"A CROSS SECTIONAL STUDY OF KNOWLEDGE, ATTITUDE & PRACTICES ABOUT MILK BORNE DISEASES AND ASSESSMENT OF QUALITY OF INFORMALLY MARKETED MILK IN URBAN & RURAL FIELD PRACTICE AREAS OF J.N.M.C., BELGAUM"

By

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Dissertation

Submitted to the
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In Partial Fulfillment
of the requirements for the degree of

M. D.
in
COMMUNITY MEDICINE

Under the Guidance of

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DEPARTMENT OF COMMUNITY MEDICINE,
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DECLARATION

I hereby declare that this dissertation entitled **"A CROSS SECTIONAL STUDY OF KNOWLEDGE, ATTITUDE & PRACTICES ABOUT MILK BORNE DISEASES AND ASSESSMENT OF QUALITY OF INFORMALLY MARKETED MILK IN URBAN & RURAL FIELD PRACTICE AREAS OF J.N.M.C., BELGAUM"** is a bona fide and genuine research work carried out by me under the guidance of **Dr. SHIVASWAMY M. S.** **M.D.,** Professor, Department of Community Medicine, Jawaharlal Nehru Medical College, Nehru Nagar, Belgaum-590010.

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LIST OF ABBREVIATIONS USED

APL	–	Above Poverty Line
BMRT	–	Brucella Milk Ring Test
BPL	–	Below Poverty Line
CDC	–	Centres for Disease Control
CPI	–	Consumer Price Index
CT	–	Coliform Test
FAO	–	Food and Agricultural Organization
FOOD	–	Food Borne Outbreak Database
HAACP	–	Hazard Analysis Critical Control Points
LPC	–	Laboratory Pasteurization Count
MF	–	Multiplication Factor
MBRT	–	Methylene Blue Reduction Test
MM	–	Mahila Mandal
NDDB	–	National Diary Development Board
PFGE	–	Pulsed Field Gel Electrophoresis
PHC	–	Primary Health Centre
PI	–	Preliminary Incubation Count
PMO	–	Pasteurized Milk Ordinance
SC	–	Scheduled Caste
SHG	–	Self Help Group
SPC	–	Standard Plate Count
ST	–	Scheduled Tribe
UHC	–	Urban Health Centre
UHT	–	Ultra High Temperature

UK	–	United Kingdom
USA	–	United States of America
WHO	–	World Health Organization

ABSTRACT

Milk being nutritional, balanced foodstuff, is a well-known medium that favours the growth of several microorganisms. Many milk borne epidemics of human diseases have been spread by contamination of milk by spoiled hand of dairy workers, unsanitary utensils, flies and polluted water supplies.

Research question

What are the knowledge, attitude and practice of respondents about milk borne diseases?

Aims and objectives

1. To assess the knowledge, attitude and practice about milk borne diseases, in rural and urban participants.

2. To assess the quality of informally marketed raw milk in rural and urban households.

Materials and methods

A cross sectional study was done in 2010 among 500 households, 250 each residing in Vantamuri rural field practice area (Vantamuri PHC) and Khasbag urban field practice area (Ward no. 21 area of UHC Khasbag) in Belgaum district using predesigned and pretested questionnaire. Informally marketed raw milk samples were collected from 10% households (25 houses) each from both the areas for laboratory analysis using Brucella milk ring test, Methylene blue reduction test and Coliform tests at the teaching hospital.

Results

None of the participants knew that unpasteurized milk can transmit diseases or symptoms of milk borne diseases caused by E. coli or Brucella, however 28% and 38% participants from urban and rural area respectively knew that milk could be contaminated; of which 8% urban and 12% rural participants thought that milk utensil as main source of contamination.

32% urban and 62.4% rural study participants reported to consume raw milk; of which 12% from urban area quoted it is healthy and convenient and 12% from rural area quoted health purpose, as the primary reason for consuming animal raw milk.

None of the participants suffered from milk borne diseases in the year preceding the survey. 92% and 87.6% reported that they washed hands, 96% and 88% washed utensils before collecting raw milk, 100% and 84% covered the milk utensils with lid, where as 32% and 70.8% added water to milk prior to consumption from urban and rural participants respectively.

13.6% and 47.2% participants possessed their own milk producing animals of which 5.2% and 45.2% used to keep animals within the house in urban and rural areas respectively. All the participants (13.6% urban an 47.2% rural) had good practice of washing milk collecting utensils, washing hands before milking and sought treatment for animals during illness from the veterinary doctor.

Laboratory analysis of 25 urban & 25 rural milk samples showed, mean specific gravity of 1.026 ± 0.004 and 1.025 ± 0.007 from urban and rural areas

respectively. 5 (10%) samples were positive for brucella milk ring test and 14 (28%) were positive for methylene blue reduction test as well as coliform test. Samples were considered positive for coliform test when viable count was $>10^5$ bacteria/mL of milk.

Low socio-economic status was associated with poor hygienic practices (i.e. not washing hands / utensils, addition of water and consuming milk on the next day of collection) among urban participants. Awareness regarding addition of water to milk and covering milk utensils with lid was better among urban than rural participants. Urban and rural buffalo milk samples showed significant association with the methylene blue reduction test and coliform test.

Conclusion

Awareness of milk borne diseases was nil among the study participants and hygienic practices of handling milk was improper. Most of them were not aware that raw milk can transmit diseases.

Key words

Milk borne diseases, informally marketed raw milk, Brucella milk ring test, Coliform test, Methylene blue reduction test.

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INTRODUCTION

Milk is an important dietary component of vast population on earth, due to its high nutritional value for human beings.[1] Being a nutritional, balanced foodstuff, milk is a well-known medium that favours the growth of several microorganisms.[2] However, milk is a natural food that has no protection from external contamination and can be contaminated easily, when it is separated from the cow.[3]

Milk of cattle, buffalo, goat, sheep, camel, yak, llama, mare etc contains almost same but varying concentration of the chemical constituents. Milk is produced in rural or suburban areas of the country and is transported from point of production to cities mainly through middle men called dodhies (milk vendor).[4]

In 2001 India became the world leader in milk production, closely followed by USA, with a production volume of 84 million tons. In 2008-2009, the total production was around 108.5million tons.[5]

India keeps over three times the number of cattle as the USA. In addition, 94 million buffaloes contribute to milk production in India. It is estimated that around 15% of the milk produced in India is marketed through formal channels, while the remaining 85% is informally handled.[6]

India's milk production has grown at around 4% annually in the recent years, which far exceeds the global average of about 1%. This sustained increase in the domestic milk production increased the country’s per capita availability of milk.[7]

The milk obtained from healthy animal's udder is free from pathogenic bacteria, but some of the animals in field condition may be suffering from sub-clinical mastitis and are excreting the causative agent in milk and thus contaminate the bulk milk.[4]

The informal milk market pathways persist because they provide social and economic benefits to smallholder producers, small market agents and consumers in terms of higher farm gate prices, creation of employment and competitive consumer prices.[8]

Considering the nutritional composition, milk is the nature's single most nearly complete food. Milk production started in the world 6,000 years back. In early age, milk was produced and utilized in the limited areas. Now milk production has increased to 10 times in the world in 2010.[9]

Milk contamination takes place through various ways such as from the barn, during chilling, during transportation, during processing and during marketing.[9] Contamination of this milk becomes much more serious problem because of the ability of these substances to support tremendous increases in bacterial numbers.

