



Impact of Food Literacy on Consumer's Food Purchasing Habits and Dietary Intake - A Systematic Review

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ABSTRACT

Introduction: A well-nourished population represents the sustainable development of a nation. Poor alignment between food intake and dietary recommendations results in consumption of high calorie, low nutrient dense foods.

Aims & Objectives: The main goal of this study is to find the relation between food literacy and dietary intake. Secondly, to assess the influence of food literacy on food purchasing habits.

Place and duration of study: For this review, collection of studies from PubMed and Cochrane databases was started in May 2020 and was finalized by June 2020.

Material & Methods: The eligibility criteria were based on two factors; that the study be written in English and published through a peer reviewed journal. Through the database search, total 673 studies were identified. After checking studies thoroughly at various steps, only 26 were included in this review.

Results: 11 studies claimed the link between food label reading and intake of nutrients, while there were 10 studies that measured the consumer's purchase and food choices by their awareness level about food labels.

Conclusion: This systematic review demonstrates nutrition education to be directly correlated with the food-related habits of people. Further research is required to get a clear vision about knowledge of nutritional labels and its effect on real life dietary choices.

Keywords: food literacy, dietary intake, food purchase, nutrition label

INTRODUCTION

Industrialization of the food system has increased the prevalence of food retail stores, which in turn has brought the change in the food supply affecting the food availability, affordability and quality¹. The change in the food supply has the direct impact on the overall dietary quality of the people as the low cost, high energy and nutrient deficient food is readily available and accessible for the people. The change in the eating pattern suggests the poor alignment between the food intake and dietary recommendation. The food consumed based on dietary choices is an area of concern as well because unhealthy dietary choices can lead to various health problems.

It is well established that food literacy has a significant influence on eating patterns². Food literacy basically consists of food skills, ability to purchase and share the food related information but this can only be beneficial with healthy food access³. It is the connection between food, health, and environment. Food literacy is an interactive,

functional, and critical ability of individuals to improve their health by managing dietary information. Food literacy is further important as it helps the consumer identify healthier products. Knowledge about health-related claims has a direct impact on food purchasing habits and dietary intake of individuals as well. Moreover, knowledge about food labels and health related claims makes it easy for individuals to shift towards the healthier food intake and alter their daily dietary intake of food and nutrients. It also influences food purchasing habits of individuals. Therefore, people having knowledge about food are more likely to opt for healthy food items while poor literacy rate and awareness amongst masses deters the attainment of healthy lifestyle and impacts overall health of the populace. Various researchers have found a link between diet related problems and the poor knowledge about the food and food system⁴.

Food purchase is also affected by different marketing strategies that impact the food purchase and hinder the effect of food literacy⁵. A possible aspect can be the misinterpretation of food labels. A positive relation between the nutrition label use and

healthier food choices has been reported in research studies. The consumers who use the nutrition labels are influenced by them and usually purchase the healthier products⁶.

The main goal of this study is to find the relation between food literacy and dietary intake. Secondly, to assess the influence of food literacy on food purchasing habits (Fig1). To examine the relationship between food literacy, dietary intake and purchase, standardized measurement tools can be used in various settings.

MATERIAL AND METHODS

Identification of Studies:

The search strategy was designed to collect the studies based on the impact of food literacy. No specified term related to study design, characteristics of participants and study settings were included in the search strategy keeping in view the broad aspect of the topic to be studied. The collection of studies was started in May 2020, and it was finalized by June 2020. We searched PubMed and Cochrane databases. The eligibility criteria for the studies to be included in this systematic review were based on two factors; the study had to be in English language and published by a peer review journal. There was no restriction of data on the search.

Selection of Studies:

Selected studies included the controlled experiment, longitudinal studies, and correlational studies. The controlled experiment studied the impact of food literacy of participants on the food purchase and dietary intake. The studies that examined the impact of food literacy on the dietary intake of participants over the period were also included. Moreover, the articles that showed the association between food literacy and food purchasing behavior were also a part of this review. There was no restriction on the demographics of the participants under study.

Studies that reflected the change in eating and purchasing behavior due to some diseases were not included. Not a single database was considered that was based on purchasing behavior of specific disease related food or food for special conditions.

