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Interrelationship of Food Safety Knowledge, Attitude and Practices of Food Handlers Working in Delhi Based Catering Estbalishment: An Exploratory Factor Analysis (EFA)

Veena Kumari[1], Deeksha Kapur[2] and Rina Chakravorty[3]

[1]Ph.D Scholar, School of Continuing Education, Indira Gandhi National Open University, New Delhi, India
, [2] Professor, School of Continuing Education, Indira Gandhi National Open University, New Delhi, India
[3]Technical Officer Grade 1, Indian Statistical Institute, New Delhi, India
E-mail: [1]vk6580@gmail.com, [2]deekshakapur@ignou.ac.in, [3]rina@isid.ac.in

Abstract
Background*: EFA tries to uncover complex patterns by exploring the dataset and testing predictions and is used to discover the number of factors influencing variables and to analyze which variables 'go together. The broad purpose of factor analysis is to summarize data so that relationships and patterns can be easily interpreted .Methods: This exploratory cross sectional study was carried out from March 2017 to September 2017 in all the nine districts of Delhi .The food safety Knowledge, Attitude and Practices questionnaires were distributed to food handlers working in the selected catering establishments involved in processing ,handling ,storing, serving and packing of food . The obtained data and information was used an input for factor analysis .Data Analysis : The SPSS version 20, statistical package was used for factor analysis .Results: KMO value of food handler's knowledge, attitude and practices variables was 0.519, 0.640 and 0.557 respectively and meeting the criteria of sampling adequacy. Bartlett's test of sphericity was also 0.0001 very significant. The determinant value (D=9.84E-00) 0.0000984 was also greater than the necessary value of 0.00001.Therefore, multicollinearity was not a problem. The Twenty four common factors were extracted out of 60 by principal factor analysis and varimax rotation, with a cumulative contribution of 66.253%.The factor loading values were more than 0.5 and ranged from 0.501 to 0.838.Conclusions: Factor analysis discovered total 24 factors that influence food safety issues in the catering establishment and analyzed which variables 'go together'.*

Keywords*: Exploratory Factor Analysis (EFA), Kaiser-Meyer-Olkin (KMO), Knowledge, Attitude, Practices.*

INTRODUCTION

Food safety is a non negotiable element and is very critical. In India food safety is currently considered to be an important issue for all the stakeholders in the area of food production. Food service staffs play a pivotal role in the prevention of food borne disease. Food service staffs continue to not follow food safety practices when working in food service facilities (Kibret & Abera, 2012) either they are unaware of the norms or they neglect it or they follow faulty practices (Choung, 2010). Knowledge, attitude and practice play main roles in the Knowledge-Attitude-Behavior (KAB) model, which proposes that accumulated knowledge in a health aspect initiates changes in attitude, and results in gradual behavior change (Gumucio et al., 2011) as shown in figure 1. A basic hypothesis of EFA is that there are *m* common 'latent' factors to be discovered in the dataset, and the goal is to find the smallest number of common factors that will account for the correlations (McDonald, 1985). It is easier to focus on some key factors rather considering too many variables that may be insignificant, and so factor analysis is useful for placing variables into meaningful categories.

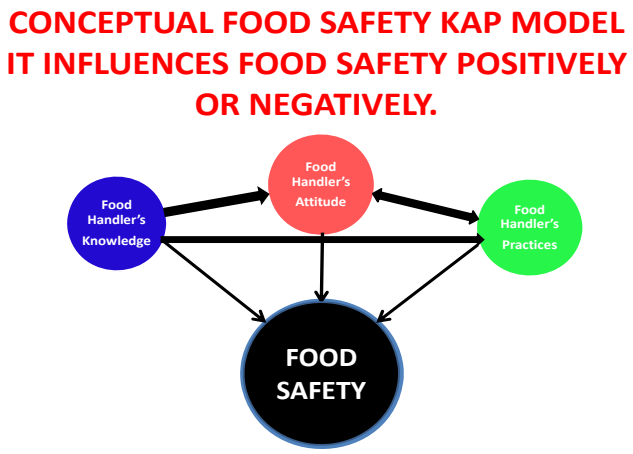

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Figure 1: Conceptual Food Safety Knowledge, Attitude and Practices Model

OBJECTIVE

The main objective of conducting exploratory factor analysis (EFA) was to determine the number of factors that influence food safety issues in the catering establishment and to summarize data so that relationships and patterns of variables can be easily interpreted.

