpose and further for analysis. This was done to understand the influence, whether positive or negative, these factors have towards early adoption to frozen food products. Factors influencing consumer adoption to frozen food products identified on the basis of literature review are exhibited in Table 2.

## *2.2 Theoretical underpinnings*

This study is based on diffusion of innovation theory proposed by Rogers in 1962 (as cited in Di Benedetto, 2010). The theory explains how a product with the passage of time may diffuse within a social system. Thus, people would slowly adopt the new product. Adoption means that a person is ready to change the way he does something compared to what he previously did. As per the theory, adopters can be categorised into five categories: innovators, early adopters, early majority, late majority and laggards. Innovators are the first ones to try any innovation. Early adopters are the ones who comfortably adopt new innovation. Early majority are the individuals who will not want

to be left behind and so will adopt before an average individual. Late majority being sceptical in their approach will only adopt after others have tried well and the Laggards are those who are not willing to change to the new innovation.

**Table 1** Studies conducted related to consumer perception and cold supply chain

<i>Authors</i>	<i>Year</i>	<i>Country</i>	<i>Key focus</i>
McKinnon and Campbell	1998	UK	Responsiveness in SC
Coulson	2000	UK	Consumer use of food labels
Im et al.	2003	USA	Consumer innovativeness and new product adoption
Reed et al	2003	UK	Consumer acceptance of chilled ready meals
Hansen	2005	Denmark	Consumer adoption of online grocery
Grunert	2005	Denmark	Consumer quality perception
Gunasekaran et al.	2008	China	Responsive supply chain
Yeh et al.	2008	USA	Barriers and facilitators for fruits and vegetable consumption
Wang et al	2008	China	Consumption attitude and product adoption
Ganesan et al.	2009	USA	Supply chain performance
Joshi et al	2010	India	Consumers' awareness, behaviour and practices
Sorenson and Henchion	2011	Ireland	Consumer cognition W.R.T. chilled ready meals
Rezai	2012	Malaysia	Consumers' awareness and intention towards green food
Vanhonacker et al	2013	Belgium	Consumer perception W.R.T. Fresh and frozen fish products
Fernqvist and Ekelund	2014	Global	Influence of credence cues over consumers' liking of food
Bhatt et al	2015	India	Consumer behaviour towards packaged food
Palma et al	2015	USA	Consumer perception of quality-differentiated food
Vukasovic	2015	Slovenia	Value-addition and customer-orientation
Koen et al	2018	S. Africa	Consumer food purchasing behaviour
Alan et al	2017	Canada	Consumer Innovation Adoption
Krishnakumare and Niranjana	2017	India	Consumer buying behaviour towards organic food
Hoek et al	2017	Australia	Consumer perception for healthy and environment-friendly food
Krishnamoorthy	2017	India	Innovation
Isoherranen	2018	USA	Customer care
Sen et al	2019	India	Consumer consumption of ready-made food