Data Extraction, Synthesis and Analysis:

The results of the compiled database were imported to Endnote X9. Three researchers completed the first pilot search and looked for any duplicates. They keenly observed the inclusion and exclusion criteria and removed the irrelevant studies accordingly. After the pilot search was done, the

other two researchers gathered the full form of articles; read them carefully and included only the relevant studies. All the data was carefully monitored and extracted based on these variables. This study includes all those studies that depicted the impact of nutrition knowledge and motivation of consumers behind dietary choices and food purchase. It also includes the results showing negative or positive association of the nutrition label reading with food intake, food purchase, food choices and consumer's perception. After the collection of data, two researchers formulated the Excel sheet of extracted data. This spreadsheet on Excel was divided into different columns that contained information regarding the studies. Any modifications or ambiguities related to data were discussed with the team members until consensus was reached.

Conceptual Framework:

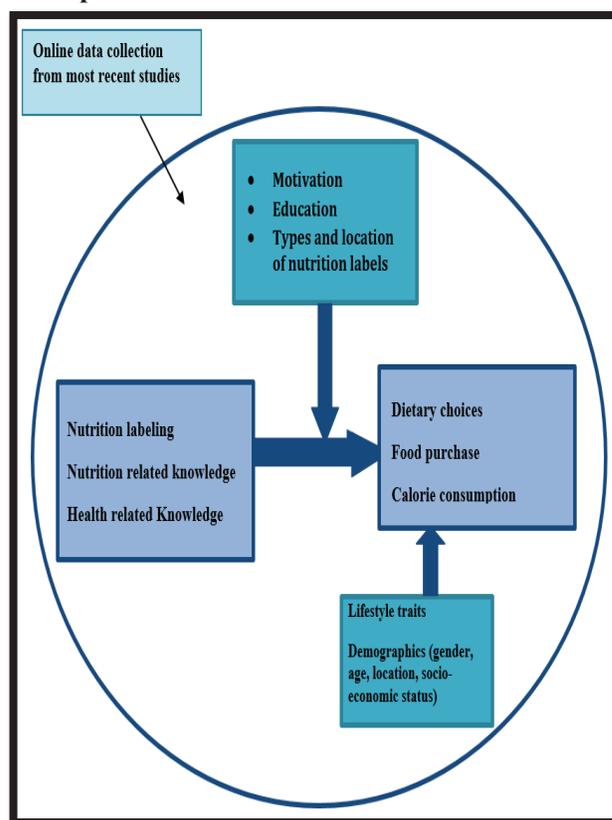


Fig-1: Conceptual Framework

RESULTS

Results of search:

The research yielded 671 studies in total by using both Cochrane and PubMed. After removing duplicates only 339 records were included. After screening the studies at various steps, only 26 were included in the systematic review. The prisma flow

diagram of the study selection process is shown in Fig-1.

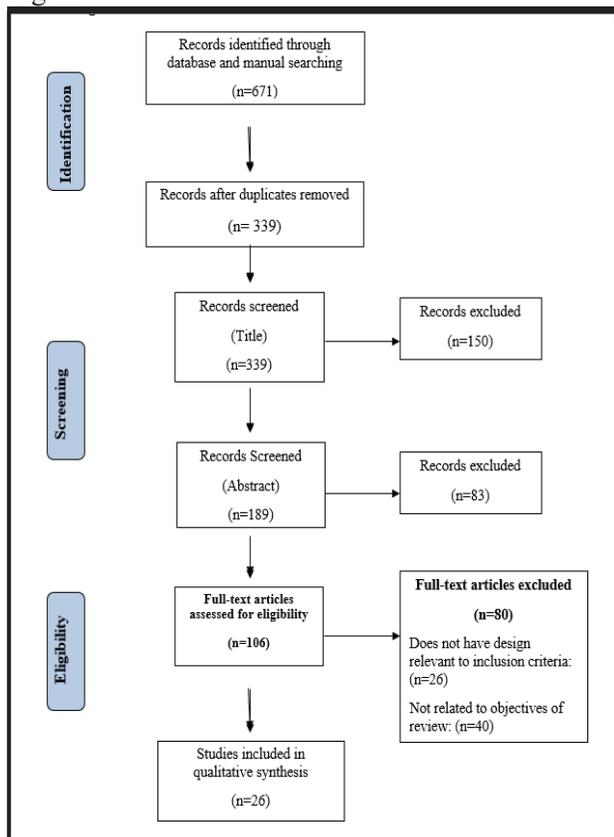


Fig-2: Prisma flow diagram showing stepwise inclusion of articles for systematic review

Type of Studies:

European and North American studies were most common. Studies from the European region included single studies from Switzerland, Italy, and Spain each and also 4 studies from the UK. North American studies included 2 studies from California, 4 studies from New York, 2 studies from New Zealand, 5 studies from the USA and 2 studies from Canada. Oceania studies included 2 studies from New Zealand and four studies from Australia. Asian studies included single studies from Korea and Baltimore each.