MATERIALS AND METHODS

This exploratory cross sectional study was carried out from March 2017 to September 2017 in 24 catering establishments selected from the nine districts of Delhi (Kumari and Kapur, 2018).The study population; sample size was selected as per procedure described by Kumari and Kapur (2019).

VARIABLES

Factor analysis is an interdependence technique. There is no distinction between dependent and independent variables. Latent Variable would be surfaced after the factor analysis.

RESEARCH TOOLS AND TECHNIQUES

The food safety Knowledge, Attitude and Practices were assessed using self administered questionnaire specially designed for the study as described in a study by Kumari and Kapur (2019).

Validity and Reliability

The questionnaires were pilot tested and validated before distribution to the food handlers. The content of the knowledge questionnaire was based on the guidelines given in schedule 4, Part 5, FSS Act, 2006. However, for attitude and practice questionnaire, the content was gathered from the beliefs which were assessed during the focus group discussion with the food handlers (Kumari & Kapur, 2018). Cronbach's alpha reliability coefficient score of the knowledge, attitude and practices questionnaire was 0.732 and revealed that research instruments had acceptable level of internal consistency.

DATA ANALYSIS

The SPSS statistical software version 20 was used for factor analysis to examine patterns of interrelationships and data reduction (Rumel,1970).Principal component analysis was used for factor extraction with a threshold of an Eigen value of 1.0 .Orthogonal Varimax rotation with Kaisers' normalization was used for data interpretation. A threshold of 0.5 was used for factor loadings which retains loading with high factor only.

RESULTS AND FINDINGS

Preliminary Analysis

Excluding any items on the questionnaire on the basis of collinearity or singularity

The correlation coefficient matrix was checked to look the pattern of relationship. The variables values greater than 0.05 significance value and 0.9 were scanned. It was found that all the 60 items were fairly correlated and none of the correlation

coefficients were large. The determinant value (D=9.84E-00 7 which is 0.0000984) was also greater than the necessary value of 0.00001. Therefore, multicollinearity was not a problem. Thus, there was no need to eliminate any item in the questionnaire.

STAGE 1: ASSESSING SAMPLE SIZE ADEQUACY USING KMO (>0.5) AND BARTLETT'S TEST OF SPHERICITY (P<0.05)

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity were used to ensure that all the 60 items were appropriate for conducting factor analysis and was based on the following criteria:

- If KMO value is < 0.5, it is unsuitable for factor analysis.
- Significant Bartlett ball test ($p < 0.05$), was used to examine whether the factor was independent.

In the present study, assumptions to conduct the exploratory factor analysis was met .The KMO value of food handler's knowledge, attitude and practices variables was 0.519, 0.640 and 0.557 respectively as shown in table 1, table 2 and table 3 and meeting the criteria of sampling adequacy. Bartlett's test of sphericity was also 0.0001which means very significant. According to Hair et al (2006) the significant level of p <0.05.The smaller value (0.0001) indicates that there exist sufficient correlation among variables. Therefore, the exploratory factor analysis could be conducted on this data.

Table 1*:* The Kaiser-Meyer-Olkin (KMO) and the Bartlett's test of sphericity for food handler's food safety knowledge variables

KMO and Bartlett's Test for Knowledge Items		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.519
Bartlett's Test of Sphericity	Approx. Chi-Square	418.924
	df	190
	Sig.	.000

Table 2: The Kaiser-Meyer-Olkin (KMO) and the Bartlett's test of sphericity for food handler's food safety attitude variables

KMO and Bartlett's Test for Attitude		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.640
Bartlett's Test of Sphericity	Approx. Chi-Square	746.181
	Df	190
	Sig.	.000