**Table 2** Description of factors influencing consumer adoption

S. no.	Factors	Description	References
1	Value for money	For most of the consumers, price of the food product was very important while making a purchase decision. Consumers are ready to pay for products with high-perceived quality. Some consumers were willing to purchase chilled meals as they considered such products being of value for money, thus exhibiting their readiness to pay premium cost considering the time saved in preparation of the food. It is assumed that the consumer wishes to maximise value which is taken to be the difference between the benefits and the costs.	Koen et al. (2018), Palma et al. (2015), Reed et al. (2003) and Ness et al. (2010)
2	Unhealthy	Consumers being health conscious, may decide not to purchase frozen food product considering it to be unhealthy. Health-conscious consumers would more readily agree to pay premium prices for healthier-foods. According to a study, health is one of the aspects of quality as considered by a consumer while making a purchase decision.	Batte et al. (2007) and Grunert (2005)
3	Quality	Food quality is a central issue in today's food economics. In a study, fear of adverse health effect could influence consumption. Frozen food products are perishable. Perishable products need to be handled carefully throughout their supply chain, therefore requiring reefers and cold storage facilities. Individuals are usually ready to pay higher price for products with better quality.	Grunert (2005), Yeh et al. (2008), Vrat et al. (2018), Akkerman et al. (2010), Rong (2011), Zeithaml (1988) and Dawar and Parker (as cited in Magnier et al., 2016)
4	Safety	Failing to keep perishable food like frozen food products in the required temperature conditions can render the product non-usable owing to spoilage due to growth of micro-organisms and pathogens. When the safety risk is not reported or unknown, the food may be consumed and cause food-borne illnesses rendering the food product unsafe. Food safety is one of the most considered factors with regard to food product selection and purchase.	Mercier et al. (2017), Akkerman et al. (2010), Nath et al. (2013) and Rezai et al. (2012)
5	Taste	Bad taste is a barrier to eating a food product frequently. It also received the highest barrier score amongst other barriers, in the study. So, taste is certainly an influencing factor. Taste, price and high quality of the product were important criteria on the basis of which the consumers selected processed fruit and vegetable products. Safety and price were followed by the sensory factors which were considered as the most important motives for food choice.	Varhonacker et al. (2013, as cited in Bhatt and Bhatt, 2015) and Zakowska - Biemans et al. (2011)
6	Trust on brand	Essentially, customers essentially are loyal to brands providing value. According to a study, Trust in the brand is a chief feature of relationship between brand and its consumers. Also, it was indicated that consumers of such convenient and packaged goods do 'multi-brand purchasing'. For the food industry, consumer trust and its effect on purchasing behaviour are considered important.	Herhausen et al. (2009), Fournier (1998) Herhausen et al. (2009), Foxall (1999) and Yee et al. (2005).
7	Convenience/easy to cook	Convenient food products which are convenient, fast and hassle-free may tend to replace the traditional ways of cooking food. Convenience is not just quality time, especially when it comes to food preparation but it also considers mental and physical effort that is associated with activities that are specific to food. One of the major reasons for increase in convenience food is time limitations.	Osman et al. (2014), Man et al. (as cited in Osman et al., 2014)
8	Easy availability	Convenient food products, such as canned, packaged and frozen food, are today available in supermarkets in close proximity to the consumers.	Osman et al. (2014)
9	Variety and novelty	Due to the nature of urban consumers who are willing to experiment and try a variety of food items, adopt frozen food products more readily. Frozen vegetables are perceived as 'easy to prepare', 'providing variety' and ideal for working and active people.	Viaene et al. (1998)

**Table 2** Description of factors influencing consumer adoption (continued)

<i>S. no.</i>	<i>Factors</i>	<i>Description</i>	<i>References</i>
10	Meet varied preferences	Variables like the number of adults in the household, number of younger members in the household, household income and regular use of credit cards influenced consumer adoption. As a greater number of members and young members may be the reason for varied preferences and so the need to meet varied preferences of the household members.	Bayus and Mehta (as cited in McLean-Meynsse, 1997)
11	Poor cooking skills/interest	Low interest in cooking or poor cooking skills can be an influencing factor for adoption of convenient products such as frozen food	Osman et al (2014)
12	Snacking purpose	Owing to conventional eating habits, in India the frozen food products are used more as snacks than any other.	
13	Long shelf life	An appropriately designed supply chain is essential in maintaining the shelf life of produce and prevents them from deterioration of the quality. Because of increased shelf life, the food product stays for a longer duration and thus food losses are also reduced. Shelf life is the period of time left until the quality of the food drops below the acceptance and safety limit. Longer the shelf life, longer will the product stay and more convenient for the consumer.	Negi and Anand (2015) and Jedermann et al. (2014)
14	Chemical content	The consumer fears the adverse effects of chemical contents and so is a great barrier towards consumption of a food product.	Yeh et al (2008)
15	Less preparation time	Some consumers purchase chilled ready meals as they consider them to be value for money, hence confirming their readiness to pay premium costs for the time saved in food preparation. So, one can assume that such meals have less preparation time and are so convenient for the consumer	Reed et al. (2003)
16	Happiness/satisfaction	Foods are a universal element of daily-life, thus they may have influence on emotional states and this may have a wider significance to consumer behaviour. For the food industry this relationship is very important since often foods are designed and marketed based on their probable emotional impact on the consumer. In the pilot study done by the researchers earlier, it became apparent that consumers also purchased frozen food products because they felt happy and satisfied after the preparation. Reasons for the happiness and satisfaction were more time for self, able to meet varied preferences of different family members, quick preparation, feeling of dining out, to name a few.	Cardello et al (2012),
17	Nutrient value	Some health-conscious consumers pointed out that they check the nutrient values on the packet for enhanced credibility about the product and that also raises the level of satisfaction.	Yeh et al (2008)



### 2.3 *Research gaps and highlights*

The extensive literature review is based more on studies done in developed countries and very few on developing countries, as is also indicated in Table 1.

