Methodology

Superfluous to say that accurate methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done. The foremost body of the report prolongs with method section after introduction and review of literature. The purpose of this section is to tell the reader how the research was conducted. The study is focused on the ergonomic assessment of the workers carrying out different activities in unorganized food units in Gujarat.

Gujarati- especially the working class people are habituated of snacking in between meals. They also prefer ready to eat snacks in the morning and in the evening along with tea. Because of changing work pattern and employment scenario, more and more ladies are working full time and are gainfully employed. The “Mall culture” & “ready to eat” foods have increased purchase of food stuffs for day to day needs & families depend on these foods. The demand for ready to eat foods has increased and so the employment in this sector too. It is nice to eat these snacks but have we given any thought to the health and safety of the worker frying chakri, sev and samosas for hours or a baker working in high temperature environment baking buns, khari, cakes and pizzas for us? We love KAJU KATRI but ever thought of a worker bending and stretching body to roll thin katri and adopt unnatural posture creating MSI?

The study is throwing light on such awkward postures and MSI occurring to workers. Especially, when unit is an unorganized one, no laws, rules and regulations are observed regarding facilities, work environment, hours of work and workers slog for long hours in peak festival seasons.

The study aims to explore problems of these workers and will suggest solutions to enhance safety and health of the workers. Indirectly it will benefit the owners by better quality production, higher production and the workers will also have better health if has proper knowledge and awareness about using correct posture.

The theoretical frame work developed in this chapter defines the variables under study and set boundaries for study setup, the methodology used in data gathering, data recording and management, measurement analysis and data interpretation. The sub topics covering the methodology of the present study in brief are grouped as follows:
3.1 Research Process

The study progressed in six steps: literature search, research design and procedure for contacting respondents, data collection methods, measurement of variables, videography and data analysis. These are illustrated in figure no. : 1

3.1.1 (a) Literature search:

The literature search includes both printed and electronic sources. Printed material includes books, reports dissertations, periodicals (journals, magazines) statistical reports, manuscripts, dictionaries, conference proceedings and hand books.

I. Printed source: printed material included books, reports, dissertations, periodicals (journals, magazines and newspapers, statistical reports, manuscripts, dictionaries, conference proceedings and hand books.

II. Electronic sources: Online data base were used to search electronically available information such as periodicals (journal articles, magazine and newspaper articles) abstracts, reports, briefing papers, working papers, annual reports and bulletins. The data base includes (1) ERIC Digest Education Resource Information Centre.(2) Inflibnet library. (3) Electronic collection online. (4) Electronic sites such as” www.blackwell-synergy.com, www.springerlink.com/journalarticles.

3.1.2 Search for the sample

The sample was selected from Anand, Nadiad, Dakor and Vanakbori districts. The selection criteria which were decided are as follows:

1. The selected food units should be unorganized not register under government.
2. The food units should be producing farsan, bakery and sweet items only.
3. The sample selected should be from Gujarat.

Confidentiality:

The selected food units were given assurance about the confidentiality and the respondents were informed very clearly that the data was to be used for educational purpose only. A letter of introduction from the department and Identity card-an official proof- was carried along with as Ph.D. scholar to get positive response.
3.1.3 Research Design

I. Variables: There were two sets of variables selected for present research. They are as follows:

A. Independent Variables:
   - Age of the selected workers.
   - BMI of the selected workers.
   - Work experience of the selected workers.

B. Dependent Variables:
   - Feeling of fatigue.

II. Conceptual framework of study: Figure (1) shows the conceptual framework of the study; it gives a clear description of the framework of the study. The workers of food units from Farsan, Bakery and Sweets were selected with the main view to assess ergonomically the selected activities carried out in food units and suggest ways to improve health and safety as well as to study the work environment, postures adopted, feelings of fatigue experienced in performing selected activities by the workers, effect of age, height, weight and work experience of the workers.
Figure: 11 Conceptual Research Framework

Posture assessment of the workers engaged in units of:

- Farsan (n=30)
- Bakery (n=30)
- Sweets (n=30)

Worker related variable:
- Age
- BMI

Work related variable:
- Work experience
- Workplace

Physiological cost of work:
- Musculoskeletal symptoms
- Feeling of Fatigue

Identification of occupational health hazards experienced by the workers of the unorganised food units

Case study of 5 workers engaged in unorganized food unit

Remedies to increase safety at workplace
III. Operational definitions:

Good Health status - is operationally defined as that status of health of the worker where the worker is physically fit to carry out the work and has no health complaint and no medical treatment is carried out during and after the work.

Average Health status - Is operationally defined as that status of health of the worker where the worker is physically fit but has sometimes health complaint and rarely takes medical treatment on doctor’s prescription during and after the work.