The two studies from New York self-reported the use of nutrition labels and watching videos about food labels. Italy, Korea, New York, and California used correlational study design to check the effectiveness of different food labels. Randomized control trial study was done by New Zealand, Spain, USA, Canada and New Haven. Two studies from the USA used experimental designs to experiment with web-based food label training in college students and the effect of different FOP food labels. Two studies from the UK conducted interviews and questionnaires to check the label understanding and perception. Single study from Switzerland explored

the awareness level of food label reading in employees.

Type of Claims:

There were 11 studies that claimed the association between food label reading/understanding and intake of nutrients and calories. Nutrient intake was measured in terms of total daily intake of fats, salts, sodium and potassium. There were 10 studies that analyzed the consumer's purchase and food choices by measuring the awareness level of food label reading. Food choices included healthy beverages, snacks, dietary choice and purchasing. Respondent or consumer understanding and health perception were measured in 4 studies.

Outcomes:

Effect of Nutrition Labeling on Dietary Choices, Nutrient Intake and Food Purchase:

From this review, nine studies demonstrated that the dietary choices of consumers were impacted by nutrition labeling or assessment. Out of them four studies presented that nutrition labels increased the healthier food choices. The study showed that the people who used the labels, consumed less sodium and less salty snacks were available at their homes⁷. It was also reported that there was a relation between the front of pack, objective, food label use with the individual readiness to reduce the saturated fat intake, increase the fruits and vegetable consumption and overall healthy nutrient intake⁸. The study showed that the training of students regarding the label use increased their healthful food choices and feeling of empowerment⁶. Some studies revealed that there was no impact of nutrition labels on food choices^{9,10} whereas some of them showed that nutrition labels increased healthier food purchasing ability^{11,12}.

One of them showed that the evaluative and reductive FOP labels were more effectual for snacks nutritional assessment rather than ones with no label¹³. Outcome of another study revealed likelihood of healthier choices when labels were modified. It showed that modification of nutrition labels increased attention and promotion of healthier food choices but there were no significant differences found¹⁴.

Six studies presented that different types of Front-of-package (FOP) labels might impact food choices, energy intake and food purchase. Two of them revealed that the Multi-Traffic Light Guideline Daily Amount (MLT-GDA) system was more effective in making healthy food choices as compared to MTL-GDA system¹⁵. In addition, the Nutriscore and MTL labels were more effective than the other three FOPLs. One of them showed that energy intake was decreased when P.A based labels

were used as compared to kcal based labels¹⁶. P.A labels were likely to be used for policy choices. Some studies had different interpretations. A study reported that understanding of HSR group labeling was easy for consumers, so Health Star Rating (HSR) label group purchases were increased as compared to MTL, Daily Intake Guide (DIG) and warning (WARN) labels¹⁷.

Nutrient Intake and Calorie Consumption Impacted by Nutritional Knowledge:

Total three studies reported that nutritional knowledge is likely to impact the nutrient intake and use of food labels while purchasing. Two studies had two different outcomes which showed that increased consumer's knowledge about health and diet increased the use of food labels while purchasing¹⁸. Another outcome depicted that 87.5% respondents (UK) identified healthier products because of increased nutritional knowledge. Hence, nutrition knowledge is highly associated with understanding the information related to nutrition present on food labels. In total, 2 studies reported that nutrition labels are likely to impact total energy intake of consumers as well. Men were more likely to consume low fat/energy foods than women. Another study showed that nutrition labels caused decreased energy consumption¹⁹. To reduce energy

intake, the use of nutrition labels was supported by this study.