In a developing country like India, cold chain is still at an amateur stage (Kitinoja, 2013). National Centre for Cold Chain Development reported that as per a study carried out in the USA, cold chain logistics is utilised to transport around 80–85% of F&V whereas in India it is nearly negligible (NCCD, 2013). India is a country with an abundance of natural resources and a land that is highly lush and fertile. Primarily, the Indian economy has been agrarian and is also one of the largest producers of fruits and vegetables in the world. The value for the market for frozen food products in India, is Rs 74 billion in 2018 and it is further predicted to reach a value of Rs 188 billion by 2024, with the CAGR expanding to around 17% from 2019 to 2024 (Goel, 2020). The state of Uttarakhand which comes under the North Hill Zone, considering its fertile landscape has a huge potential in its natural resources.

Thus, research is needed to identify the factors influencing consumer adoption with the purpose of enhancing adoption finally leading to utilisation of agricultural production and reduced wastage. With that in consideration, this study aims to focus on adoption towards frozen food products. The researchers have considered three levels of adoption, the levels being low, medium or high. Low adoption relates to individuals who are Laggards and Late majority; Medium level relates to individuals who are Early majority and High level relates to Innovators and Early adopters.

The study also attempts to analyse the relation between demographic variables with levels of adoption and further a framework is proposed. Consumers' attitude and their adoption behaviour can be influenced by their demographic profile and other factors. These factors contribute to the consumers' confidence and trust towards consuming food product which leads to the consumers adopting a positive attitude (Rezai et al, 2012). The influence of above-mentioned factors is then studied with respect to consumer adoption to frozen food products.

## 3 **Methodology**

A consumer questionnaire was developed and conducted for collection of responses related to the factors that are probable in influencing the adoption of frozen food products. The research used both exploratory and descriptive research. Exploratory study was initially done to get insights on consumer perception and identify various factors that influence consumer adoption of frozen food products. Descriptive research helped in analysing the association between demographic variables, factors with consumer adoption. Non-probability sampling technique, namely, Convenient sampling, has been used for eliciting responses from the consumer. The sampling technique was used owing to the COVID situation where the residents of Uttarakhand, India were under lockdown and were operating from home. A survey was done to understand the consumer perception towards adopting frozen food products. The survey was done using Google forms and the analysis was carried out using SPSS Version 22.

The questionnaire consisted of two sections. First section collected information related to the demographics of respondents and the other section collected information pertaining to preferences of respondents for frozen food products. A five-point Likert

scale (from 1 – strongly agree to 5 – strongly disagree) was used to understand the perception of respondents with respect to frozen food. The questionnaires were sent to 250 respondents, out of which 231 responded and 19 responses were not filled properly. Research Methodology was done in three stages. In the first phase, chi-square test of independence was conducted for demographic variables as well as for the influencing factors to understand the degree of association between them and the adoption level. In Stage 2, factor analysis was conducted to reduce the dimensionality of the influencing factors. In the final stage logistic regression was conducted for analysing the influence of reduced factors on consumer adoption and the testing of the proposed model.

#### **4 Data analysis**

Inferential statistics approach was used in the study for analysing data and arriving at results. Applying inferential statistics, data is taken from samples and generalisations are made generalisations about a population. Thus, it allows inferences to be derived from that data.

With reference to the level of adoption, the researchers asked the question to be responded as

- 1 hardly tried frozen food product
- 2 sometimes tried
- 3 regularly tried.

However, for further analysis, a new variable (Adopt\_Y\_N) was created having values 1 (adoption) and 0 (no or negligible adoption). Hardly tried responses were considered under level 0 while sometimes tried and regularly tried were considered under level 1. The study attempts to analyse the influence of the factors on consumer adoption (Adopt\_Y\_N).

Cronbach's alpha, reliability analysis, was tested to check the internal consistency and reliability of the factors. Cronbach coefficient value was arrived at to be 0.743 which is greater than 0.5. Reliability tested on demographic variables included along with the factors, Cronbach's alpha was found to be 0.697 that is also greater than 0.50. Hence, as an indication of reliability, the sample is considered acceptable (Chawla and Sodhi, 2011).

##### *4.1 Chi-square test of Independence*

Chi-square ( $\chi^2$ ) test is a statistical, nonparametric test and is applied to determine if the variables used are independent or not (Zibran, 2007). Proper application of Chi-square test can help us arrive at the outcome by accepting or rejecting the null hypothesis. The test is based on the chi-square ( $\chi^2$ ) distribution. Before accomplishing the test, level of confidence is defined, which is the probability level that the researcher is willing to accept.