Among total milk produced in our country, 55% is consumed as fluid milk and rest 45% is sent for industrial processing. Most of the poor Indian communities, who are staying in rural areas, are involved in milk production. Though India is located in tropical climate, sufficient cold chain and refrigeration facilities are not available in many parts of the country. These are very expensive for the rural people. Although milk is produced mostly in rural areas, its demand

is high in urban areas. Milk preservation prior to distribution and sale is a major problem in tropical climate of India.[10]

Many milk-borne epidemics of human diseases have been spread by contamination of milk by spoiled hands of dairy workers, unsanitary utensils, flies and polluted water supplies.[1]

Milk is an excellent growth medium of organisms when suitable temperature exists, [4 & 8] and it is prone to all types of microbiological contamination.[9]

Risks of milk-borne zoonoses posed by the informal market are amplified by poor handling procedures in the market, the lack of quality standards and the fact that most consumers prefer raw milk over pasteurized milk.[2]

As classified by the Joint FAO / WHO Expert Committee (1970) on milk hygiene; the most important milk borne diseases transmitted from animals to humans are: brucellosis, tuberculosis, streptococcal infection, staphylococcal, salmonellosis and Q fever. Diseases of less importance are - cow pox, foot and mouth disease, anthrax, leptospirosis and tick borne encephalitis. Infections transmitted through milk are - typhoid, paratyphoid fevers, shigellosis, cholera and entero-pathogenic E coli.[11]

There is limited data existing on raw milk consumption and corresponding risks of milk borne illnesses. It is a highly perishable commodity and poor handling can exert both a public health and economic toll, thus requiring hygienic vigilance throughout the production to consumer chain.[8]

The purpose of this study was to ascertain information on (a) knowledge, attitude and practices regarding milk borne diseases among rural and urban households, (b) assessing the milk quality regarding adulteration with water, contamination with E. coli and brucella.

OBJECTIVES

The objectives of the present study were;

1. To assess knowledge, attitude and practices about milk borne diseases in rural and urban field practice areas of Belgaum.

2. To assess the quality of informally marketed raw milk in rural and urban field practice areas of Belgaum.

REVIEW OF LITERATURE

Milk is a white liquid produced by the mammary glands of mammals. It is the primary source of nutrition for young mammals before they are able to digest other types of food. The precise components of raw milk vary by species and by a number of other factors, but they contain significant amounts of saturated fat, protein and calcium as well as vitamin C.[12]

There are two distinct types of milk consumption: a natural source of nutrition for all infant mammals and a food product for humans of all ages that is derived from other animals. In many cultures of the world humans continue to consume milk beyond infancy, using the milk of other animals (especially cattle, goats and sheep) as a food product. For millennia, cow's milk has been processed into dairy products such as cream, butter, yogurt, kefir, ice cream, and especially the more durable and easily transportable product, cheese. Modern industrial processes produce casein, whey protein, lactose, condensed milk, powdered milk, and many other food-additive and industrial products.

Humans are an exception in the natural world for consuming milk past infancy. The largest producer and consumer of cattle / buffalo milk in the world is India.[13]

History

Humans first learnt to regularly consume the milk of other mammals following the domestication of animals during the Neolithic revolution or the invention of agriculture. This development occurred independently in several

places around the world from as early as 9,000 to 7,000 BC in Southwest Asia to 3,500 to 3,000 BC in the Americas. The most important dairy animals like cattle, sheep and goats were first domesticated in Southwest Asia, although domestic cattle have been independently derived from wild auroch populations several times since. Initially animals were kept for meat, and archaeologist Andrew Sherratt has suggested that dairying, along with the exploitation of domestic animals for hair and labour, began much later in a separate secondary products revolution in the fourth millennium BC.[14]

From Southwest Asia domestic dairy animals spread to Europe (beginning around 7,000 BC, but not reaching Britain and Scandinavia until after 4,000 BC), and South Asia (7,000–5,500 BC). The first farmers in central Europe and Britain milked their animals and subsequently spread across much of the Eurasian steppe. Sheep and goats were introduced to Africa from Southwest Asia, but African cattle may have been independently domesticated around 7,000 to 6,000 BC. In the rest of the world (East and Southeast Asia, the Americas and Australia) milk and dairy products were historically not a large part of the diet, either because they remained populated by hunter-gatherers, who did not keep animals or the local agricultural economies did not include domesticated dairy species. Milk consumption became common in these regions comparatively recently, as a consequence of European colonialism and political domination over much of the world in the last 500 years.[15]

In 1863, French chemist and biologist Louis Pasteur invented pasteurization, a method of killing harmful bacteria in beverages and food products.[15]

Sources[15]

In addition to cattle, the livestock like camel, donkey, goat, horse, reindeer, sheep, water buffalo and yak provide milk used by humans for dairy products. In Russia and Sweden, small moose dairies also exist.

Production

In the Western world today, cow's milk is produced on an industrial scale and is by far the most commonly consumed form of milk. Commercial dairy farming using automated milking equipment produces the vast majority of milk in developed countries. The largest producers of dairy products and milk today are India, followed by the United States, Germany and Pakistan. [16]

Increasing affluence in developing countries, as well as increased promotion of milk and milk products, has led to a rise in milk consumption in developing countries in recent years. In turn, the opportunities presented by these growing markets have attracted investment by multinational dairy firms. Nevertheless, in many countries milk production remains on a small scale and presents significant opportunities for diversification of income sources by small farmers.[17] Local milk collection centers, where milk is collected and chilled prior to being transferred to urban dairies, are a good example of where farmers have been able to work on a cooperative basis, particularly in countries such as India.[18]

Numerous studies have found that conjugated linoleic acid, found mainly in milk, meat and dairy products, provides several health benefits including prevention of atherosclerosis, different types of cancer, hypertension and

improved immune function.[19, 20 & 21]There is recent evidence suggesting consumption of milk is effective at promoting muscle growth.[22]

Physical and chemical structure

Milk is an emulsion or colloid of butterfat globules within a water-based fluid. Cow milk contains on average, 3.4% protein, 3.6% fat, and 4.6% lactose, 0.7% minerals and supplies 66 kcal of energy per 100 grams.

Processing

In most western countries, centralized dairy facilities process milk and products obtained from milk (dairy products), such as cream, butter and cheese.

Pasteurization[15]

Pasteurization is used to kill harmful microorganisms by heating the milk for a short time and then cooling it for storage and transportation. Pasteurized milk still is perishable, however, and must be stored cold by both suppliers and consumers. Dairies print expiry dates on each container, after which stores will remove any unsold milk from their shelves. The pasteurization process destroys the vitamin C content of the raw milk.

A newer process, ultra-pasteurization or ultra-high temperature treatment, heats the milk to a higher temperature for a shorter amount of time. This extends its shelf life and allows the milk to be stored unrefrigerated because of the longer lasting sterilization effect.