Table 3*:* The Kaiser-Meyer-Olkin (KMO) and the Bartlett's test of sphericity for food handler's food safety practices variables

KMO and Bartlett's Test for Practices		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.557
Bartlett's Test of Sphericity	Approx. Chi-Square	486.616
	df	190
	Sig.	.000

STAGE 2: FACTOR EXTRACTION AND RETENTION USING PRINCIPAL COMPONENT ANALYSIS (PCA) AND EIGEN VLUES

PCA is a data compression method and is used to determine the min number of factors that will account for max variance in the data. The number of factors to be retained is similar to the number of positive Eigen values of the correlation matrix. It indicates the amount of overall variances that each factor accounts for. Rule of Thumb is if Eigen values >1 is to be retained and <1 need to be dropped. Since Eigen values were more than 1, twenty four meaningful factors were extracted with a cumulative variance of 66.628% as shown in table 4.

Table 4: Total Variance Explained Using Principal Component Analysis
(Only extracted factors are shown)

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.996	6.659	6.659	3.996	6.659	6.659	2.444	4.073	4.073
2	2.930	4.883	11.543	2.930	4.883	11.543	2.083	3.471	7.544
3	2.346	3.910	15.453	2.346	3.910	15.453	1.974	3.290	10.833
4	2.306	3.843	19.296	2.306	3.843	19.296	1.908	3.179	14.013
5	2.223	3.705	23.000	2.223	3.705	23.000	1.847	3.079	17.092
6	1.943	3.239	26.239	1.943	3.239	26.239	1.830	3.050	20.142
7	1.831	3.052	29.291	1.831	3.052	29.291	1.732	2.886	23.028
8	1.793	2.989	32.280	1.793	2.989	32.280	1.728	2.881	25.909
9	1.705	2.842	35.123	1.705	2.842	35.123	1.722	2.869	28.778
10	1.637	2.729	37.852	1.637	2.729	37.852	1.713	2.855	31.632
11	1.570	2.617	40.468	1.570	2.617	40.468	1.674	2.790	34.422
12	1.449	2.415	42.883	1.449	2.415	42.883	1.654	2.757	37.179
13	1.433	2.388	45.271	1.433	2.388	45.271	1.593	2.655	39.834
14	1.359	2.266	47.536	1.359	2.266	47.536	1.593	2.655	42.489
15	1.319	2.199	49.735	1.319	2.199	49.735	1.533	2.556	45.044
16	1.257	2.095	51.831	1.257	2.095	51.831	1.528	2.546	47.590
17	1.244	2.074	53.904	1.244	2.074	53.904	1.526	2.543	50.133
18	1.196	1.993	55.898	1.196	1.993	55.898	1.523	2.538	52.672
19	1.157	1.929	57.827	1.157	1.929	57.827	1.489	2.482	55.154
20	1.129	1.881	59.708	1.129	1.881	59.708	1.410	2.350	57.503
21	1.087	1.811	61.519	1.087	1.811	61.519	1.396	2.326	59.829
22	1.031	1.719	63.237	1.031	1.719	63.237	1.393	2.322	62.152
23	1.022	1.704	64.941	1.022	1.704	64.941	1.378	2.297	64.449
24	1.012	1.687	66.628	1.012	1.687	66.628	1.308	2.179	66.628
25	.983	1.639	68.267						

