



Knowledge and Awareness of Artificial Food Colours and its Impact on Nutrition and Health Among Adolescent Population

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ABSTRACT

Food serves as the primary factor for human survival. Various types of foods are consumed by different people of various localities. For children and adolescents, the food is consumed predominantly by its colour. Unfortunately, the natural colours of food are not maintained as such and are altered by using several non-permissible artificial food colour additives. A large body of laboratory research has demonstrated that changing the intensity/saturation of the colour of food and beverage items can exert a sometimes dramatic impact on the expectations, and hence on the subsequent experiences, of consumers (or participants in the lab). However, should the colour not match the taste, then the result may well be a negatively valenced disconfirmation of expectation. The study was designed to find the impact of colour of food in nutrition consumption among 100 participants. In our study, 58% male and 42% female participated, out of them 60% are undergraduates, 29% are graduates, 8% are postgraduates and 3% are uneducated. 75% of the population says colour of food affects nutritional consumption. 63% answered nutritional value of food is dependent upon its colour. The study found that the colour of food can cause an impact on nutritional consumption of health among the adolescent population. As prevention is better than cure, it is essential to implement certain rules or law to evaluate the frequency of using toxic non permitted colour as well as permitted colours and also to prevent ill effects on using both synthetic colour (non-permitted colours) and permitted colour above permissible law to improve health among the population.



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INTRODUCTION

Colour is the most important product that produces sensory information when it comes to people's expectation regarding flavour of food and drink. Consumers have the opportunity to accept food and drink, especially before deciding on whether to buy or not that product (Spence and Piqueras-Fiszman, 2014). A growing body of scientific research has now suggested that our experience of taste and flavour is determined largely by expectation that we generate automatically before tasting (Siagian

et al., 2015). Artificial food dyes are responsible for bringing colour of candy, soft drinks and baked soda (Anitha and Devi, 2017). They are often used in certain bread, smoked salmon and salad dressing as well as mediterranean. In fact, artificial food dye consumption has increased by 50% in the last 50 years, and children are the biggest consumers (Sekar *et al.*, 2019). Some artificial food dye used for colour of food can cause allergies reactions and many other problems (Arnold *et al.*, 2012). Although there are many reasons for the increase in prevalence of obesity (Menon and Thenmozhi, 2016) frequency of consumption of unhealthy food due to its colour is an important risk factor (Ashfaq and Masud, 2002). Ross, et al., conducted research in visceral masking technique of two wise by trained assessors. Their study was based on a technique called colour masking. Masking uses colour variants to distinguish them in order to minimize sensory perception of evaluation and analytical. The importance of sensory perception of colour is related to food choice is validated through a variety of studies conducted by different researches (Ross *et al.*, 2008).

A recent paper by Schuldt, 2013 tested the automatic influences of colour of nutritional labels on people's perceptions of food healthiness. Schuldt tested the hypothesis that a green nutritional label promotes inferences of a healthier product, compared to an identical nutritional label coloured in red (Schuldt, 2013). Researchers have reported that people judge the freshness of fish, in part, based on the luminance distribution (the glossiness) of fish eyes. The luminance distribution also appears to be important for judging the freshness of certain fruit and vegetables as well. The influence of visual food texture on people's sensory perception and consumption behaviour has also been studied by researchers (Murakoshi *et al.*, 2013). Different studies revealed that analysis of various food products with respect to the added colours showed that concentrations of food colours in different food products ranges from 15-20 mg/kg, which was within the minimum permissible limit. It was found that a few foods manufactured by unorganized private sector and small vendors contain colours in higher concentration than permitted range (Knights, 1994). Many of these dyes were originally derived from coal tar and were commonly called coal-tar dyes, they contain the azo group. Colour chemicals are by definition active chemicals hence require greater care than bland additives such as emulsifiers (Krishna and Babu, 2016). Natural food colours are extracted and isolated from different plants and animals as they have no harmful effect so they can be used in

any food in any amount. These colours are less stable, less bright and not uniform but they are very expensive. Moreover, it is also difficult to find the exact shade required for different food products. Most of the food colours tested in conventional toxicity experiments showed toxic effects at a very high level of intake that was not normally encountered. Human studies indicated that food colours could induce a wide range of allergic reactions only in sensitive individuals (Bidinger *et al.*, 1986).