Poor Health status - is operationally defined as that status of health of the worker where worker is not physically fit and always has health complaint and is under the medical treatment, always takes drugs on doctor’s prescription, feel the fatigue during and after work.

IV. Selection, Description and Development of the tool:

A researcher will be required to use more number of data gathering techniques. Each tool is appropriate for the collection of certain types of evidences and information.

A. Selection of the instrument:

1. Observation sheet for preliminary information - Observation technique was used to collect the information of the subjects regarding working pattern, postures adopted and work environment.

2. Interview schedule for general survey - The close ended interview schedule was formulated; it was adopted from standardized Nordic Questionnaire (Kourinka et al., 1987). It was divided into different parts:

   Part-A - Personal Detail: Name, age, gender, education, height, weight, working hours etc.

   Part-B - General Health - this part includes the information on the status of health of respondents. It covered the habits, feeling of fatigue through body map and universal pain assessment tool. Low back pain, neck and/or shoulder pain.

   Part-C - Work Environment Assessment - it included information on ambient temperature, noise level, illumination level, types of safety apparel worn, housekeeping practices of food unit.
3. **Signs and symptoms interview schedule for experimental study**-

   **Section -A-Personal Detail**: Age, gender, height, weight, working hours etc.

   **Section -B - General Health**: It covered information on feeling of fatigue, severity of pain, area of pain through body map and universal pain assessment tool.

   **Section-C- Work Environment Assessment**: It included ambient temperature, noise level, illumination level, types of safety apparel worn, housekeeping practices of food unit.

4. **Videography for experimental study**- Videography was used for collecting technical data and collecting data pertaining to the posture adopted by the workers while working. The investigator had taken videography of the workers, who were engaged in selected activities to get the perfect idea about stress to various body parts. For analyzing the angle of working posture ergo master software was used (Ergo master the software the copyright 2003 by Next Gen). In this method different postures were observed by stopping the film after every 30 seconds and check the score according to RULA sheet.

5. **Case study of selected respondents**- Case study of 5 subjects was carried out after the experimental study to see the effect of minor engineering changes on postures at work in which changes in the design of workplace and equipment were incorporated.

   Thus Combination of methods and tools were used for present study.

6. **Tools and Equipment used included**: Lux meter, sound meter, weighing machine, measuring tape, thermometer, ambient temperature thermometer and Handycam.
Body Map Techniques For Assessing Of Body Part Discomfort: -

Body map was used to measure the localized discomfort, musculoskeletal problems and intensity of pain in different body parts resulting from Postural discomfort (Corlett and Bishop 1976). Body Part Discomfort Score (BPDS) can be obtained using “Human Graphic” or “Body Map” (Figure: 2). In this technique the body is divided into a number of regions. After a bout of work the subjects were asked to indicate the body parts that were most painful. After noting these, the next painful parts were asked and so on till the respondents indicated no further parts. Thus, intensity of pain perceived in each reported body part was determined on a 5-point continuum. The maximum intensity level of pain was given a rating of 5 (very severe), 4 (severe), 3 (moderate), 2 (mild) and for body part experiencing least pain the rating given was 1 (very mild). It is advisable that the data were collected at the end of 2 hours work period in case of light and moderate work. For assessing localized discomfort, scores were allotted to different regions as per Corlett and Bishop (1976) technique and total score for the subject were calculated. The body discomfort score of all the subjects were added and averaged to get mean total score.

**Plate No.15** - Body Map Technique for Assessing Body Part Discomfort
Moderate Universal Pain Assessment Tool:

Plate No.16 - Universal pain assessment tool


The pain assessment tool is intended to help researcher assess pain according to individual worker needs. Explain and use 0–10 scale for worker self-assessment. Use the faces or behavioral observations to interpret expressed pain when worker cannot communicate his/her pain intensity.

Ergomaster software for posture analysis:

Mastering ergonomic analysis just became easy with ErgoMaster.

ErgoMaster is a suite of attractively priced ergonomic analysis software modules containing a broad range of features and capabilities. The system is easy to use and produces easy to understand reports incorporating pictures or images of the job task being analyzed or redesigned.

ErgoMaster enables users with minimal computer expertise to easily utilize the system. The user can customize various reports and analysis. The system also includes detailed on-line help and instructions.
The system's applications include ergonomic analysis, risk factor identification, training, as well as job and workstation redesign. Its suite of modules and tools assists in the analysis of lifting tasks, repetitive tasks, awkward postures, office ergonomics and many other areas. Modules can be purchased individually.