Impact Of Nutrition Related Knowledge and Motivation on Dietary Choices and Food Purchase:

Analysis of 2 studies results showed that educational intervention promotes healthier food purchases. Whereas 20 studies presented the results that Sodium (Na) and Potassium (K) has positive association with gender and waist/hip ratio but no significant association with health literacy scores²⁰. Similarly, the other study concluded the same results showing that food purchase was enhanced by educational intervention so it can lead to positive changes in improving food-purchasing choices²¹. Motivation of consumers to purchase healthy food rested on their attention towards nutritional labels. One study estimated that enhanced motivation of consumers to buy healthier foods subsequently promoted the consumer's interest to read food labels²². This study showed the association between two variables. One was nutritional symbols and logos on FOP and the other variable was ability, motivation while looking at areas of food packaging.

Result of Eligible Studies:

Sr. no	Variables	Frequency	Reported in studies	Results	Explanation
1.	Dietary choices impacted by nutrition labeling or assessment	n-9	(7), (8), (23), (6), (9), (10), (14), (12), (24)	*Increased food choices= n-4 (7), (8), (23), (6) *no impact= n-2 (14), (12) *increased food purchase= n-2 (9), (10) increased nutrition assessment= n-1 (24)	Out of them, most of the studies presented that nutrition labels increased healthier food choices while some studies revealed that there was no impact of nutrition labels on food choices. Some of them showed that nutrition labels increased healthier food purchasing ability. One of them showed increased effective nutritional assessment of snack products
2.	Label formats modification lead to healthier choices	n-1	(11)	*No difference	This study showed that modification of nutrition labels increased attention and promotion of healthier food choices but there were no significant differences found.

Sr. no	Variables	Frequency	Reported in studies	Results	Explanation
3.	FOPL may impact food choices, energy intake and food purchase	n-6	(15), (16), (17), (25), (26), (27)	<p>*MLT-GDA more effective than MTL-GDA system= n-2 (15), (25).</p> <p>*Nutri-score, MTL labels more effective than 3 FOPL s= n-2 (15), (25)</p> <p>*Energy intake decreased when physical activity (P.A) based labels used = n-1 (16).</p> <p>*HSP purchases increased as compared to MTL, DIG, WARN Labels= n-1 (17).</p> <p>*Purchases increased by using graphic warning labels while decreased by using SSB warning labels= n-2 (26), (27)</p>	<p>Some studies revealed that Multi Traffic Light Guideline Daily Amount system was more effective in making healthy food choices as compared to MTL-GDA system. Also Nutri-score and MTL labels were more effective than other three FOPLs.</p> <p>One of them showed that energy intake was decreased when P.A based labels were used as compared to kcal based labels.</p> <p>Another study reported that understanding of Health Star Rating group labeling was easy for Consumers, so purchase was increased as compared to MTL, Daily Intake Guide and warning labels.</p> <p>Other studies reflected that purchase was increased by using Graphic warning labels and decreased by using sugar sweetened beverage warning labels.</p>
4.	Nutritional knowledge impact on nutrient intake and usage of food labels while purchasing	n-3	(18), (28), (29)	<p>*increased knowledge, diet and use of labels= n-2 (18), (29).</p> <p>*No impact on total fat intake= n-1 (28)</p>	<p>Most of the studies reported that increased knowledge about health also increased the use of food labels as well as identification of healthier products while another study revealed that nutritional knowledge had no impact on total fat intake.</p>
5.	Impact of nutrition labels on total energy intake	n-2	(30), (31)	<p>*Increased food Consumption= n-1 (30).</p> <p>*Decreased energy consumption= n-1 (31)</p>	<p>Results of one study showed that men were more likely to consume low fat/ energy foods than women. The other study revealed that nutritional labels cause decreased energy consumption</p>
6.	Impact of educational intervention on increased food purchasing choices and knowledge	n-2	(20), (21)	<p>*No association= n-1 (20).</p> <p>*Increased food purchase = n-1 (21)</p>	<p>A study presented the result that Na and K has position association with sex and waist /hip ratio but no significant association with health literacy. Another study concluded that food purchase enhanced by educational intervention</p>
7.	Calories information	n-2	(32), (33)	<p>*Individuals had caloric information= n-1 (32).</p> <p>*Decreased caloric intake= n-1 (33)</p>	<p>In one study, few individuals were able to calculate calories when the consumption of 260 calories were observed. On the other hand, another study represented that calorie label information decreased 250 calories intake of consumers at restaurants</p>

Sr. no	Variables	Frequency	Reported in studies	Results	Explanation
8.	Attention towards nutritional labels through motivation inclined to purchase healthy foods	n-1	(22)	*Increased motivation	The study reflected that enhanced motivation of consumers to buy healthier foods subsequently promoted their interest to read food labels.