Microfiltration[15]

It is a process that partially replaces pasteurization and produces milk with fewer microorganisms and longer shelf life, without a change in the taste of the milk. In this process, cream is separated from the whey and is pasteurized in the usual way, but the whey is forced through ceramic micro-filters that trap 99.9% of microorganisms in the milk (as compared to 95% killing of microorganisms in conventional pasteurization). The whey is then recombined with the pasteurized cream to reconstitute the original milk composition.

Nutrition and health

The composition of milk differs widely among species. Factors such as the type of protein; the proportion of protein, fat, and sugar; the levels of various vitamins and minerals; and the size of the butterfat globules, and the strength of the curd are among those that may vary. Cow milk contains, on average, 3.4% protein, 3.6% fat, and 4.6% lactose, 0.7% minerals and supplies 66 kcal of energy per 100 grams.

Importance of milk in human life

Milk is considered an attractive source of energy, proteins and calcium for infants and young children who have few alternative sources for these nutrients. Besides its beneficial effects on nutrition, milk is ideally suited for growth of microorganisms.[23]

Milk borne diseases

The importance of milk in human diet is well established, as it is considered as the best, ideal and complete food for all age groups. However, in spite of being so, milk can also serve as a potential vehicle for transmission of some diseases under certain circumstances. Moreover, by virtue of possessing almost all the essential nutritional factors, milk can also serve as an excellent source and protective medium for certain microorganisms, which may include potential pathogens capable of causing various health problems.

Milk may serve, not only as a potential vehicle of transmission of disease causing organisms, but it can also allow pathogens to grow, multiply and produce certain toxic metabolites, thereby making itself an extremely vulnerable commodity from the health point of view.

A variety of pathogenic organisms may gain access into milk and milk products from different sources and cause different types of food-borne illnesses. Milk and milk products may carry organisms as such or their toxic metabolites (poisons) called 'toxins'. Ingestion of toxins already synthesized in the food, that is pre-formed, brings about food poisoning syndromes.

As classified by the Joint FAO / WHO Expert Committee (1970) on milk hygiene; the most important milk borne diseases transmitted from animals to humans are: brucellosis, tuberculosis, streptococcal infection, staphylococcal, salmonellosis and Q fever. Diseases of less importance are - cow pox, foot and mouth disease, anthrax, leptospirosis and tick borne encephalitis. Infections

transmitted through milk are - typhoid, paratyphoid fevers, shigellosis, cholera and entero-pathogenic E coli.[11]

A study done in England and Wales between 1951 - 1980 reported 233 outbreaks of communicable diseases attributed to milk or dairy products affecting nearly 10,000 people. [24]

A study done from 1973 to 1992 in U.S.A. showed that, raw milk was associated with 46 outbreaks of food borne illness.[25]Another study done in England and Wales from 1992 to 2000, showed 52% of food borne outbreaks was attributed to raw milk. [25]

Sources of bacteria in raw milk[26]

Milk is synthesized by cells within the mammary gland and is virtually sterile when secreted into the alveoli of the udder. Beyond this stage of milk production, bacterial contamination can generally occur from three main sources; within the udder, outside the udder and from the surface of equipment used for milk handling and storage. Cow's health, environment, milking procedures and equipment sanitation can influence the level of microbial contamination of raw milk. Equally important is the milk holding temperature and length of time milk is stored before testing and processing that allow bacterial contaminants to multiply.

Microbial Contamination From Within the Udder[26]

Raw milk, as it leaves the udder of healthy cows, normally contains very low numbers of microorganisms and generally will contain less than 1000

colony-forming units of total bacteria per milliliter (cfu/ml). In healthy cows, bacterial colonization within the teat cistern, teat canal, and on healthy teat skin do not significantly contribute total numbers of bacterial neither in bulk milk, nor to the potential increase in bacterial numbers during refrigerated storage. This natural flora of the cow generally will not influence the standard plate count (SPC), preliminary incubation count (PI), laboratory pasteurization count (LPC), or Coliform counts. While the healthy udder should contribute very little to the total bacteria count of bulk milk, a cow with mastitis has the potential to shed large numbers of microorganisms into her milk.

Microbial Contamination from Outside the Udder[26]

The exterior of the cow's udder and teats can contribute microorganisms that are naturally associated with the skin of the animal as well as microorganisms that are derived from the environment, in which the cow is housed and milked. In general, the direct influence of natural inhabitants as contaminants in the total bulk milk count is considered to be small and most of these organisms do not grow competitively in milk. Of more importance is the contribution of microorganisms from teats soiled with manure, mud, feeds or bedding.

Teats and udders of cows inevitably become contaminated while they are lying in stalls or when allowed in dirty lots. Used organic bedding has been shown to harbour large numbers of microorganisms often exceed 100,000,000 to 10,000,000,000 per gram of bedding. Organisms associated with bedding materials that contaminate the surface of teats and udders include streptococci,

staphylococci, spore-formers, coliforms and other Gram-negative bacteria. Both thermoduric and psychrotrophic strains of bacteria are commonly found on teat surfaces indicating that contamination on the outside of the udder can influence PI, LPC, and Coliform counts.

Microbial Contamination from Equipment Cleaning and Sanitizing Procedures[26]

The degree of cleanliness of the milking system probably influences the total bulk milk bacteria count as much, if not more, than any other factor. Milk residue left on equipment contact surfaces supports the growth of a variety of microorganisms. Organisms considered to be natural inhabitants of the teat canal and teat skin are not thought to grow significantly on soiled milk contact surfaces or during refrigerated storage of milk. This generally holds true for organisms associated with contagious mastitis (*Staphylococcus aureus* and *Streptococcus aeruginosa),* though it is possible that certain bacteria associated with environmental mastitis (coliforms) may be able to grow significantly. In general, bacteria from environmental contamination (bedding or manure) are more likely to grow on soiled equipment surfaces. Water used on the farm might also be a source of bacteria, especially psychrotrophs, which could seed soiled equipment.

Cleaning and sanitizing procedures can influence the degree and type of bacterial growth on milk contact surfaces by leaving behind milk residues that support growth, as well as by setting up conditions that might select for specific microbial groups. Even though equipment surfaces may be considered efficiently cleaned with hot water, more resistant bacteria (thermodurics) may endure in low numbers. If milk residue is left behind (milk stone) growth of these types of

organisms, although slow, may persist. Old cracked rubber parts are also associated with higher levels of thermoduric bacteria. Significant build-up of these organisms to a point, where they influence the total bulk tank count, may take several days to weeks, though increases would be detected in the LPC.

Milk Storage Temperature and Time[26]

Refrigeration of raw milk, while preventing the growth of non-psychrotrophic bacteria, will select for psychrotrophic microorganisms that enter the milk from soiled cows, dirty equipment and the environment. Minimizing the level of contamination from these sources will help to prevent psychrotrophs from growing to significant levels in the bulk tank during the on-farm storage period or at the processing plant. In general these organisms are not thermoduric and will not survive pasteurization. The longer raw milk is held before processing (legally up to 5 days), the greater the chance that psychrotrophs will increase in numbers. Holding milk near the pasteurized milk ordinance (PMO) legal limit of 45°F allows much quicker growth than milk held below 40°F. Although milk produced under ideal conditions may have an initial psychrotrophic population of less than 10% of the total bulk tank count, psychrotrophic bacteria can become the dominant bacteria after 2 to 3 days at 40°F, resulting in a significant influence on PI counts. Colder temperatures at 34-36°F will delay this shift, though not indefinitely.