The overall conclusion of study was the visceral sensory perception of the product may influence nutrition consumption of the population. The aim of the study is the impact of food colour on nutrition and health among the adolescent population.

MATERIALS AND METHODS

The study was designed to find the impact of colour of food in nutrition consumption among 100 participants. A well-structured questionnaire containing basic information like personal details, socio-economic information, frequency and awareness on nutrition labelling was prepared and circulated through online. Both male and female subjects of the adolescent South Indian population were selected. Online based survey study, no human or animal ethical needed (Hafeez and Thenmozhi, 2016). The sample collection was a random sampling method. The data was collected among the age group of 16 - 47 years. 10 questions were prepared and uploaded on an online survey planet. Statistical software used was SPSS IBM version 20.0. Statistical analysis used was descriptive statistics of frequency distribution. The correlation analysis used was the Chi-square test. All the data were collected and was analyzed statistically and graphically represented.

RESULTS AND DISCUSSION

Survey conducted among age groups of 10-19 years (Figure 1). In our study, 58% male and 42% of participants were female (Figure 2). 75% of the population says the colour of food affects nutritional consumption (Figure 3). Most of the participants answered that, red 39%, yellow 33% and 18% assured white colour of food has high nutritional value (Figure 4). 74% answered that, addition of artificial colours to food could cause nutritional problems (Figure 5) (Sriram *et al.*, 2015). 83% percent of the population answered that package colour of food could affect (Figure 6). 84% of the population answered that colour of food stimulates appetite (Figure 7).

The association between gender and awareness of

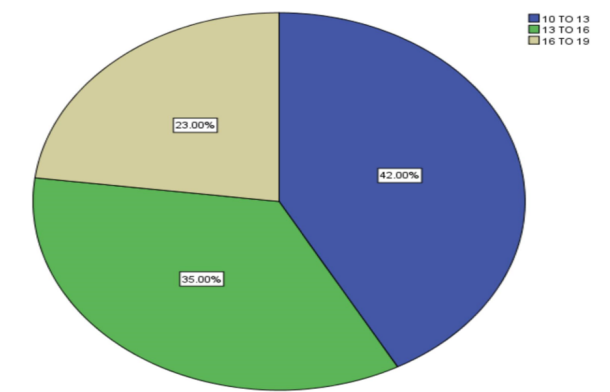


Figure 1: Pie charts showing frequency distribution of age of the participants

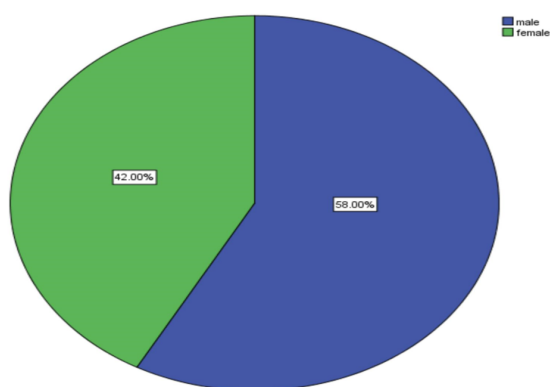


Figure 2: Pie charts showing frequency distribution of gender of the participants

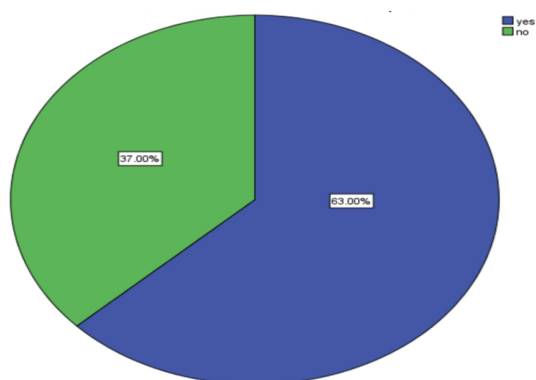


Figure 3: Pie charts showing frequency distribution of responses on the awareness of colour of food affecting nutrition consumption

colour of food affecting nutritional food consumption was done (Figure 8). It was found that 43% of male responded that they are aware, but only 32% of females responded they are aware. This indicates that adolescent males were more aware of the colours of food affecting nutritional food consumption than females but was not statistically significant ($p>0.05$).