Table-1: Results of Eligible Studies

Summary of Studies:

Sr. No	Author	Region	Study design	Target Group	Exposure variable	Outcome Variable	Major findings	Conclusion
1.	20	Switzerland	Exploratory and hypothetical	145 employees with age ranging between 15 to 65 working in one of eight social services or public service organization	Sex, health literacy, salt awareness, and hypertension measured by linear regression	Mean salt and potassium intake (g/day), Na and K ratio Measured by 24 hour urine analysis	Salt and K intake was associated with sex ($p < 0.001$ each), waist-to-height ratio ($p = 0.03$), Age ($p = 0.02$), Awareness variable "impact of salt content on food choice" was linked with salt intake ($p = 0.005$).	It is highly recommended to increase the health-based knowledge, skills and abilities about salt and K amongst the working people of Switzerland to fill the gap between knowledge and dietary practices.
2.	7	New York	Correlational study design	The target group was NHANES participants who took part in two 24-hour dietary recalls (N=9,982). 7,040 adult participants with age ≥ 20 years composed the final sample.	Use of nutrition labels while purchasing a food product was self-reported	1. Daily Na intake estimated by mean usual daily Na intake 2. Availability of Na rich snacks at home 3. Frequency of frozen meals intake	Individuals using nutrition related labels frequently took 92.79 mg lesser Na per day (95% CI=-160.21, -25.37), they were also less likely to have salty snacks at home, but consumption of frozen meals was same as infrequent nutrition label users (incidence rate ratio =0.96, 95% CI=0.84, 1.08).	Use of nutrition label is linked with moderately lower dietary sodium consumption

Sr. No	Author	Region	Study design	Target Group	Exposure variable	Outcome Variable	Major findings	Conclusion
3.	8	California	Correlational study	Stratified cluster sampling to enlist 1891 families in the Sacramento area in 2013–2014 with publicly accessible contact numbers. Final sample contained 358 individuals, aged 20–78, mean age = 49.9.	Objective food label use was operationalized during a mock shopping task. Individuals were shown the fronts of two packaged foods, each having fops that varied in nutrient composition and eye-tracking methodology was used to monitor their eye movement.	It included participant's willingness to lower saturated fat and junk food intake and raised vegetable and fruit intake. Nutrient consumption was measured by the Automated Self-Administered 24-h Dietary Recall System (ASA24).	The stage of change lowered the predictive power of subjective food label use ($p < 0.09$), but not the objective one ($p < 0.01$). Both objective and self-reported measures of food label use are positively linked with diet quality.	It was found that abbreviated nutrition information on package fronts is essential for health-conscious consumers.
4.	23	Korea	Correlation study Measure by multiple logistic regression	Citizens and families residing in the Republic of Korea n=13924	Intake of nutrients measured by 24-hour recall	Nutrition label users by multiple regression analysis	Relation between nutrition labels use and eating habits through KNHANES data.	Reading of Nutrition label was significantly high amongst the youth, women, and individuals with high education and household income
5.	6	New Zealand	RCT	1357 household shoppers having smart-phones 18years or above	Effects of 2 interpretive nutrition labels compared with a non-interpretive label on consumer food purchases	Packaged beverages and foods purchased over the four-week intervention period were measured by NPSC	Participants exposed to HSR and TLL had significantly better NPSC scores	Individuals who used interpretive labels found them to be relatively more useful
6.	9	United States	Experimental design	44 college students (26 females and 18 males) between age 18 to 20	Web based food label training by IPR framework	Perception of health food choices Measured by Paired t-test	Increases in accuracy of label reading with training, raise in healthy food intake empowerment scores	Training of Label-reading was linked with increased empowerment related to healthy food choices.
7.	18	Italy	Correlation and measured by strata program	No selection criteria limited the participation n= 340	Consumer knowledge and perception about food labels	Recognition of healthier product purchasing	On average, customers care the most about the global quality of product rather than the nutritional content.	People with health-diet relationship knowledge are more likely to use food labels to direct their decisions in food and beverage choice