Under conditions of poor cooling with temperatures greater than 45°F, bacteria other than psychrotrophs are able to grow rapidly and can become predominant in raw milk. *Streptococci* have historically been associated with

poor cooling of milk. These bacteria will increase the acidity of milk. Certain bacteria are also responsible for a "malty defect" that is easily detected by its distinct odour. Storage temperatures greater than 60°F tend to select for these types of contaminants. The types of bacteria that grow and become significant will depend on the initial contamination of the milk.

A study was carried out to assess the milk quality in Tarakeswar, India in 2006, with special reference to coliforms. By standard plate count (SPC) method, out of ten raw milk samples collected, the microbial colonies were found to be high in six samples and the colony content was low in rest four samples. In pasteurized milk samples, the colonies were low in seven samples and high in three samples. The methylene blue test performed for raw milk samples showed that out of ten samples, the five samples were poor, two samples were fair, two samples were good and only one sample was found to be an excellent. Out of ten pasteurized samples, nine samples were of good quality and one was found to be excellent. Bacterial colony was found to be opaque and metallic sheen in color prepared from five raw milk samples, and by biochemical characterization, it was identified as *Escherichia coli*.[1] A study from Thrissur, India in 2007 reported that, among 240 milk samples, 31.6% were positive for E. coli. [27]

Another study was done in 2008 to evaluate the bacteriological profile of the traditionally collected industrial raw milk from the milk pocket zones of Bangladesh. About 365 raw milk samples were collected from the milk tanker, who brought raw milk from the mother chilling centre, where raw milk was chilled at 4°C following traditional method. All milk samples were subjected to

perform standard plate count and total coliform count. The average standard plate count was found to be 4.37 x 10^6 cfu/ml.[9]

A study done to assess quality control measures of pasteurized milk in Western Cape, South Africa reported that, E. coli was isolated from 3.9% of the pasteurized milk samples with count of more than 190 cfu/ml. [28]

In a study from Lahore, Pakistan in 2009, the quality of the milk was assessed by monitoring aerobic viable bacterial count, coliform count and methylene blue reduction (MBR) test. Milk was procured from rural or suburban areas, transported at ambient temperature to different marketing points of Lahore city and sold as loose raw milk to consumers. It indicated that 53% to 100% milk samples from different towns contained the bacterial counts beyond the acceptable limits (10^6/ ml). There was no linear correlation between aerobic bacterial count and coliform count in samples collected. Although, there was no correlation between results of total aerobic bacterial count and that of MBR test in the market samples, but higher dilution was having lower MBR time of the same sample. This is why negative correlation between aerobic bacterial count and MBR is still reliable and valid test for monitoring hygienic status of market milk.[4]

A study done in Pakistan in 2004, aimed to isolate some pathogens from raw milk of different milch animals reported that, 66 raw milk samples collected, six samples were positive for E. coli, suggesting contaminated milk can contribute a potential risk for public health, in case it is consumed or used in the

production of dairy products such as cheese, butter, cream and ice cream without being pasteurized or being subjected to a sufficient heat process.[29]

A study reported that, during the period 1983-1984, 32 outbreaks of disease (11 in 1983 and 21 in 1984) associated with consumption of milk and dairy products and affecting at least 714 people were reported from England and Wales. Twenty-seven of the outbreaks were attributed to raw milk, two to contaminated pasteurized milk and one each to cheese, cream and ice-cream. Twenty-two were due to salmonellas, seven to campylobacters and one each to Staphylococcus aureus, Yersinia enterocolitica and Streptococcus zooepidemicus. Two sporadic cases of Corynebacterium ulcerans infection associated with raw milk were also reported. There were eight deaths, all associated with the S. zooepidemicus outbreak. The continuing occurrence of milk-borne outbreaks, and an increasing number of incidents affecting rural communities, emphasizes the urgent need for enforcing pasteurisation of milk and dairy products in England and Wales.[30]

A study reviewed outbreaks of infection associated with milk and other dairy products in Europe and North America from 1980 to 1985. *Salmonella* spp. and *Campylobacter* spp. were the most commonly identified etiological agents, while other infections of animal origin, in particular listeriosis and yersiniosis, were increasingly reported. Most infections were attributed to untreated cows' milk or cheese, but also increasingly to contaminated "heat-treated" products. Heat-treatment is highly effective in controlling foodborne disease, but may be insufficient, if not complemented by high standards of hygiene throughout production and processing. Large community outbreaks of salmonellosis,

listeriosis, and yersiniosis in Canada, Sweden, the United Kingdom, and the USA that were associated with contaminated "heat-treated" liquid milk, powdered milk, or cheese emphasize the vulnerability of dairy produce.[31]

In 2005, health officials in Clark County, Washington, USA noted a higher than expected number of Escherichia coli cases among residents and sought to identify a possible common source for infection. In order to identify risk factors, health officials conducted a retrospective cohort study and an environmental site investigation using pulsed-field gel electrophoresis (PFGE) to identify and prevent future cases from occurring. Several lines of evidence supported raw milk as the cause of infections: 1) All ill persons drank raw milk from the same cow share; 2) Illness was associated with an increasing amount of milk consumed; 3) E. coli O157:H7 was isolated from raw milk samples and environmental samples collected from the floor of the milking parlour; and 4) PFGE patterns were indistinguishable between case-patients, raw milk samples, and environmental samples. Together, these findings made clear the health risks associated with the consumption of raw milk. The high amount of media interest in this investigation empowered public health officials to work with state legislators to pass State Senate Bill 6377 in Washington State, USA, which clarified that state licensing requirements apply to all milk production facilities including cow-share programs.[32]

Recently a study in Senegal (2010) collected 85 bulk-tank milk samples from 68 smallholder dairy farms throughout the territory of Senegal. Microbiological quality of milk samples was analyzed according to the official standards. Further, raw milk and pasteurized milk were screened for

Mycobacterium bovis, Coxiella burnetii, and anti-Brucella abortus antibodies. Pathogens detected in milk were C. burnetii (6/41, 15%), which seemed to be endemic in Senegal, coagulase-positive staphylococci (18/70, 26%), and Salmonella johannesburg in one sample. Further analysis of coagulase-positive staphylococci isolated from samples containing more than 10 (4) colony-forming units per gram showed the presence of enterotoxigenic strains in 9 of the 10 samples. These results confirmed the poor microbiological quality of milk produced by small units in Senegal, especially and surprisingly of pasteurized milk. Study highlighted the need to implement good hygiene practices, particularly in the post-pasteurization process, and an effective monitoring throughout the production and delivery chain.[33]

A recent study to characterize the traditional milk chain in Gambia and Senegal to analyze milk chain actors' risk behaviours for milk-borne diseases transmission involving survey of cattle herds in milk production, milk collectors, milk vendors and small-scale milk processing units reported that, similar general milk chain organization was found in the two sites with some peculiarities in farm management, compliance with hygienic measures at different levels, treatment of milk and milk consumption patterns. This resulted in a variable degree of risk of consumers' exposure to milk-borne diseases. Although the quality of the milk had been improved with the development of small-scale milk processing units, serious efforts were still needed with respect to pasteurisation procedure and to change the mindset of consumers who prefer in their majority drinking raw milk, fresh or soured, without any prior treatment.[34]