The association between gender and participant

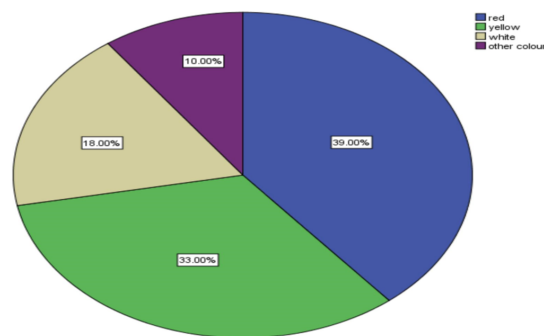


Figure 4: Pie charts showing frequency distribution of responses of colour of food with high nutritional value

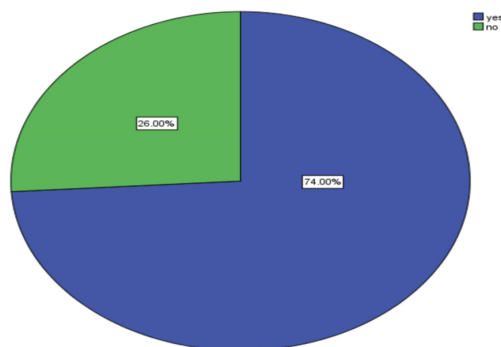


Figure 5: Pie charts showing frequency distribution of awareness on addition of artificial colours to food cause health problems

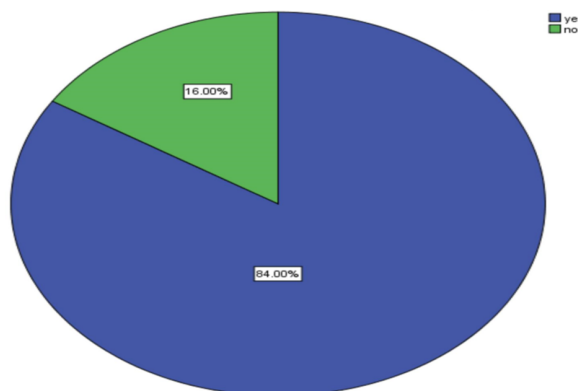


Figure 6: Pie charts showing frequency distribution of responses of colour of food on stimulation of appetite

responses on the awareness of colour of food having high nutritional value was done (Figure 9). It was observed that 22% of male responded that they preferred red food colour, but this was less when compared to females who preferred red food colours to only 17%, indicating that there was a difference in the responses between adolescent male and females on colour of food with high nutritional value but was not statistically significant ($p>0.05$).

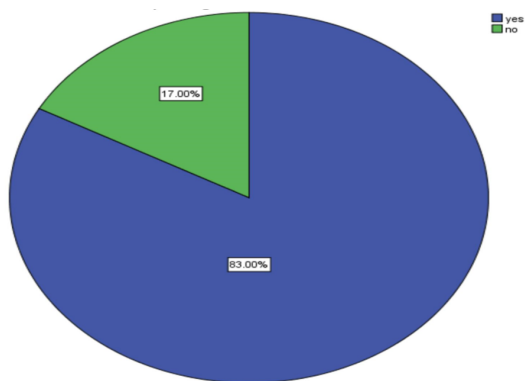


Figure 7: Pie charts showing frequency distribution of responses of package colour of food affects choice of food