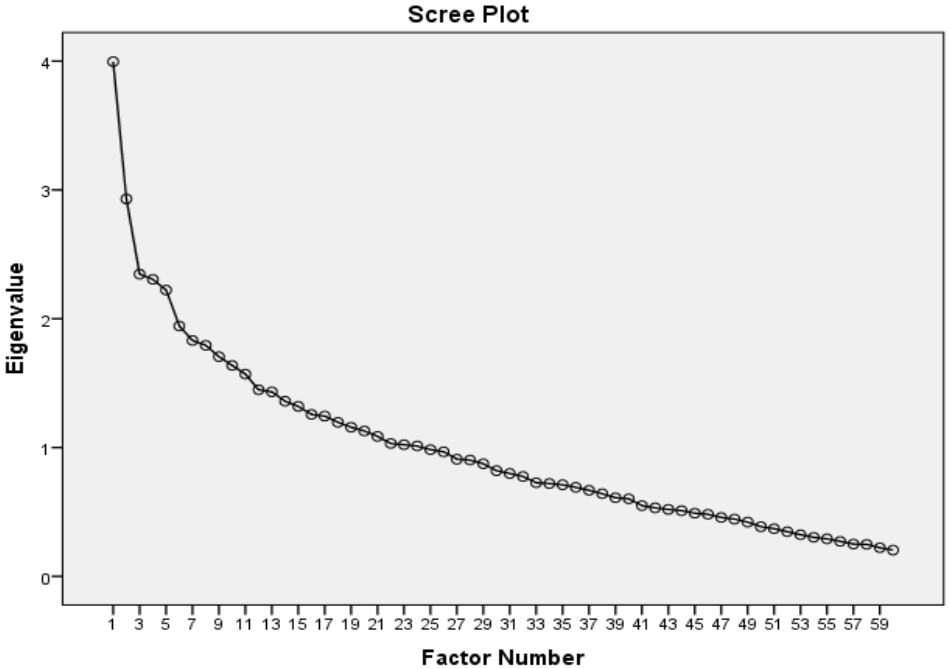
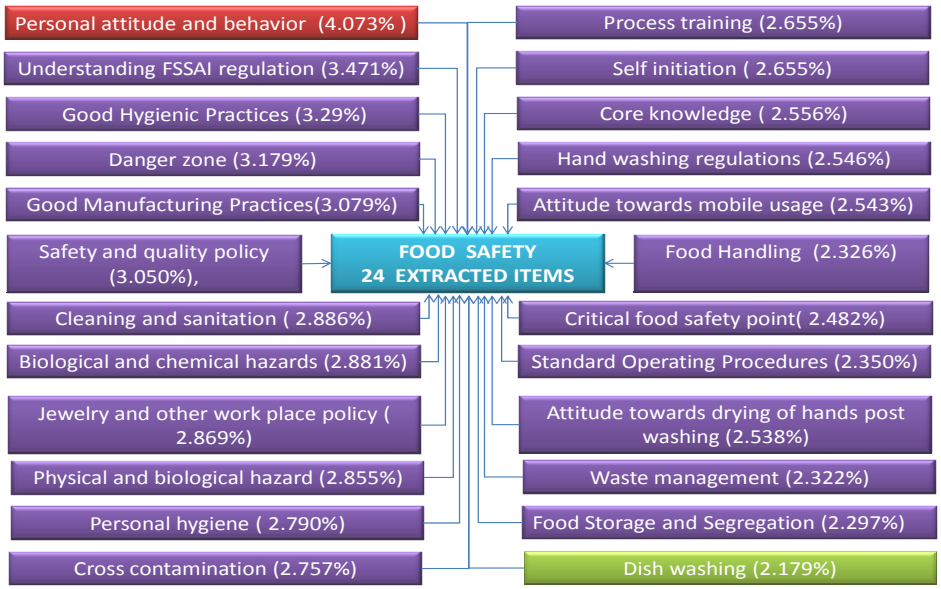


Figure 1: Scree Plot from Principal Component Analysis

STAGE 2: ROTATION METHOD

- Varimax rotation was conducted for better interpretation since unrotated factors are ambiguous. Rotation keeps together those items that are closely related and separates them clearly from other items. Knowledge, attitude and practices factors were denoted by symbol K1, K2 ,K3……K20, A1, A2 .A3….A20 and P1,P2, P3….P20 respectively . Factor Loading Ranged both +/-1 like in Correlational Analysis. The closer to 1 the better was used for extraction.Loading determine the strength of the relationship. The signs of loading show the direction of the correlation and don't affect the interpretation of the magnitude of the factor or the number of factors to be retained (Kline, 1994). Highest Scoring variables were retained compared to lowest scoring variables. Before omission, low variables were conceptually compared to all those included. All the 24 identified factors were grouped into common themes for better interpretations and understanding as can be seen in figure 2.