Sr. No	Author	Region	Study design	Target Group	Exposure variable	Outcome Variable	Major findings	Conclusion
8.	15	Spain	RCT	81 Healthy Spanish school going adolescents (14-16 years)	Healthy food selection by comparing two simplified FOP-GDA nutrition labels.	The average contents of total energy, saturated and total fat, salt and sugar were estimated by T-test.	Participants chose less total energy, sugar, salt, and saturated fats using MTL-GDA system as compared to M-GDA system	MTL-GDA helped adolescents to choose diet according to dietary recommendations than M-GDA system
9.	10	New Zealand	Starlight RCT	1255 household shoppers having smartphones 18years or above	Impact of food labels on consumers purchase using Health Star Rating labels, Traffic Light Labels, or Nutrition Information Panels	Purchase of packaged food over the 4-week intervention period analyzed by NPSC	Subsequent purchase of food product after viewing nutrition label in the same shopping episode were significantly healthier than products not purchased subsequent	There is significant relation between nutrition label use and the product healthiness. Use of nutrition label may help in healthier dietary choices.
10.	14	USA	RCT	Parent/child pairs (n=153)	Impact of explained and unexplained nutrition labels on food choices of parent/child Using FOP label type: fuf, MTL	Food healthfulness was Quantified. Products, with lower levels of saturated fat, sugar, sodium considered more healthful using BMI and parents self-reported demographic	FOP labels had little effect on improvement of food choices in terms of healthfulness, with few exceptions	Healthy food choices with low sugar, sodium and saturated fat were not supported by any FOP label (FuF/MTL) Signs explaining the labels helped consumers in healthy dietary decision making.
11.	12	Canada	RCT	635 Canadian adults aged >18 years	Nutrition labeling on menus including traffic light labeling and adding other nutrient. Measurement: Traffic light format, Subway website	Calorie knowledge, Nutrition information, ordered and consumed. Measurement: Questions asked	No critical differences were seen for consumption or ordering of sodium, sugar or fat across conditions.	Use of nutrition information and awareness is increased by menu labeling. It lead to lower consumption.
12.	11	USA	Experimental design to check comparison	4- and 2-year college students (n=155) -studying Psychology	Modifying the Nutrition Facts Label (NFL) Measurement: consumer viewing the products with modified versus existing NFLs	Increase in consumer attention + Promotion of healthier dietary choices	No significant difference between the existing and modified NFL groups	There was no difference in attention drawn towards modified NFLs

Sr. No	Author	Region	Study design	Target Group	Exposure variable	Outcome Variable	Major findings	Conclusion
13.	16	UK	Online questionnaire platform	UK adults n=458 age 18-64 years BMI range 16-41 kg/m ²	Physical activity based and kilocalorie (Kcal) based labels Measurement: Four label information conditions were asked	Snack choice and beverage choice Measurement: Regression model	Significantly less energy beverage and snack choices using PA label than the Kcal label condition	Physical activity labeling on pre-packaged foods helps to encourage lower energy food consumption.
14.	30	UK	Experimental design	50 subjects (18-65 years)	Nutrition labeling information Measurement: Baseline, high fat/energy and low fat/energy	Food portion size consumption. Measurement: lunch meal was manipulated (median (IQR in SPSS-11.5)	Relative to females, Males consumed more food (g) and total energy at the lunch under each test condition (P < 0.001 in all cases)	Low fat/energy condition leads to increase food/energy intake.
15.	17	Australia	Double-blind, randomized, parallel-group, placebo-controlled trial	N=1578 adults, age: 18 years and older living in Australia, owns i-Phone or smart-phones	Formats of FOP labeling Measurement: Individuals were randomly given access to one of four varying formats of nutrition labelling	Mean transformed nutrient profile score of packaged foods was used to define healthiness.	Mean healthiness of the purchases in the HSR group was non-inferior as compared to MTL, DIG, or WARN	This study provides aid for the policy choice of HSR.
16.	24	US	Between subjects experimental design	US grocery shoppers n=161 age 18 - 69 years.	FOP label format effectiveness Measurement: Four label condition groups were shown three product categories (cereal, dairy, and snacks) with respective questions.	Consumer's assessment of nutrient density of food products Measurement: Use of label and attitude regarding eating healthy, self-directed knowledge about health and nutrition, diet self-assessment.	FOP label encouraged consumers towards healthy and nutrient dense choices.	As compared with no label, reductive and evaluative FOP labels seems effectual for nutrition assessment of snack products
17.	28	Netherlands	Randomized, pretest-posttest, experimental control group design	2203 clients of 13 supermarkets	An educational program without labeling, or an educational program extended with labeling Measurement: Posters, brochure	Total fat intake and psychosocial determinants of eating less fat (social influence, attitudes, intention and self-efficacy) Measurement: food frequency questionnaire	There were no effects for the educational intervention alone or in combination with the labeling, on the psychosocial determinants of eating less fat and total fat intake.	Nutrition labeling and education of food products low in fat in supermarkets failed to show any effect.