Milk born diseases

It is impossible to produce sterile milk. Sources of contamination include commensals or pathogenic flora of the udder or teat canal, the animal's skin, fecal soiling of the udder, contaminated milking equipment, water used to clean the milking equipment, and milk storage containers.[35]

In addition, commensals or pathogenic organisms from milkers, insects, rodents, birds, and other animals may enter milk. Milk and milk products from domestic animals, which are potential infectious hazards, are made more so, by modern milk production, because milk from thousands of animals is often pooled prior to bottling or before manufacturing derivative products. Many infectious diseases are milk borne. Sir Graham Wilson described milk as "one of the most dangerous articles in our dietary". Organisms from human carriers, the environment, milk-producing animals, or other animals have been agents of milk borne disease.[35]

Brucellosis

All three species of Brucella have been isolated from milk in various parts of the world. In non-pregnant cows the organism is found in the secretory tissue of the udder. In man it causes systemic disease, usually with an insidious onset resembling flu, and clinical diagnosis is usually difficult.[36]

In a review to assess outbreaks of infection associated with milk and other dairy products in Europe and North America from 1980 to 1985 reported that, in 1984 an outbreak of brucellosis was reported in a village community of Italy.[31]

Staphylococcus infections

In man, pathogenic staphylococci are commonly associated with skin lesions, infected lacerations, boils and pustules that are common in farm workers. In cattle, staphylococcus is often found in older cows as a low grade, sub-clinical mastitis or from small ulcers on the teats.[36]

E. coli

E. coli is found naturally in the environment for example in soil, water and faeces / manure or in the digestive tract of humans and animals. It is an important indicator of poor hygiene practices or improper processing. Symptoms of contracting this organism are vomiting, fever, diarrhoea and stomach cramps.[36]

Tuberculosis

Infected milk is the most important vehicle for the transmission of bovine tuberculosis in man, and it would appear that the presence in man is dependent on the prevalence in cattle, and the amount of raw milk consumed. Bovine tuberculosis commonly affects ileocaecal junction in abdomen.[36]

Streptococcal infections

Group A streptococci (sore throat, scarlet fever and mastitis) originate from human carriers, that in turn, may affect the udder. Unpasteurized or inefficiently cooled milk can lead to a rapid multiplication.[36]

Typhoid and Paratyphoid (Salmonellosis)

These are not natural pathogens of milk animals, but are readily transmitted by milk in those areas, where pasteurization is not enforced. This is a common food poisoning organism due to poor hygiene or incorrect processing. Symptoms associated with contracting this organism are nausea, vomiting, abdominal pain, headache, chills and diarrhoea.[36]

Shigellosis

Shigella infections in man are often associated with the ingestion of raw milk. It occurs worldwide and two thirds of the cases and most of the deaths are in children under the age of 10 years. This occurs commonly in population living under poor conditions-malnutrition, poor sanitation and crowding. Sources are hands of milkers, water and flies.[36]

Campylobacter jejuni

This organism is found naturally in soil, water, and farm waste and in the digestive tract of animals. In recent years there have been reports of severe outbreaks of enteritis in the U.K. attributed to Campylobacter jejuni. In all cases consumption of unpasteurised milk was implicated. Symptoms are profuse diarrhoea (sometimes bloody), stomach cramps, nausea, dizziness and fever.[36]

Helicobacter pylori

This organism may be transmitted through contaminated milk. Infection with the organism is a powerful predisposing factor to the development of

stomach cancer. Treatment of clinical cases is expensive, and a correct diagnosis in humans requires a gastric biopsy.[36]

Listeria monocytogenes

This organism is found naturally in the environment. Consuming raw milk could lead to contracting this organism. It could cause symptoms like flu-like illnesses to meningitis. It may also cause abortion in pregnant women. It has a mortality rate of 30% of those who are infected.[36]

Outbreaks associated with the consumption of raw milk routinely occur every year.[25, 31] A study conducted in Canada from 1973 - 1982 revealed over 300 incidences of milk borne disease mainly of bacterial origin.[31] Another study conducted by Centres for Disease Control and Prevention, U.S.A**.** from 1998 to 2006 revealed that more than 800 people in U.S.A. had suffered from milk borne diseases from drinking raw milk or eating cheese made from raw milk.[37] Increased incidence of milk borne diseases has also been observed in U. K**.**[31]

A study done between 1973 - 1992 in U.S.A. showed that, raw milk was associated with 46 outbreaks of food borne illness. Another study done in England and Wales between 1992 - 2000, showed 52% food borne outbreaks were attributed to raw milk.[25]

A study was carried out to estimate the proportion of diseases due to milk and milk products among food-borne diseases in France and in other countries since 1980. Particular attention was given to whether the milk involved was heat-treated or not. Four etiologic agents were considered: Salmonella spp.,

Staphylococcus aureus, Listeria monocytogenes, and pathogenic Escherichia coli. An overview of food-borne disease annual reports from seven countries indicated that milk and milk products were implicated in 1-5% of the total bacterial outbreaks; however, details about the type of product and milk involved were usually not provided. When considering 60 outbreaks and four single cases described in the literature and implicating milk and milk products, confirmed or suspected food vehicles were distributed as follows: milk, 39.1%, cheese, 53.1%, other milk products, 7.8%. Overall, 32.8% of the food vehicles were made from pasteurized milk; 37.5% from raw milk; 10.9% from milk stated as "unpasteurised"; and 18.8% from unspecified milk. Salmonella spp. were responsible for 29 outbreaks, L. monocytogenes for 10 outbreaks and four well-documented single cases, pathogenic E. coli for 11 outbreaks, and S. aureus for 10 outbreaks. Analysis of unpublished data about food-borne disease outbreaks, listeriosis excluded, collected by the coordinator of the French surveillance system from 1992 to 1997, revealed 69 documented outbreaks for which milk and milk products were confirmed as the vehicle by the isolation of the etiologic agent. The food vehicles were distributed as follows: milk, 10%; cheese, 87%; others, 3%. UHT milk accounted for 1.5%, raw milk and raw milk products for 48%, and milk and milk products from unspecified milk for 50.5% of the 69 outbreaks. S. aureus was by far the most frequent pathogen associated with these outbreaks (85.5% of the outbreaks), followed by Salmonella (10.1%).[38]

Another study reported that, the presence of food borne pathogens in milk is due to direct contact with contaminated sources in the dairy farm environment and to excretion from the udder of an infected animal. Most milk is pasteurized;

so why should be the dairy industry concerned about the microbial quality of bulk tank milk? There are several valid reasons, including; [39]

(1) Outbreaks of disease in humans have been traced to the consumption of unpasteurized milk and have also been traced back to pasteurized milk.

(2) Unpasteurized milk is consumed directly by dairy producers, farm employees, and their families, neighbours, and raw milk advocates.

(3) Unpasteurized milk is consumed directly by a large segment of the population via consumption of several types of cheeses manufactured from unpasteurized milk.