In the study, Chi-square test of independence along with Fisher's Exact test (wherever Chi-square assumption was not met, Fisher value was taken) was employed to determine the association between demographic variables and level of adoption as well as between influencing factors and level of adoption. The reason why Fisher's Exact test

was used as sample size was not very large, there were many cells with expected count less than 5 and in such situations, it is recommended to use Fisher's Exact test of independence in place of Chi-square test. If p-value is less than 0.05, then there is said to be association else there is no association. Further Cramer's V Statistic has been used to ascertain the strength of association between the demographic characteristics/factors and the level of adoption, as the number of rows was not equal to the number of columns. Considering, if the Cramer's V statistic value is greater than 0.80, strength of relationship is Strong, if value is between 0.40 and 0.80, strength of relationship is moderate, if value is between 0.20 and 0.40, strength of relationship is weak and if it is between 0.00 and 0.20, relation is negligible (Chawla and Sodhi, 2011; Kumar et al., 2013).

4.2 Factor analysis

Factor analysis is a scientific method for data analysis. Factor analysis derives its value from the extent of variability of involved data. If there is no variation in the data, then more than one factor cannot be derived from the data. So, factor analysis helps in uncovering the independent sources of variation in the data. Factor analysis discloses dimensions which can be interpreted as the measures of the amount of patterned variation in data (Rummel, 1988; Kumar et al., 2014).

The study employs Factor Analysis on the influencing factors to reduce the number of variables. KMO-value was 0.687 and significant value was 0.000 and hence it is indicated that the dataset is fit for Factor analysis and it can be conducted. The factors Unhealthy (negative) and Chemical Content (negative) were considered separately as being combined into one variable named 'Unhealthy and Chemical content' for a more accurate representation of the result. The transformation of the variable was done using log and mean. This variable is considered as a moderator variable as the perception of consumer with respect to the product being unhealthy or containing chemicals can change them from Adopting the frozen food product (FFP) to Not Adopting the FFP. The remaining variables were extracted into three variables, namely, product attributes; consumer convenience/flexibility; and variety and cooking skills.

**Table 3** Variables and analysis technique

<i>Variable name</i>	<i>Analysis technique employed</i>
<i>Dependent variable: Adopt_FF</i>	<i>Chi-square test of independence</i>
City	
Gender	
Age	
No. of members in household	
No. of young members	
Household income	
Education	
Marital status	
Employment status	
Use of credit card	

**Table 3** Variables and analysis technique (continued)

<i>Variable name</i>	<i>Analysis technique employed</i>
<i>Unextracted factors:</i>	<i>Factor analysis</i>
Value for money	
Unhealthy	
Quality	
Safety	
Taste	
Trust on brand	
Convenience	
Easy availability	
Variety and novelty	
Meet varied preferences	
Poor cooking skills/interest	
Snacking purpose	
Long shelf life	
Chemical content	
Less preparation-time	
<i>Unextracted factors:</i>	<i>Factor analysis</i>
Happiness/satisfaction	
Nutrient value	
<i>Extracted factors:</i>	
Product attributes	
Consumer convenience/flexibility	
Variety and cooking skills	
Unhealthy and chemical content	
Outcome variable: Adopt_Y_N	Logistic
<i>Predictor variables:</i>	Regression
Product attributes	Analysis
Consumer convenience/flexibility	
Variety and cooking skills	
Unhealthy and chemical content	

### 4.3 Binary logistic regression

Using regression analysis, mathematical relationship can be estimated to predict an unknown variable given known variables (Kumar, 2017; Safari et al., 2020). Generally, in regression, dependent variables are of scale data type. The model is referred to as binary logistic regression when we attempt to predict membership of two categories only. The dependent variable can hold binary values like Yes/No ultimately being referred as 1/0. For convenience, the response has been defined to be  $Y = 0$  or  $1$ , with the occurrence of the event of interest being denoted by  $Y = 1$ . How predictor variables are related to the

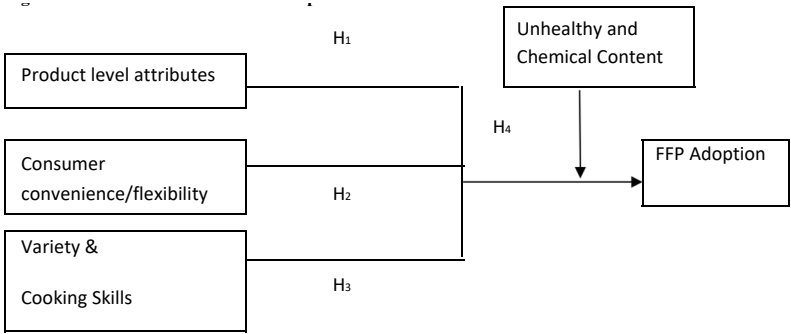
dichotomous response variable is then studied. Table 3 represents the variables, dependent/independent and the analysis technique applied.