The system allows users to obtain images from a variety of popular packages and receive such images even via the Internet. The system includes a database, which enables users to easily save and retrieve their studies including the images.

**Suite of Ergonomic Analysis Modules**

The ErgoMaster is comprised of several different analysis modules. These modules are designed to satisfy the evaluation needs of a specific area of interest and are categorized as follows:

- **Lift Analyst**: provides tools to evaluate and document materials handling activities and perform biomechanical predictions for the lower back. These tools include Materials Handling Assessment, 2-D Biomechanical Prediction, Revised NIOSH Lifting Equation, and Discomfort Survey.
- **Task Analyst**: includes various tools to evaluate task design and perform job analysis. These tools include Task Assessment, Tool Assessment, RULA, Work/Rest Cycles, and Discomfort Survey.
- **Biomechanics Analyst**: enables users to easily interface with the University of Michigan's 3D SSPP in 2D mode (which is purchased directly from the University of Michigan Software) by simply clicking on the joint positions in the digital image.
- **Posture Analyst**: provides tools to evaluate an individual's posture as it pertains to range-of-motion, biomechanics and anthropometrics. These tools include Posture Assessment, RULA, Dimensional Analysis, and Discomfort Survey.
- **Workstation Analyst**: provides tools for the evaluation of industrial and/or office environments for ergonomic risk factors. This includes the assessment of furniture and equipment. These tools include Workstation Assessment, Video Display Assessment, Tool/Product Assessment, and Discomfort Survey.
• **Ergo Product Database:** is a resource of ergonomic related products that may be used as recommendations to environmental layout or tool/equipment selection. This database does contain sample products but is encouraged to be user defined.

• **Getting Started:** contains general tools to begin an ergonomic evaluation. General Information, Discomfort Survey.

Many of the modules have image digitization capability. Users have a variety of tools to enter information (text and basic drawings) in the image area and obtain information from the image itself (such as distances and angles) as well as edit the image itself.

These modules include the capability to digitize any digital image converted from video frames and other digital and scanned images (captured using a variety of popular packages). Users can also capture images from an AVI file. Images or AVI files can be received from clients or plants by sending them over the Internet and then simply importing them into ErgoMaster's image areas.

The ability to incorporate the image of the job greatly increases the effectiveness in the presentation of the final report and recommendations.

**RULA**

The RULA posture analysis is used to investigate the exposure of workers to the risk of upper limb disorders. RULA provides a record of each operator's general posture with particular reference to the trunk, neck and upper limbs. RULA examines several risk factors associated with the body posture, loads, and muscle use and compiles these factors into a posture score.
VI. Validation:
The interview schedule for general survey was validated for correctness and content of the subject matter by giving it to the 8 experts from different institutes;
1. Vishwakarma Institute of Technology, Pune.
2. NIOH (National Institute Of Occupational Health) Ahmedabad,
3. Department of Physiology, University of Calcutta.
4. NITIE (National Institute of Industrial Engineering) Mumbai.
5. Faculty of Family & Community Sciences, M. S. University, Vadodara.
6. Home Science College, Sardar Patel University, Vadvanagar.
According to the suggestions of the judges changes were incorporated to finalize the tool. The structured tool was pretested by giving it to five respondents from each unit namely farsan, bakery and sweets unit which were not included as subjects for the final survey. Thus the tool was finalized after the result of pretesting.

3.1.4 Sample, sampling procedure and sample size.

I. Selection of universe
The unorganized food units selected were of Anand, Nadiad, Dakor and Vanakbori. The sample selected was workers of unorganized food units.

II. Locale of the study.
The survey was conducted on workers of the food units i.e. farsan, sweet and Bakeries.

III. Sampling procedure and sample size.
1. Sampling procedure:
   Sampling helps to determine the corresponding value of the population and plays a vital role in research.
   i. Snowball Sampling method:
   Snowball sampling is generally used in the case of explorative research study/design, where researchers do not have much lead information. It starts by identifying respondents who meet the criteria for selection/inclusion in the study and can give lead for another set of respondents/information to move further in the study. Snowball sampling is especially useful when you are trying to reach
populations that are inaccessible or difficult to find, for example, in the case of identifying injecting drug users (Singh, 2007)

**Advantages of snowball sampling:**

- The chain referral process allows the researcher to research populations that are difficult to sample when using other sampling methods.
- The process is cheap, simple and cost efficient.
- This sampling technique needs little planning and fewer workforce.

**ii. Selection of food units:**

For the present study the workers selected were from unorganized food unit producing farsan (sev, chavanu, tam tam, fafda, ganthia, samosa, batatavada, papdi etc), Bakery items (cakes, khari, pastry, buns, sweet khari, puff, pizza rotla) and sweets (jalebi, kajukatri, ladu, peda, halwasan etc.)