(4) Entry of food borne pathogens via contaminated raw milk into dairy food processing plants can lead to persistence of these pathogens in biofilms, and subsequent contamination of processed milk products and exposure of consumers to pathogenic bacteria

(5) Pasteurization may not destroy all food borne pathogens in milk.

(6) Inadequate or faulty pasteurization will not destroy all food borne pathogens. Furthermore, pathogens such as Listeria monocytogenes can survive and thrive in post-pasteurization processing environments, thus leading to recontamination of dairy products.

These pathways pose a risk to the consumer from direct exposure to food borne pathogens present in unpasteurized dairy products as well as dairy products that become re-contaminated after pasteurization.[39]

A study to establish baseline characteristics for milk borne outbreaks, an expected milk borne outbreak profile, and identify potential indicators of food terrorism used 1990–2006 data from the Centers for Disease Control and Prevention Annual Listings of Disease Outbreaks and the Food borne Outbreak Database (FOOD) to establish epidemiologic baseline characteristics for disease outbreaks associated with fluid milk. FOOD data from 2007 were used to qualitatively validate the potential of the baseline characteristics and the expected outbreak profile. Eighty-three fluid milkborne outbreaks were reported between 1990 and 2006, resulting in 3621 illnesses. The mean number of illnesses per outbreak was 43.6 (illness range: 2–1644). Consumption of unpasteurized milk was associated with 55.4% of reported outbreaks. *Campylobacter* spp., *Escherichia coli*, and *Salmonella* spp. caused 51.2%, 10.8%, and 9.6% of reported outbreaks, respectively. Private homes accounted for 41.0% of outbreak locations.[40]

Quality of informally marketed raw milk

Milk is considered an attractive source of energy, proteins and calcium for infants and young children who have few alternative sources for these nutrients. Besides its beneficial effects on nutrition, milk is ideally suited for growth of microorganisms.[23] Consuming raw (unpasteurised) milk could expose the public to many disease-causing organisms.[36] To protect public health against these milk borne diseases, there are regulations that require proper hygienic handling of milk and its pasteurization.[41]

The informal milk market pathways persist because they provide social and economic benefits to smallholder producers, small market agents and consumers in terms of higher farm gate prices, creation of employment and competitive consumer prices.[19]

Food safety standards require monitoring from production-to-consumption. The Hazard Analysis Critical Control Points (HACCP) process, recommended by FAO / WHO, [42] is now a widely accepted methodology in risk analysis for industrially processed foods. HACCP identifies the points in a process that are hazardous, their risk factors and potential level of risk so that "critical control points" for remedial action can be implemented. Controls are specific actions taken to prevent hazards. The application of HACCP is a major challenge in developing countries, where food markets are mostly informal. Market channels for milk range from direct sales of liquid milk or processed dairy products from producers to consumers, to a long chain involving combinations of private traders on bicycles, public or private transport, milk bars and kiosks, dairy farmer groups, small-scale and industrial processors.[43]

Informal milk markets involve milk sale through unregulated channels. Such markets account for over 80% of convenient delivery and lower prices from these informal milk markets.[44] However, there are regulations such as restricting milk handling to cold chain pathways to discourage such markets for public health reasons, though these regulations are not generally implemented in many countries. [45-47] In Ghana, studies done on selected farms show that raw milk may be contaminated by a wide range of bacteria, including *Staphylococcus aureus*,

Escherichia coli, Pseudomonas pyocyaneus, Bacillus, and *Corynebacterium* spp.[46 & 47]

A study from Ghana in 2007 had shown that informally marketed raw milk in the two cities could be an important source of infection with a wide range of organisms, particularly enteric pathogens. An important source of microbial contamination of the milk is faecal pollution probably from cow dung. It also emphasized the need for instituting effective control measures to protect public health. This includes mandatory milk pasteurization by traders and improved hygienic handling of the commodity during milking, ensuring milking is not done in presence of cow dung.[41]

Another study done in 2011, to investigate the microbiological quality and the presence of antibiotic residues in raw cow milk and in some indigenous milk products produced and marketed by the informal sector in the coastal savannah zone of Ghana concluded that, bulk milk contains unacceptable levels of hygiene indicators and antibiotic residues and is a potential source of milk-borne infections. The detection of E. coli and antibiotic residues raised public health concerns about the safety of fresh unpasteurized cow milk in Ghana and called for improved farm hygiene, the need for milk pasteurization and the sensible use of antibiotics in the milk industry.[48]

Knowledge, attitude and practices of milk borne diseases [49]

It is well established that food borne diseases cause significant economic and social losses. In the United States, there are estimates that food borne diseases account for millions of illnesses, hundreds of thousands of

hospitalizations, and thousands of deaths each year. Many of the agents responsible for foodborne diseases have only recently been recognized. Well-publicized foodborne disease outbreaks have created widespread consumer awareness of potential threats to human health from contaminated food. Modern communication systems have enhanced consumer awareness of outbreaks occurring throughout the world and have reduced the sense of safety associated with distance. Geographical barriers to the spread of disease have been reduced by the globalization of food systems and by the frequent movement of people and animals.

The potential for additional animal or human pathogens to survive current food processing methods (such as pasteurization) is an area of ongoing research.

The dairy industry has been extremely successful in producing safe and nutritious products. Consumption of raw milk remains a well-identified risk factor for foodborne disease, but pasteurization has been highly effective in ensuring the safety of dairy products. Even though dairy products are consumed on a daily basis, milk, ice cream, and cheese have been identified as the vehicle for less than 1.5% of all foodborne disease outbreaks investigated by the Centers for Disease Control. In cases involving pasteurized dairy products, errors in the pasteurization process have frequently been identified as the route of contamination.

Potential threats to human health related to the dairy industry include errors during pasteurization, consumption of raw milk products, and contamination of milk products by heat-resistant pathogens, chemical

adulteration of milk, and foodborne disease transmission by market dairy cows. An additional concern is transmission of zoonotic pathogens to farm workers and visitors.

The role of antibiotics used in animal agriculture in the development of antimicrobial resistance is controversial and increasingly scrutinized. Most dairy farmers feel responsible for the safety of milk and beef that originate on their farms, but linkage between farm production practices and the quality of processed products have been weak. The safety of dairy products can be enhanced by adoption of a number of management practices.

Healthy dairy cattle are considered a reservoir for several of the most important foodborne human disease pathogens. Nontyphoidal *Salmonella* spp., and *Campylobacter jejuni* are considered important threats to food safety, because of the enormous number of illnesses they cause. *Listeria monocytogenes* and *Escherichia coli* O157:H7 are priority pathogens because of the severity of symptoms associated with infection and because of the number of deaths that occur in infected people. All of these pathogens are shed in cattle faeces and can contaminate dairy farm premises including unpasteurized bulk tank milk. In some instances, colonization of the udder can also contribute to contamination of bulk milk supplies. *Salmonella* spp., are an infrequent cause of mastitis in dairy cows but several species of *Salmonella* have been documented to colonize udders and shed at levels of up to 2,000 organism/ml. *Listeria monocytogenes* has been reported to cause mastitis and can be shed in milk. A study that examined more than 500 isolates of milk obtained from coliform mastitis cases was not able to isolate O157:H7 from any of the samples and *E. coli* O157:H7 has not been

recognized as a cause of mastitis. *C. jejuni* can be shed in milk, but fecal contamination of milk is a more likely route of exposure.