Sr. No	Author	Region	Study design	Target Group	Exposure variable	Outcome Variable	Major findings	Conclusion
18.	25	Australia	Experimental design with randomized interventions	A set target of 1000 respondents from 12 countries ages >18 years	Five different FOP labels (MTL, HSR, Nutri-Score, Warning label and Reference Intakes) Measurement: Survey instrument	Improvement in the healthiness of the chosen product Measurement: Bonferroni correction ANCOVA	The highest effective labels were the Nutri-Score and the MTL (mean improvement score = 0.09; 95% confidence interval [CI] = 0.07, 0.11), then the Warning Label, the HSR and lastly the Reference Intakes	Well-designed and intuitive FOP labels can have significant effect on a global scale.
19.	31	New York	Experimental study with randomization	47 participants (male or female) ages between 18-50 years	Watching videos about food labels Measurement: US Department of Agriculture format	Energy intake, Hunger, and fullness Measurement: Questionnaire, 100-mm visual analog scales	The nutrition labeling group tends to consume less energy from food sources. While both labeling groups had similar baseline hunger and reductions in hunger.	Study confirms the use of nutrition labels for energy intake reduction.
20.	22	USA	Experimental study with randomization	90 Caucasian, Asian, African and American participants mean age was 19.89 yrs.	Nutrition logos and symbols on the front of food packages Measurement: Fops, nutrition fact labels, shop and asked questions to participants	Ability, motivation and gaze duration while looking at different areas of food packaging Measurement: Dual processing models, eye-tracking methodology (My Tobii D10 Eye Tracker)	People with healthful food motivation spent significantly more time reading all available nutrition information as compared to those who are motivated by taste.	This study can be implicated for message design, public policy and food labeling.

Sr. No	Author	Region	Study design	Target Group	Exposure variable	Outcome Variable	Major findings	Conclusion
21.	32	Canada	Experimental study	Canadian adults n=687 took an online survey.	Labelling location, serving size portion, socio-demographic variables, perceived nutrition knowledge, label use and perceived general health	An exact measure (260 KCal) and other range measure.	In all the circumstances, 54.2% individual accurately recognized the total Calories in the beverage. Only 11.8% correctly estimated the total calorie content, as compared to 91.8% who saw calorie content per container.	Very few participants were able to calculate calorie content using nutrition table when container contained more than single serving. Voluntary industry measures can lead to drastic underestimates of calorie intake.
22.	26	Australia	RCT	994 Australian adults	Compared to the control group, the text warning, graphic warning, HSR labels and sugar information all significantly lowered the selection of a SSB	Association of drink selection with adverse health outcomes was explored across label conditions. For all the secondary analysis, logistic regressions were determine	The result was highest for the label with graphic warning (OR 0.22, 95% CI 0.14-0.35) than the group in control. HSR label raised the preference of the drinks with high HSR (OR 2.18 95% CI 1.20-3.97).	FOP labels with warnings (graphic) Have greater influence to decrease expected purchases of SSB.
23.	21	UK population	Experimental study	General public (23 males and 80 female), {age <30 years (23), 31-45 years (25), 46-60 years (30), >60 years (22)}.	The nine categories of food used for comparison were: fruit and vegetables, saturated fats, MUFA, PUFA, white cereals, wholegrain cereals, processed foods, reduced fat and full fat items.	Food purchase of specific food group	For the intervention group, purchases in three of the nine food categories lead to significant improvements : increased purchases of vegetables and fruits (P < 0.001); less purchase of saturated fats (P < 0.001); and reduced white cereal purchases (P < 0.050). The control group showed no differences in any category	Positive effect on food purchasing choices can be made by using educational interventions