**iii. Selection of activity:**

In unorganized food units numbers of activities are carried out. The preparation of various types of farsan (snacks), sweets, bakery items and relevant food items were prepared in food units and these units were selected for the study on cooperation basis. The activities carried out in these unorganized food units were as follows:

In bakeries: rolling, cutting, tray stacking, baking and dough making were carried out.

In Farsan (snacks) Unit: sev making, dough making, dough flattening, cutting and frying, making bolls of samosa, samosa rolling, filling samosa and frying samosa.

In sweets Unit: making bolls of laddu, stirring the batter of barfi, making bolls of gulab jamun, cutting of barfi, cutting kajukatri, frying boondi, frying of gulab jamun, dough preparation of peda, shaping peda and packing peda.

**2. Sample size:**

All the workers those who were working in selected unorganized food units were included as sample for general survey from farsan makers -120, bakery workers -60 and sweets maker-60 and for experimental work 90 workers were selected from Farsan shops - 30, Bakery shops-30 and sweets shops -30 each. Case study of 5 subjects was carried out where minor engineering changes were made by the
researcher to see the effect of minor engineering changes in the postures adopted at work.

3.1.5 Analysis of data:
The data analysis procedure covered categorization, coding, tabulation and statistical analysis of the data. The data collected with the help of interview schedule for general survey, and for experimental study to know sign and symptoms of pain and video recording were coded and tabulated for ease of analysis.

a) Categorization- Categorization of the variables for the purpose of analysis and tabulation:

categorization is the first step in any analysis. Categories are setup according to the research problem and purpose. For the present study, variables were categories in the following manner.

1. **Age (years): It was categorized as follows**
   i. Young (15-35 yrs.)
   ii. Middle (36-57 yrs.)
   iii. Old (58-80 yrs.)

2. **Educational level** - Education was one of the factors associated with the extent of involvement in various activities. It determined the formal education attained by the respondents. It was categorized as
   i. Illiterate
   ii. Up to Secondary

3. **Body Mass Index (WHO, 2004)** - It was recognized on equal interval basis as
   i. Underweight (<20)
   ii. Normal weight (20-25)
   iii. Over weight(25-30)
iv. Obesity (>30)

4. **Working Hours**: Working hours was also one of the factors associated with the occupational health hazards that affect working of unorganised food units. It was categorized as

i. < 8 hours

ii. 8 - 11 hours

iii. > 11 hours

5. **Years of working** - Working experience affects the working performance of workers working in Unorganized food unit.

i. 1-10

ii. 11-20

iii. >21

6. **Work Place**: It was categorised on the basis of types of food units selected.

i. Farsan

ii. Bakery

iii. Sweets

b) **Coding** - refers to the process of assigning numerals or other symbols to answers so that responses can be put into a limited number of categories or classes. Such classes should be appropriate to the research problem under consideration. They must also possess the characteristic of exhaustiveness’s and also that of mutual exclusivity which means that a specific answer can be placed in one and only one cell in a given category set. Another rule to be observed is that of unit dimensionality by which it is meant that every class is defined in terms of only one concept.

c) **Tabulation** - when a mass of data has been assembled, it becomes necessary for the investigator to arrange the same in some kind of concise and logical order. This
procedure is referred to as tabulation. Thus, tabulation is the process of summarizing raw data and displaying the same in compact form (i.e. in the form of statistical tables) for further analysis.

The data were transferred from excel sheet into tabular form to give a clear picture of findings.

d) **Statistical analysis**- The data was computerized and SPSS (17.0) was used for analysis. Correlation and ANOVA test was carried out to correlate effect of age, BMI and work experience with feeling of fatigue.

e) **Descriptive statistics**- The data were presented in frequencies, percentages, suitable graphs.

f) **Relational statistics**-

Correlation among sweets workers’ feeling of fatigue and selected independent variables. Correlation among bakeries workers’ feeling of fatigue and selected independent variables

Correlation among farsan workers’ feeling of fatigue and selected independent variables

Analysis of Variance one way ANOVA was computed to determine statistical relationship between dependent and independent variables.

3.16 **Limitations of the study**

1. The guidelines developed would be applicable to the workers working in unorganized food units.

3.17 **Delimitations of the study**

1) The study was limited to the Anand and kheda district.
2) The study was limited to the workers engaged in unorganized food units.
3) The study was limited to the food units which were not registered.
4) The study was limited to 120 farsan workers, 60 bakery and sweet workers for the general survey.
5) The study was limited to 30 workers each from farsan, bakery and sweet unit for experimental study.