When regulatory standards for bacterial counts in raw milk are met, pasteurization of milk is highly effective in destroying all of these organisms. There are three primary routes of potential exposure of humans to these bacteria and other potential threats to human safety associated with the dairy industry: 1) ingestion of contaminated raw milk, 2) contact with beef contaminated with faeces, and 3) direct contact with infected animals. Ingestion of raw milk is a high-risk behaviour that is reported by a small proportion (< 2%) of the overall US population, but can be a significant risk factor for specific subpopulations.

Consumption of raw milk or raw milk products occurs frequently in dairy farm workers and in some ethnic communities. Direct or indirect contact with infected animals is also a known risk factor for a number of zoonotic diseases. Contact with farm environment, living in an area in proximity to livestock farms, and living in an area where manure is applied to farm land, have all been identified as significant risk factors for *E. coli* O157:H7. The common characteristic of these potential routes of exposure is the presence of fecal contamination, and it is intuitive that the reduction of fecal contamination of food products should be a primary objective of food safety programs.

METHODOLOGY

The present study was conducted in the rural field practice area of Primary Health Center (PHC), Vantamuri, Belgaum and urban field practice area of Urban Health Centre (UHC) Khasbag, Belgaum. The Vantamuri PHC has five sub-centers catering to 18 villages, having total population of 31,510. It is situated by the side of Pune-Bangalore National Highway and is 20 Kms. from Belgaum towards north (Figure 1). Ward No. 21 of Urban Health Centre, Khasbag, Belgaum is situated at old Pune-Bangalore Road and is 6 Kms from Jawaharlal Nehru Medical College, Belgaum towards south. It has about 1,250 households with 7,689 people (Figure 2).