*Source: Created by an Author**
**Inclusion and Exclusion is an art and not a science. Self Judgment was used*
Figure 2: Extracted factors grouped in common themes.

Clusters were formed (grouped together similar and homogeneous sub samples) for assessing interrelationships. Five clusters were formed as shown in figure 3,4,5,6 and 7.

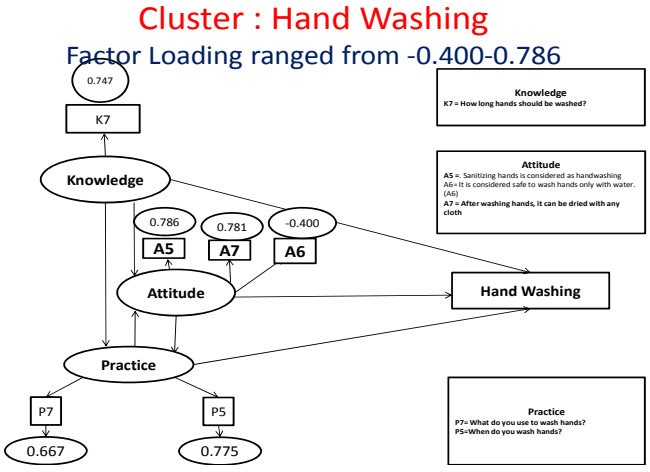


Figure 3: Cluster Hand Washing

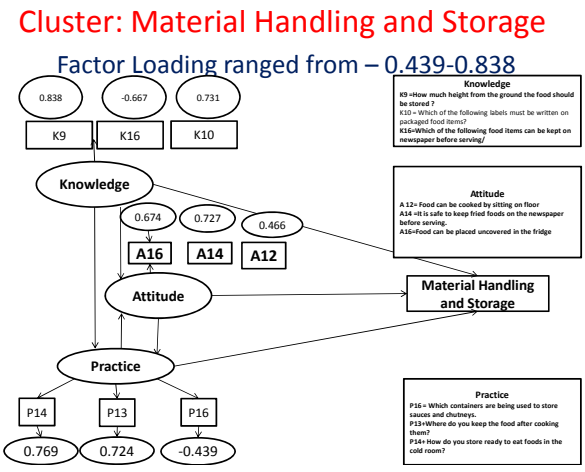


Figure 4: Cluster Material Handling and Storage

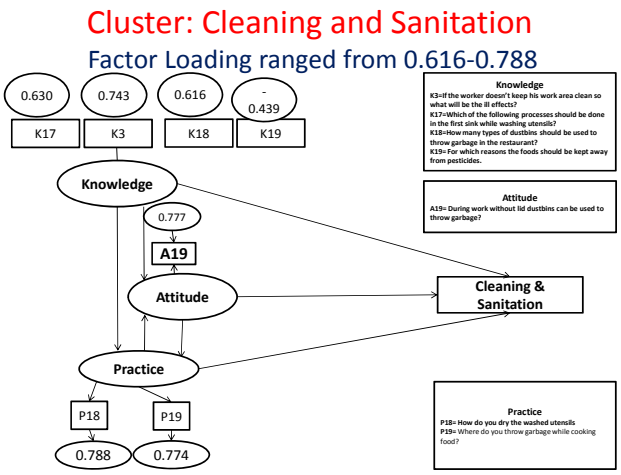


Figure 5: Cluster: Cleaning and Sanitation

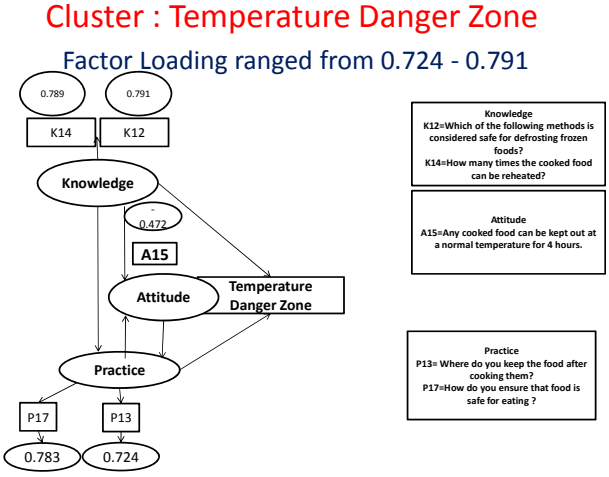


Figure 6: Cluster: Temperature danger Zone

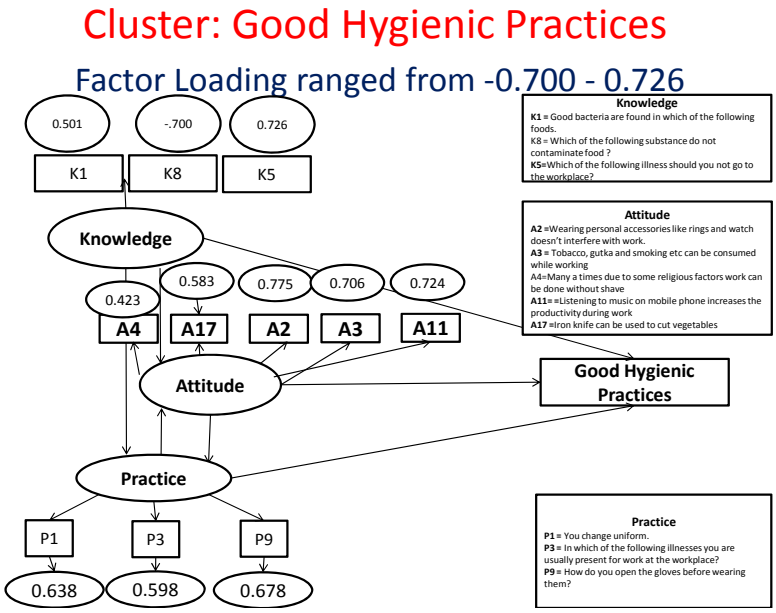


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Figure 7: Cluster: Good Hygienic Practices

Interpreting Cluster: Hand Washing

The Factor Analysis has surfaced attitude items compared to practices and knowledge items and is exerting direct positive influence in the cluster as shown in figure 3.The food handlers strongly believed (0.786) that hands can be sanitized without washing with the liquid cleanser. Similarly strong belief was observed for washing hands with just plain water. Though the influence is not powerful but exert a direct negative influence (-0.400).It may pose a potential threat by food handlers in contaminating the food by not following the appropriate hand washing practices. Drying of hands is equally important as washing of hands and has exerted a direct positive influence (0.781) .Therefore; improper hand washing may be an important factor in the spreading of food borne diseases by cross-contamination.

Interpreting Cluster: Material Handling and Storage

Factor Analysis has surfaced the Knowledge items compared to practices and attitude and is exerting direct positive influence as shown in figure 4. Strong positive influence is exerted by food labels (.731) and storing food items off the floor (.838). If the product is packed, labeled and stored appropriately then food borne outbreaks can be prevented. Food handlers generally have a habit of keeping food directly on the floor due to ignorance or faulty practices or space constrains. Similarly, storage containers

(-0.439) and serving containers (-0.667) are also exerting direct negative pressure. Food handler's insufficient knowledge about the harmful effect of using newspapers with strong belief systems about its usage safety (0.727) can pose a negative health impacts .The newspaper ink could be a potential source of chemical hazard and can produce negative health effect on consumption of food.

Interpreting Cluster: Cleaning and Sanitation

Factor Analysis has surfaced a strong positive association between attitude (0.777) and practices (0.788) as can be seen from the figure 5. Food handlers strong belief system in using dustbins without lid is exerting positive influence and making them practice open dustbins in production. Open dustbins can attract pest and become a shelter house for microorganisms which in turn can contaminate food and can be a cause of food borne outbreaks if neglected .Similar positive influence was exerted by post drying method of washed utensils (0.788) .