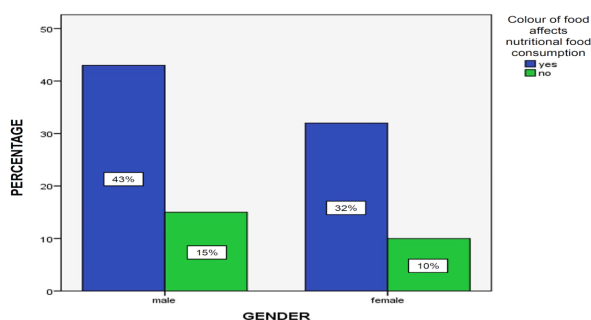


Figure 8: Bar chart showing the association between gender and awareness of colour of food affecting nutritional food consumption

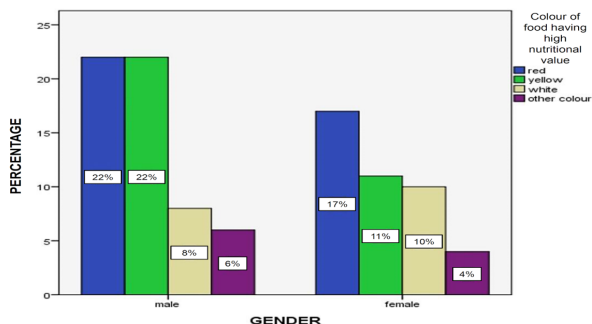


Figure 9: Bar chart showing the association between gender and participant responses on the awareness of colour of food having high nutritional value

To analyse the association between gender and participant responses on the awareness of addition of artificial colours to food causes health problems Chi-square test was performed. 42% of male responded 'yes' that they are aware, but only 32% of females responded that they are aware indicating that there was a difference in the responses between adolescent male and females on the awareness that addition of artificial colour to food causes health prob-

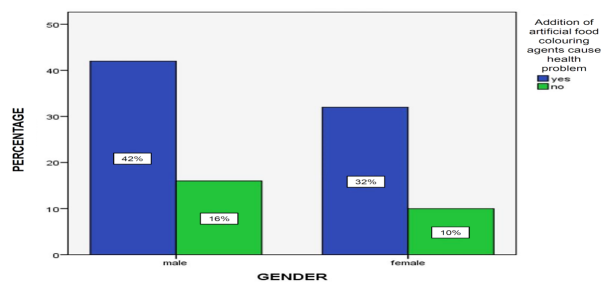


Figure 10: Bar chart showing the association between gender and participant responses on the awareness of addition of artificial colours to food causes health problems

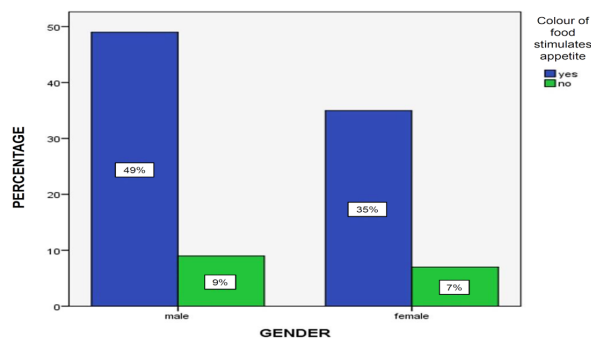


Figure 11: Bar chart showing the association between gender and participant responses on the colour of food stimulating appetite

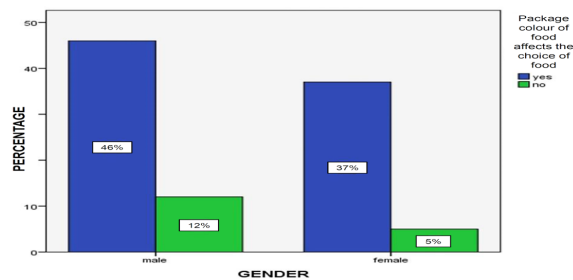


Figure 12: Bar chart showing the association between gender and participant responses on the package colour of food affects choice of food

lems but was not statistically significant ($p > 0.05$) shown in Figure 10.