Though the initial factors identified in the study were categorical but after applying factor analysis, the extracted variables were in scale form. The dependent variable, ‘Adoption’ (Adopt\_FF), originally in ordinal form was transformed into binary form (Adopt\_Y\_N) having values 0 and 1 in order to analyse the status of adoption, if adoption is there or not. In this study, we exploit a binary logistic regression model with adoption (Adopt\_Y\_N) as the outcome variable having two values, 0 for No Adoption and 1 for Adoption and there are four predictor variables: Product attributes; Consumer convenience/flexibility; Variety and cooking skills; and unhealthy and chemical content. The tool is then used to test the proposed model.

The assumptions of the binary logistic regression model are met in this study. Test of linearity was done using correlation and scatter plots, results of which showed that there no linear relationship existed between dependent and independent variables. Maximum likelihood method has been used to estimate the parameters in the logistic regression model. Hypothesis in the logistic model can be tested using the likelihood ratio, score, and Wald statistics. The increased or decreased probability of the occurrence of the event can be indicated by the odds ratio. An odds ratio having value less than one indicates reduced likelihood of the occurrence of the event and the odds ratio having value greater than one indicates increased likelihood of the occurrence of the event.

The proposed model for this study is shown in Figure 1.

**Figure 1** Research framework - FFP adoption



We also propose the following research hypotheses:

- H1a Product level attributes has a significant influence on consumer adoption of frozen food products
- H2a Consumer convenience / flexibility have significant influence on consumer adoption of frozen food products.
- H3a Variety and Cooking Skills has significant influence on consumer adoption of frozen food products.
- H4a Perception of being Unhealthy and Chemical content, as a moderator variable, has significant influence on consumer adoption of frozen food products

## 5 Results

### 5.1 Frozen food consumption and demographic profile

The percentage of consumers falling in different consumption category based on non-adoption (non-triers), medium adoption (sometimes-triers) and high adoption (frequent-triers) is reflected in Table 4. Around 54.9% respondents only indicated consumption of frozen food products though 92% of the respondents were aware about frozen food products. The demographic variables and their association (along with the strength of association) with adoption of frozen food products are represented in Table 5.

**Table 4** Percentage of Non-adopters, Medium-adopters and High-adopters for FFP

<i>Level of adoption</i>	<i>Percentage</i>
Non-adoption	29.4%
Medium-adoption	26.8%
High-adoption	43.7%
Total	100.0%

**Table 5** Association between demographic characteristics and adoption of frozen food

<i>Demographic variable</i>	<i>Chi square/fisher value</i>	<i>Degree of association</i>	<i>Strength of association</i>
City	12.813	0.169	Very Weak
Gender	20.591	0.299	Weak
Age	125.446	0.521	Moderate
No. of members in household	62.048	0.366	Weak
No. of young members in household	67.375	0.382	Weak
Household income	65.797	0.377	Weak
Education	41.697	0.300	Weak
Marital status	168.286	0.854	Strong
Employment STATUS	125.418	0.521	Moderate
Use of credit card	118.44	0.506	Moderate

Note: Primary data: significant at 0.05% level.

Larger proportion of respondents who answered the questionnaire were females ( $\chi^2 = 20.591$ ,  $p < 0.005$ ). It was noted that though negligible association was found in terms of degree of association between city and adoption, however, respondents who dwelled in urban locations were more probable to adopt frozen food products ( $\chi^2 = 12.813$ ,  $p < 0.05$ ). This was more likely because of the awareness owing to non-availability of such products in non-urban locations.

Age ranged from 15 to above 60 and all age groups represented the study ( $\chi^2 = 125.446$ ,  $p < 0.05$ ). More number of young members in the household can also be a cause of adoption ( $\chi^2 = 67.375$ ,  $p < 0.05$ ) while number of members in the household also has association with adoption ( $\chi^2 = 62.048$ ,  $p < 0.05$ ).

Household income also has a significant influence on adoption ( $\chi^2 = 65.797$ ,  $p < 0.05$ ). Results indicated that marital status significantly effects adoption ( $\chi^2 = 168.286$ ,  $p < 0.05$ ). Employment status also indicates that the working or non-working status of a consumer effects adoption ( $\chi^2 = 125.418$ ,  $p < 0.05$ ).