Interpreting Cluster: Temperature Danger Zone

Factor Analysis has surfaced a strong positive association between knowledge (0.789, 0.791) and practices (0.783, 0.724) as can be seen from the figure with respect to food safety. High correlation value was observed for knowledge related to reheating temperature of cooked food before serving (.789) and thawing of food (0791). With insufficient knowledge and belief towards letting food sit in inappropriate environments for four hours can cause harmful bacteria to grow at any stage, from production to consumption. Cooked foods should not be left to sit in room temperature for longer than two hours. These foods should be cooled rapidly and kept refrigerated; preferably at a temperature less than 5°C.Microorganisms can reproduce very rapidly at room temperature. Temperatures below 5°C and above 63°C cause the reproduction of microorganisms to slow down or stop. The purpose is to inhibit or prevent harmful micro-organisms from multiplying by keeping food outside of the recognized best practice 'danger zone'(5°C and 63°C) as shown in figure 8.

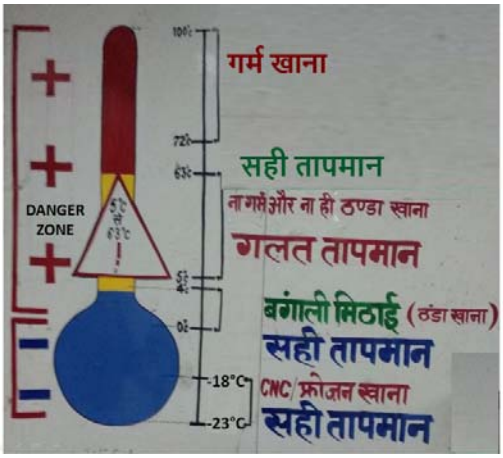

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Figure 8: Temperature Danger Zone

Interpreting Cluster: Good Hygienic Practices

The Factor Analysis has surfaced attitude items (0.755,0.706, 0.724) compared to practices (0.638,0.598,0.678) and knowledge items (-0.700, 0.726) and is exerting direct positive influence in the cluster as shown in figure 7.Good hygienic practices covers the minimum sanitary and hygienic practices to ensure that food is safe and suitable for human consumption. Strong positive influencing attitude items are related to wearing personal accessories (0.775), eating tobacco and substance abuse (0.706) and using mobiles (.724) at work place two other attitude items were exerting positive influence like usage of iron knife (0.583) and avoiding shaving due to religious factors in certain days of the week (.423). A strong but negative correlation (-.700) was observed for one of the knowledge items related to substances that are responsible to contaminate the food items. However, Practices item were related to changing uniform at work place (0.658) and gloves usage (0.678). Knowledge and practices were positively associated to item attending work place during disease conditions (0.726 and 0.598).

DISCUSSION

The factor analysis had surfaced the latent variables and grouped them into meaningful sets .The 60 variables of knowledge, attitude and practices were reduced and transformed into 24 patterned interrelationships with a cumulative contribution of 66.628%. These identified factors were grouped into five clusters which have a direct role in preventing food borne outbreaks. The items into group were related to the personal habits of food handlers, their understanding to food safety law, the required good hygienic practices in operations, safe material handling and its storage, workplace policies related to safety, quality, hygiene and sanitation, identification of hazards physical, biological and chemical, cross contamination and its impact on food safety, hand washing, waste management and dish washing.

Thus, stringent controls measures are required throughout the food chain from production to consumption stage as this would reduce the risks to food safety. Therefore, the catering establishment management, administrators and the food handlers have to share equal responsibility to promote food safety culture in the organization. Although these identified factors seem to be easy to control but there is still a long way to go in understanding these knowledge, attitude and practices attributes. The food handlers need to change their mindsets and be ready to adopt new food safety principles as per the new regulatory framework of the country and need to work as a change agents.

CONCLUSIONS

Factor analysis discovered total twenty four factors that influence food safety issues in the catering establishment and analyzed which variables 'go together'. All the identified factors are important and have a cumulative contribution to variance .Food handlers play a significant role in the prevention of food borne disease and are the first line of defense to ensure food safety. They need to build their capacity with regard to food safety and quality issues so that they can implement good manufacturing and hygienic practices at all points of time.

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