The association between gender and participant responses on the colour of food stimulating appetite was carried out (Figure 11). X-axis represents gender and the Y-axis represents the percentage of responses of the participants. 49% of adolescent males responded 'yes' and only 35% of female participants responded 'yes' indicating that there was a difference in the responses between adolescent male and females that colour of food stimulates appetite but was not statistically significant ($p > 0.05$).

Figure 12 depicts the association between gender and participant responses on the package colour of food affects choice of food. 46% of adolescent males responded 'yes' but only 37% of female participants responded 'yes' indicating that there was a difference in the responses between adolescent males and females. Thus for males, package colour of food affects choice of food more than females and was statistically significant ($p < 0.05$).

The study evaluates the relation between the colour of food on nutritional consumption and found that, there is relation between food colour. Package colour of food and addition of artificial flavour to food can cause impact in nutritional consumption (Pratha and Thenmozhi, 2016).

Intense colour and uniform colour, cheap and easy blending synthetic food are widely used in the modern food industry as important products (Purba and Shukla, 2015). Natural or synthetic colour can induce wide range of adverse relation in sensitive individual and some of non-permitted colour consider as carcinogenic in nature (Suryanarayana et al., 2017). The overall label in food produced has limited effect on perception and it has no effect in choice of snacks was concluded by some studies (Crockett et al., 2011). Emotions on nutritional labels yield a stronger effect on perception of snacks than colour labels (Potera, 2010). The study was done by Carol p et al. shows consumption of artificial food dye increased by 50% in last 50 years. The most popular dye used are red 40% and yellow 5 and yellow 6. These dyes make upto 90% of all food dyes in the United States (Varma and Prasad, 2018).

Packaging colour, printed information, packaging material, design of wrapper, broad image that helps consumers in their decision in the buying process. Some study shows that there is an association between artificial food dye and hyperactivity in children (Johnson et al., 2020). More recently, the potential role of adding food colouring in marketing was demonstrated by the dramatic rise in sales of tomato ketchup when Heinz decided to add a tiny amount of food colouring and turn this staple of the dining table green (Space Research Today, 2018). Other large drink brands that have, in recent years, launched drinks in unusual colours include an amber-coloured cola, called Pepsi Gold, in India (Thejeswar and Thenmozhi, 2015).

Genetic differences may play an important role in determining just how much of a role colour plays in flavour perception (Garber et al., 2016). Some people have far more taste buds than others (the former are known as supertasters, the latter, non-tasters) with 25% of the population falling into each

category (Subashri and Thenmozhi, 2016). The remaining half of consumers fall into an intermediate group, known as medium tasters (Bartoshuk, 2000). Over the years, there has been ongoing concerns expressed about the negative health (Nandhini et al., 2018) and well-being consequences that are apparently associated with the consumption of certain artificial food colourings, despite their being rated as being safe and tasteless (Keerthana and Thenmozhi, 2016; Nandhini et al., 2018). This causes some customers to buy food that is free from all colours (Harris, 2018). Nowadays, more consumers are concentrated on label information, so it leads to health and nutrition issues (Coulson, 2000). The material used in packaging is an important element which prevents the product from any damage or loss (Samuel and Thenmozhi, 2015). It is more likely that the high quality material might attract customers more than low quality material. So, packaging material has a strong impact on buying behaviour (Coulson, 2000).

Health care providers need to be aware of this, which is necessary to identify the harmful effect of addition of artificial food colours. It is important to make people select the food based on nutritional value and not based on colour of food (Coulson, 2000; Choudhari and Thenmozhi, 2016; Kannan and Thenmozhi, 2016). Limitation of our study is number of subjects selected for our study. The knowledge of population to answer the questions is also the main limitation of the study. Because of lack of information regarding the association between food colour and nutrition consumption, people suffer from health diseases (Seppan et al., 2018). Future scope of our study is to create awareness among people about the addition of artificial colour to food and its impact and selection of nutrition and healthy food.