Consumers who use credit card more are more willing to adopt frozen food products than non-users ( $\chi^2 = 118.41$ ,  $p < 0.05$ ).

Thus, marital status has strong association, Usage of credit card, employment status and age have moderate association while education, no. of members in the household, number of young members, household income, gender and city have weak association with adoption of frozen food products.

## 5.2 Frozen food product and Influencing variables

Table 6 shows Chi-square test of independence results for individual factors to determine if there is association, along with degree of association, between the variables and Adoption.

**Table 6** Association between Influencing factors and Adoption of frozen food

<i>Influencing factors</i>	<i>Chi square/fisher</i>	<i>Degree of association</i>	<i>Strength of association</i>
Value for money (Value_Money)	99.915	0.408	Moderate
perception of being unhealthy (Unhealthy)	131.046	0.533	Moderate
Quality (quality)	240.232	0.688	Moderate to strong
Safe (safety)	197.491	0.654	Moderate to strong
Tasty (taste)	104.885	0.476	Moderate
Trust on brand (trust)	90.941	0.444	Moderate
Easy to cook and convenient	66.523	0.370	Weak to moderate
(Convenience) ease of availability (Ease_of_availability)	90.268	0.462	Moderate
Variety and novelty (Variety_novelty)	111.981	0.485	Moderate
Meet preferences of different family member (Meet_preferences)	76.627	0.395	Weak to moderate
Poor cooking skills or no interest in cooking (Cooking_Skills)	112.690	0.494	Moderate
Use mainly as Snacks (Snacks)	89.758	0.441	Moderate
Longer shelf life (Shelf_life)	75.278	0.410	Moderate
Contains chemicals (Chemical_content)	128.433	0.527	Moderate
Less cooking time (Prep_time)	181.708	0.627	Moderate to strong
Gives happiness and satisfaction (Happiness_satisfaction)	117.313	0.504	Moderate
Know about nutrient values (Nutrient_values)	68.532	0.385	Weak to moderate

Note: Primary data: significant at 0.05% level.

Table 7 presents the extracted variables and the component variables included in the extracted variables.

**Table 7** Extracted variables and its components

<i>Variable</i>	<i>Variable name</i>	<i>Component variables (in case of predictors)/values (in case of response variable)</i>
Response variable: adoption	Adopt_Y_N	1 – Adoption present 0 – No adoption
Predictors:	Prod_attrib	Value for money
X1: product attributes		Quality Safety Taste Trust Less preparation-time Happiness and satisfaction Nutrient Values
X2: Consumer convenience/ flexibility	Cons_Conv	Convenience/easy to cook Easy availability Meet varied preferences Used mainly as snacks Longer shelf life
X3: variety and cooking skills	Va_Cs	Variety Poor cooking skills / interest in cooking
Moderator variable:	Unhealthy	Perception of being unhealthy
X4: Unhealthy and chemical content	Chemical	Chemical content

### 5.3 Results of binary logistic regression model

As per the Omnibus tests of model coefficients in Table 8, the logistic regression model was found to be statistically significant at  $\chi^2 (4, N = 231) = 227.480, p < 0.05$ . Table 8 represents the Model Summary indicating the explained variation. This table contains the Cox and Snell R Square and Nagelkerke R square values, methods used for calculating the explained variation. These values are also referred to as pseudo  $R^2$  values (statistics, 2020, July). Therefore, 62.6% to 89.2% of the variance in the dependent variable Adopt\_Y\_N, is explained by our independent variables, which is good. The Hosmer and Lemeshow Test results in Table 8 depict the p-value as equal to 0.991. As per this test result, if p-value  $> 0.05$ , the values are insignificant and that is good for us. Binary logistic regression is used for estimating the probability of the occurrence of an event, in this study the event being adoption. If the estimated probability of the occurrence of the event is  $\geq 0.5$ , the event is classified as occurring according to the SPSS Statistics. If the probability is  $< 0.5$ , then the event is classified as not occurring which is no adoption in this study. According to the classification results shown in Table 9, PAC = 97.4%, which means that using our model, if we do this 97.4% times, our prediction will be correct. So, it is again indicated that our model is good. The subscript below Table 8 which states, 'The cut value is 0.500' means that if the probability of a case in 'yes'



category is  $> 0.500$ , then that case is classified into the 'yes' category else the case is classified as in the 'no' category.