Sr. No	Author	Region	Study design	Target Group	Exposure variable	Outcome Variable	Major findings	Conclusion
24.	33	New Haven, Connecticut, community	RCT	303 participants	Impact of restaurant menu calorie labels using questionnaire and interview	Total ordered calories, total consumed calories, total consumed calories after the study meal, calories consumed at and after study meal, accuracy of estimating calories consumed using ANOVA	Individuals in the group having calorie labels and information took an about 250 Kcal less than participant from other groups	Restaurant menus having calorie labels affects the food intake and selection.
25.	27	The cities of San-Francisco and Baltimore, California, New York,	RCT	n=2,202 adolescents age= 12–18 years	One out of the total four types of a warning label; calorie label; No warning label	Calorie intake using ANOVA	Warning label helped participants change their beliefs about a beverage's healthfulness (M=3.51 [SD=1.34] on a 5-point scale) and encouraged them to purchase fewer ssbs (M=3.65 [SD=1.25] on a 5-point scale).	The hypothetical choices to buy beverages sweetened with sugar were reduced with the help of warning labels related to health. It also improved the recognition of sugar amount in these beverages by adolescent.
26.	29	UK	In-store interviews and questionnaires filled out at home and returned	2019 participants for in-store interviews+ 921 participants who filled questionnaires	Nutrition information on food labels Measures: The nutrition table and label for guideline daily amount (GDA)	Respondent's understanding Measures: Regression analysis	87.5% of respondents were able to identify the healthiest product	Nutrition information understanding on food labels and nutrition knowledge are inter-linked.

Table-2: Summary of Studies

DISCUSSION

The data deduced from the studied articles in this paper comprises the information, regarding influential impacts of nutrition labeling on consumer's dietary choices and food purchase. This Systematic review demonstrated nutrition education to be directly correlated with the food-related habits of people. Although some of the choice experiments were conducted in an artificial context, the external validity is limited. The qualitative findings from the existing literature allowed for a careful systematic review in which comparable hypotheses were analyzed according to the objectives of this study.

This literature review included most recent studies that declared the positive correlation between the variables. The constructs related to food literacy discussed in the literature, show vital relation with health and purchase environment of consumers both theoretically and practically. At public stores, the food products have different labeling claims regarding different food groups, energy content and other information, aiding the consumers to buy according to their nutritional knowledge and hence, affect their dietary intake. Healthy dietary choices reflect the intake of food groups according to the recommended guidelines and RDAs, integrating the nutritional contents of food products. Alternatively, some results showed that well-designed FOPs were

more helpful for consumers to opt for healthier choices and grabbed their attention towards food labels during purchasing²². Four food labels formats used were Traffic Light Labels (TLL), Health Star Rating (HSR), warning labels and Daily Intake Guides (DIG). FOPs with graphic warning labels, warning texts and Health Star Rating (HRS) had a greater impact in reducing the purchase of sweetened sugar beverages (SSB). Results showed that food labels not only changed the perceptions but also aided the consumers to choose healthy products²⁷. Recent results of meta-analysis showed various confounding factors were responsible for the negative impact of food labels on healthy dietary choices. Interpretive labels had negative taste perception among consumers which made them choose unhealthy items because of anticipating a tasty product. Most people underestimate or overestimate the portion of one serving. In May 2016, Food and Drug Authority updated the food label formats and made them more understandable. These scientific developments were done to improve serving size by reading food labels correctly and align with better dietary intake.

Limitations of review:

This systematic review is the first attempt to analyze the effect of food literacy on dietary intake and assess its influence on food purchase by collecting relevant data from PubMed and Cochrane library and interpret their results on the willingness of reading food labels, healthy food purchase and consumption. As there had been a large amount of research studies published on these aspects, but during the abstract screening stage, studies were only included if the abstract mentioned one of the following outcomes: “food literacy”, “food intake” and “food purchase”. Studies in which knowledge about food had an impact on diseases were not included. There are some studies that did not mention outcomes relevant to systematic review, that were also excluded. Some relevant studies are further excluded based on full-text screening. However, we attempted to limit the bias through careful screening of relevant articles at each step and discussed thoroughly about the excluded articles before exclusion.

CONCLUSION

Results of maximum research studies suggest that food literacy has a substantial effect on dietary choices and consumption; however, this effect varies according to the different types of food labels and the way through which consumers perceive

those nutrition labels. Consumer dietary choices and understanding of nutrition education also affect the consumer purchasing habits. Furthermore, researched studies proposed that people also have great perception and understanding about reading food labels and have beneficial health outcomes. Therefore, this review highlights the need for more research to get a clear vision about knowledge of nutritional labels and its effect on real life dietary choices. Moreover, it also suggests that food label format is more significant in healthy food choices.

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