In Figure 1, 42% of participants belonged to the age group 10-13 years (blue colour). 35% of participants belonged to age group 13-16 years (green colour). 23% (yellow) participants belonged to age group 16-19 years (green colour). Participants of age ranging from 10 to 13 were more in the study. In Figure 2, 58% were male participants (blue colour) and 42% were females (green colour). Male participants were more in this survey study. In Figure 3, 63% (blue) answered nutritional values of food depend on its colour and 37% (green) answered nutritional value does not depend on colour of food. More participants responded that the colour of food affects nutrition consumption. In Figure 4, 39% answered red colour of food (blue), 33% yellow colour of food (green), 18% white colour of food (white), 10% preferred other colours of

food (purple) having high nutritional value. Comparatively red food colour was the most preferred colour among the participants. In Figure 5, 74% (blue) answered artificial colour can cause nutritional problems, 26% (green) answered artificial colour does not cause any nutritional problems. Most participants are aware that addition of artificial colours to food cause health problems. In Figure 6, 84% (blue) answered colour of food stimulates appetite and 16% (green) answered colour of food does not affect appetite. More participants responded that the colour of food stimulated their appetite. In Figure 7, 83% (blue) answered package colour of food affects choice of food and 17% (green) answered package colour of food does not affect choice of food. More participants' preference of packed foods depends on its package colour. In Figure 8, X-axis represents gender and the Y-axis represents the percentage of responses of participants. 43% of male responded that they are aware, but only 32% of females responded they are aware. This indicates that adolescent males were more aware of the colours of food affecting nutritional food consumption than females but was not statistically significant. Chi-square test showing $p=0.815$ ($p>0.05$) indicating statically not significant. In Figure 9, X-axis represents gender and the Y-axis represents the percentage of responses of the participants. 22% of male responded that they prefer red food colour, but this was less when compared to females who preferred red food colours to only 17%, indicating that there was a difference in the responses between adolescent male and females on colour of food with high nutritional value but was not statistically significant. Chi-square test showing $p=0.488$ ($p>0.05$) indicating statically not significant. In Figure 10, X-axis represents gender and the Y-axis represents the percentage of responses of the participants. 42% of male responded 'yes' that they are aware, but only 32% of females responded that they are aware indicating that there was a difference in the responses between adolescent male and females on the awareness that addition of artificial colour to food causes health problems but was not statistically significant. Chi-square test showing $p=0.671$ ($p>0.05$) indicating statically not significant. In Figure 11, X-axis represents gender and the Y-axis represents the percentage of responses of the participants. 49% of adolescent males responded 'yes' and only 35% of female participants responded 'yes' indicating that there was a difference in the responses between adolescent male and females that colour of food stimulates appetite but was not statistically significant. Chi-square test showing $p=0.877$ ($p>0.05$) indicating statically not significant. In Figure 12, X-

axis represents gender and the Y-axis represents the percentage of responses of the participants. 46% of adolescent males responded 'yes' whereas only 37% of female participants responded 'yes' indicating that there was a difference in the responses between adolescent males and females. Thus for males, package colour of food affects choice of food more than females and was statistically significant. Chi-square test showing $p=0.048$ ($p<0.05$) indicating statically significant.

CONCLUSION

Based on the survey conducted we can conclude that most people are aware of food colour additives in their food and also majority of the adolescent population are aware of these food colouring agents causing negative impact on health. But, they are not much aware about the underlying complications when they consume it more frequently without any limit. As prevention is better than cure, it is essential to implement certain rules or guidelines to evaluate the use of toxic non permitted food colours as well as permitted food colours. And also the government should inspect this scenario periodically through local governing bodies to prevent the ill effects of using both synthetic colours (non-permitted colours) and permitted colour above permissible law to prevent any health issues among the population. Moreover, as the children and adolescents are not mature enough to understand the condition it is the responsibility of adult and aged people to educate them to avoid consumption of unnecessarily coloured unhealthy foods often and to habituate them to eat naturally coloured healthy foods.

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Conflict of Interest

The authors declare that there is no conflict of interest for this study.

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