Table 9 depicts the contribution of each independent variable to the model and its statistical significance. Looking at significant value, we can interpret that the predictors Prod\_Attrib, Cons\_Conv, Va\_Cs, have considerable impact on the response variable, Adopt\_Y\_N. The variable Unhealthy\_Chemical, being a moderator variable, also has significant impact on the response variable. The Wald test ('Wald' column) is used to determine statistical significance for the independent variables. From these results, we can see that Prod\_Attrib ( $p = 0.038$ ), Cons\_Conv ( $p = 0.005$ ), Va\_Cs ( $p = 0.000$ ) and Unhealthy\_Chemical-log ( $p = 0.000$ ) contributed significantly to the model/prediction. Putting it all together, we can report the results as follows: A logistic regression was performed to ascertain the effects of product attributes, Consumer convenience/flexibility, Variety and Cooking Skills, Unhealthy and Chemical content on the likelihood that consumers will adopt frozen food products. The logistic regression model was statistically significant,  $\chi^2$  (4, = 227.480,  $p < 0.05$ ). The model explained 89.2% (Nagelkerke  $R^2$ ) of the variance in adoption and thus classified 97.4% of the cases.

**Table 8** Model summary and Hosmer Lemeshow test results of binary logistic regression

Model	Omnibus test of model coefficients			Model summary results		
	Chi-square	Df	Sig.	-2Log likelihood	Cox snell square	Nagelkerke R square
Proposed	227.480	4	0.000	52.502	0.626	0.892
	Hosmer and L test results			Classification table results		
	Chi-square	Df	Sig.	Overall		
Proposed	1.575	8	0.991	97.4 <sup>a</sup>		

Note: The cut value is 0.500.

**Table 9** Results of Variables in Equation table of Binary Logistic Regression

Predictor variables	B	S.E.	Wald	Df	Sig.	Exp(B)
Prod_Attrib (Product attributes)	1.507	0.727	4.303	1	0.038	4.515
Cons_Conv (Consumer convenience/flexibility)	1.720	0.619	7.725	1	0.005	5.585
Va_Cs (Variety and cooking skills)	5.289	0.996	28.196	1	0.000	198.114
Unhealthy_Chemical (Unhealthy and chemical content)	-2.909	0.804	13.080	1	0.000	0.055

Generally, coefficients that are positive are indicative of increased likelihood of the occurrence of the event as there is increase in the predictor. Coefficients that are negative are indicative of decreased likelihood of the occurrence of the event as there is increase in the predictor (Interpret the key results for binary logistic regression, 2019). As in case of Product attributes (Prod\_Attrib), Consumer convenience/flexibility (Cons\_Conv), Variety and Cooking skills (Va\_Cs), the coefficients are 1.507, 1.720 and 5.289 which are positive. So, it can be deduced that as probability of occurrence of the event, in this case adoption of frozen food products, will increase as there is improvement (increase) in these attributes. While, the moderator variable, unhealthy and chemical content has a

negative coefficient,  $-2.909$ , which indicates that the likelihood of adoption of frozen food products, will decrease with increase in this attribute.

## 6 Findings and discussion

In a study done on organic food products (Krishnakumare and Niranjana, 2017), it was reported that there was significant association between the level of awareness and demographic characteristics however there was no indication of the consumer's level of adoption. Also, as per a study done on healthy and environment-friendly food (Hoek, 2017), consumers gave more impetus to health. According to a study on packaged food (Bhatt, 2015), health, convenience, price was considered as exerting influence on purchase of packaged food. However, as per the present study, though the awareness of frozen food products is high, as much as 92%, only a little more than 50% were adopters of frozen food products. This relates to earlier suggestions that owing to conventional food eating habits and limited availability, the percentage of consumers adopting frozen food products is not very high. It is only the big retail stores that stocked frozen food products and so only consumers visiting such stores had access to it. While a large population that meets their grocery needs by purchases through mom-and-pop stores may not have access to these products. Considering association between city and adoption, poor availability of the products along with traditional eating habits explains low or negligible adoption in consumers of non-urban locations. Whereas consumers that reside in urban locations readily experiment new food products. Single consumers more readily adopt frozen food products owing to various reasons. It is, however, apparent that all the demographic variables have association with adoption of frozen food products.

**Table 10** Summary of findings-based implications

<i>Hypothesis</i>	<i>Finding</i>	<i>Action-driven implications</i>
H1 Product level attributes has a significant influence on consumer adoption of frozen food products	The probability of adoption increases as well as more consumers will adopt frozen food products since there is increase (enhancement) in attributes of frozen food products.	The Producer and retailer need to focus on improving quality, safety, taste and trust. Nutrient values, though, is required as a quality norm, does not very strongly influence adoption. Happiness and satisfaction can be emphasized more considering hectic schedules of working population.
H2 Consumer convenience/flexibility has a significant influence on consumer adoption of frozen food products	The probability of adoption increases as well as more consumers will adopt frozen food products since there is increase in convenience and/or flexibility that consumers have by using frozen food products.	The producer can enhance convenience of cooking. Presently, frozen food products are available at big retail outlets. If reach needs to be increased, then the product should be made available at pop-mom stores as well. The products are generally sold only for snacking purposes. This can be increased to fresh vegetables and other products as well. Shelf life can further be enhanced.

**Table 10** Summary of findings-based implications (continued)

<i>Hypothesis</i>	<i>Finding</i>	<i>Action-driven implications</i>
H3 Variety and cooking skills has significant influence on consumer adoption of frozen food products.	The probability of adoption increases as well as more consumers will adopt frozen food products since there is increase in Variety and less cooking skills required for using frozen food products	The producers need to work on offering more variety for the frozen food products.
H4 Perception of being Unhealthy and Chemical content, as a moderator variable has significant influence on consumer adoption of frozen food products	Probability of the likelihood of Adoption of frozen food products decreases with increase in perception of it being unhealthy and containing chemicals.	Producers and retailers have to emphasize more on making products that are more organic/natural while working towards healthier products.

The test results of Binary logistic regression indicate that the model consisting of three predictors, Prod\_Attrib (product attributes), Cons\_Conv (consumer convenience), Va\_Cs (variety and cooking skills) and the moderator variable, Unhealthy\_Chemical (unhealthy and chemical content) is a good model being statistically significant and correct prediction 97.4% times. Also, the variables have significant influence on the response variable Adopt\_Y\_N. Improving upon Product attributes, Consumer convenience; Variety and cooking skills are associated with increased likelihood of increased adoption. However, a decrease in Unhealthy and chemical content can be significantly associated with an increase in the likelihood of adoption. Implications that are based on findings related to the hypothesis have been represented in Table 10.

## 7 Conclusions

From the logistic regression analysis employed in the study, it can be concluded that the odds of improving product attributes, consumer convenience/flexibility and variety and cooking skills are significant predictor variables and seem to indicate better adoption of frozen food products. It can also be concluded that Unhealthy perception of frozen food products and the chemical content in them can change the level of adoption from Yes to No or vice-versa.

Based on the dataset, we examined the influence of demographic variables, product attributes, consumer convenience, and variety and cooking skills and unhealthy and chemical content on the level of adoption of frozen food products. The major findings of this study are as follows: First, Marital status has strong association, Usage of credit card, employment status and age have moderate association while education, number of members in the household, number of young members, household income, gender and city have weak association with adoption of frozen food products. Second, the variables: product attribute, consumer convenience and variety and cooking skills have significant impact on adoption. Third, the variable unhealthy and chemical content acts as a moderator since it can influence the level of adoption and other variables too. Finally, our findings indicate that adoption can be influenced by the product attributes, consumer convenience, variety and unhealthy and chemical content.

Firms must lay emphasis on value-based promotion as it is shown to influence consumer perception about a product (Joy et al., 2014). Customer satisfaction certainly has impact on a firm's performance (Ling et al., 2009). For improving the consumer adoption and enhancing consumer satisfaction, the cold chain will have to be strengthened and its performance enhanced. This will strengthen the different cold chain partners like farmers, cold storage and logistics service providers, retailers, etc. The different firms can thus learn from the study and focus on increasing consumer adoption benefitting not just them but all the cold chain partners involved. There will also be significant reduction in waste, energy consumption making the cold chain more sustainable too. Thus, it will help not only the cold chain partners but also will contribute towards economy of the nation.

### 7.1 Limitations and future research

The study can be of help to the producers, marketeers and retailers and other supply chain partners to plan their product development, marketing and distribution strategies accordingly and focus on those aspects which will help increase the consumer adoption of frozen food products. In interpreting our findings, it is important that we mention about the limitations in our study, which point to future research directions. The list of influencing variables is not fully exhaustive. For example, traceability, sustainability, traditional beliefs also can be considered for further research. Future research can benefit by examining more comprehensive number of variables influencing adoption with more study done on the influence of control variables. Also, since the data collected was online and it was during the COVID-pandemic, the responses could be biased. The researchers are encouraged to collect data from both online and offline modes so as to avoid response biasness. Also, other models like SEM can be considered for an exhaustive research on the factors and its various aspects.

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