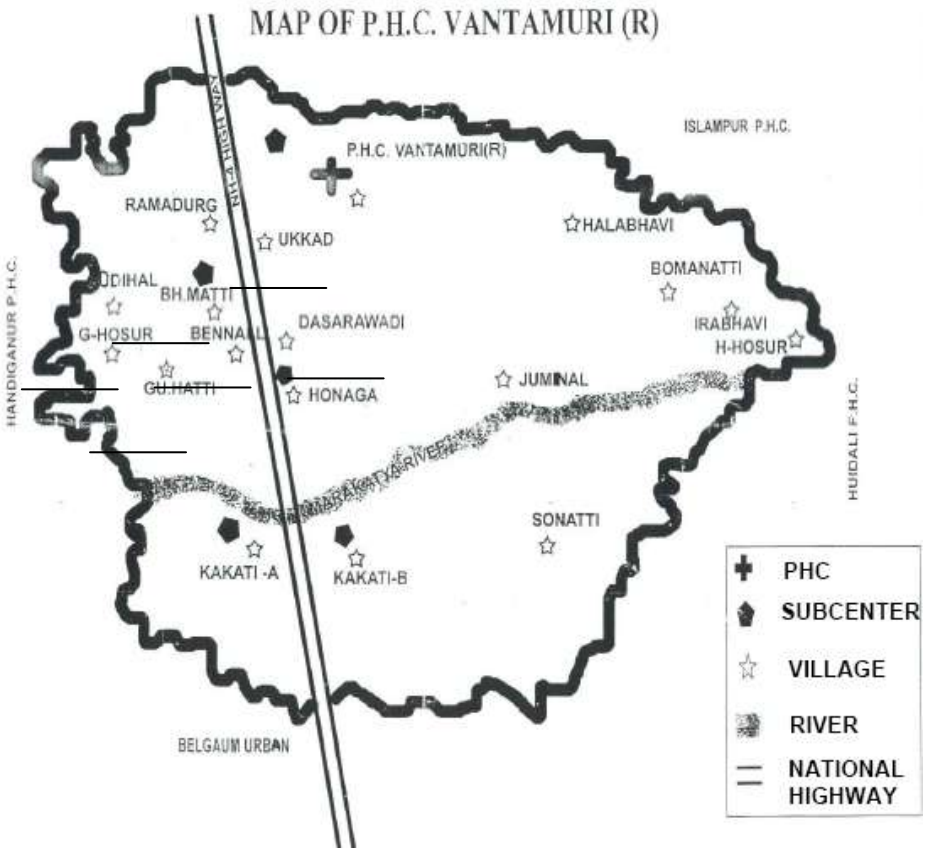


Figure 1. Map of Rural Field Practice Area of Vantamuri, Belgaum

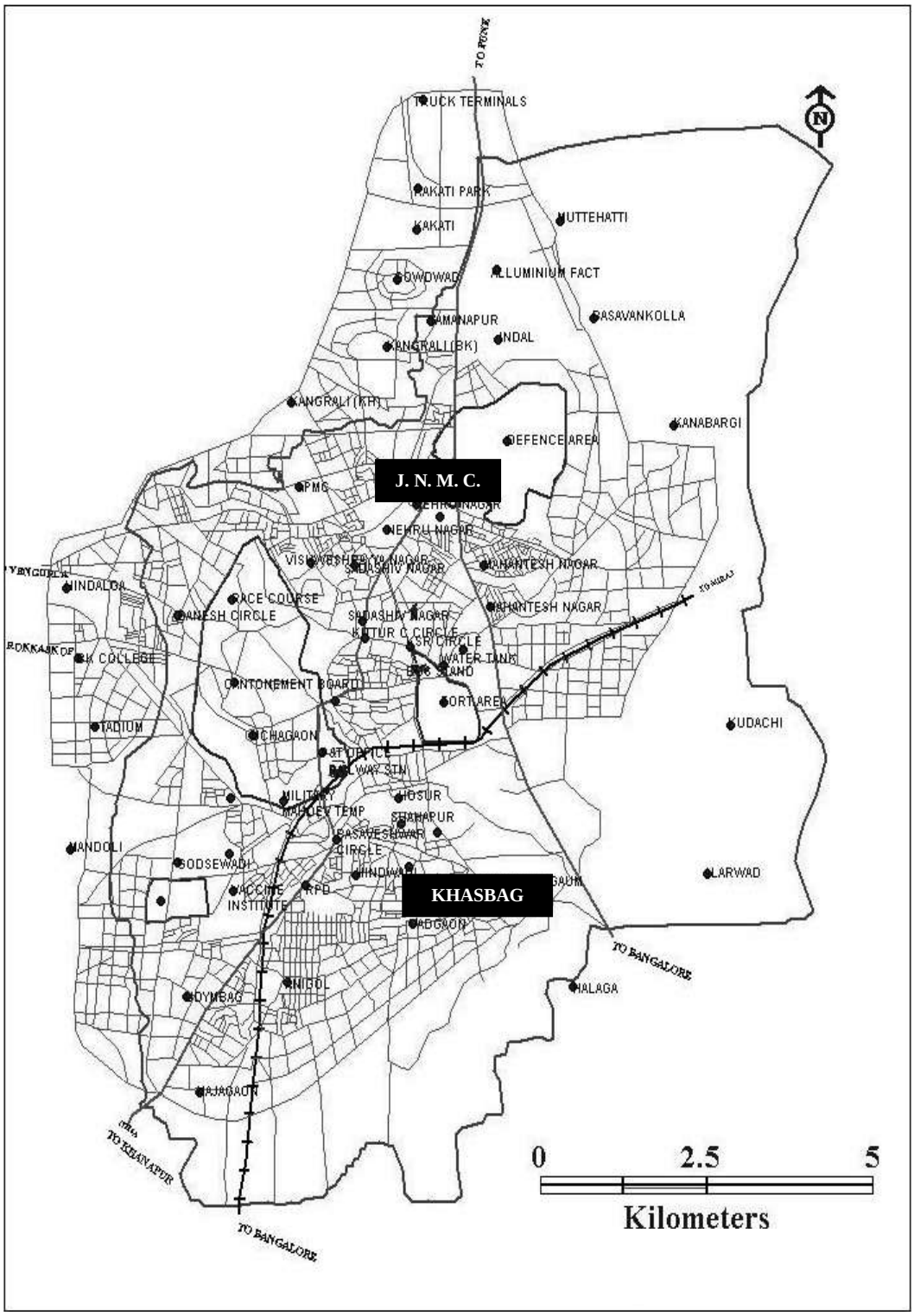


Figure 2. Map of Urban Field Practice Area, Khasbag, Belgaum

Design

The study design was community based cross-sectional study.

Duration

This one year study was conducted from January 2010 to December 2010.

Participants

Households residing in the rural field practice area of Primary Health Centre, Vantamuri, Belgaum and urban field practice area of Urban Health Centre, Khasbag, Belgaum were selected for the study.

Sample size

Five hundred (500) households residing in the above areas were selected for the study.

Sampling procedure

Vantamuri PHC in Belgaum district has five sub-centers and Vantamuri Subcentre covers total 1,234 households with 6,995 people. A total of 250 (20% of the households) households were selected by systematic random sampling to collect data by questionnaire.

Similarly ward No. 21 of Urban Health Centre, Khasbag, Belgaum, has about 1,250 households with 7,689 people. Hence a total of 250 were selected by systematic random sampling.

Of these 10% of the households, that is 25 houses each from both the areas using informally marketed milk, were selected by simple random sampling and raw milk samples were collected for laboratory analysis.

Selection criteria

Inclusion

- All households consuming informally marketed milk during the period of survey were included.

Exclusion

- Nil

Ethical Clearance

The study was approved from Institutional Ethics Committee for Human Subjects' Research, Jawaharlal Nehru Medical College, Belgaum (Annexure I).

Informed consent

The study participants were interviewed in their households by the investigator. Based on the selection criteria, the study participants were selected and written informed consent (Annexure II) was obtained from all the participants.

Procedure

Before starting the study, pilot study was carried out in the study population using a predesigned and structured questionnaire. Appropriate

changes were made to the questionnaire, based on the pilot study results. The data was collected using predesigned and pretested proforma (Annexure III).

Data regarding demographic variables like place of residence, age, sex, education status, marital status, socio-economic status and type of family were recorded. The assets and liabilities such as land holdings, live stock - specially milk producing animals, insurance, affiliation with self help groups and environment conditions were also noted.

A predesigned and pretested questionnaire assessing information regarding milk consumptions in terms of source, type, quantity (ml) and per capita consumption (ml) / day, knowledge about milk borne diseases, attributes that influence raw milk consumption practices, attitude (especially disease), consumption practice (hygiene of premises and personnel, adulteration), animal sources for milk (hygienic measures while milking) were assessed.[50]

About 10 ml of raw milk sample was collected from 10% of the households interviewed, by simple random sampling method. Specific gravity of the raw milk sample was measured at the collection point by the investigator using lactometer. Then milk samples were poured into separate sterile test tubes and covered with cotton plug and sent to Laboratory, Department of Microbiology, Jawaharlal Nehru Medical College, Belgaum, within three hours of sample collection and it was subjected to the following microbiological tests:

As per the standard protocol,

1. Methylene blue reduction test to test presence of bacteria.

2. Coliform test to detect milk dilution by contaminated water.
3. Brucella milk ring test to know the infection of cow's udder with brucella abortus.

Statistical analysis

The data was tabulated and master chart was prepared (Annexure IV). Data collected in the questionnaire was coded and entered in Microsoft excel sheet. Data was analysed and expressed in terms of rates, ratios and percentages. Laboratory reports were analysed separately. Statistical analysis was done using Chi Square test. A probability value (p value) of less than 0.05 was considered as significant.

Definition of study variables

Age: Age was recorded to the nearest completed year as per information given by the study subject.

Religion: The subject's religion was noted and was grouped as "Hindu", "Muslim", and "Others" (Jain, Boudh, Parsi and Christian etc).

Type of family[11]

Nuclear family: Married couples, along with their dependent children living in the same house.

Joint family: Many married couples and their children who are living in the same household. All males in the family are blood relatives and all females of the family are related to them by either marriage or blood relation.

Three generation family: Married couple with married children and their kids (three generations) related to each other by direct descent and living together.

Broken family: One where, the couple have separated, or where death has occurred for one or both the spouses.

Socioeconomic status: Information of total monthly income of the family in rupees was obtained as well as the family size. Per capita monthly income in rupees was calculated, and then the family was classified using modified B. G. Prasad's classification.[11]

Modified B. G. Prasad's Classification

Socioeconomic class	Prasad's classification (1961) per capita income in Rs/ month[11]	Modified Prasad's classification in the study period (2010) Per capita income in Rs/month[52]
I	100 & above	4100 & above
II	50 – 99	2050 & 4099
III	30 –49	1230 & 2049
IV	15 – 29	615 & 1229
V	below 15	below 615

Average Consumer Price Index for the year 2010 = 841[52]

Modification was done with the aid of Multiplication Factor (M.F), which was obtained as below:

$$\text{M. F.} = \frac{\text{Average Consumer Price Index for study period}}{100} \text{ X } 4.93$$

$$\text{M. F.} = \frac{841}{100} \text{ X } 4.93$$

$$= 41.46 \approx 41$$

Educational status: The subjects were asked about their educational qualifications and were grouped into following categories as per NFHS 3 Criteria 2005-06.

Illiterate: A person above 7 years, who could not read and write with understanding in any language as per 2001 census.

First to fifth: A person who had studied up to fifth standard or a person who can read and write with understanding in any language (without attending the school).

Sixth to Tenth: A person who had studied between sixth to tenth standard.

Tenth plus: A person who had studied above 10^{th} standard and attended college/diploma.

Physical test

Specific gravity of milk by lactometer

Specific gravity of milk was measured using lactometer of Amber Company to detect the change in density of adulterated milk with water. Milk sample was gently poured into a measuring cylinder (50 ml). The lactometer was let to sink slowly into the milk. Measurement was read and recorded to the last Lactometer degree (^oL) (30) just above the surface of the milk. For the calculations, lactometer degrees were used, and for the conversion to density 1.0

was written in front of the true lactometer reading, that is, 1.030 g/ml. The average specific gravities considered were;

- Cow Milk - 1.028 to 1.030
- Buffalo Milk - 1.030 to 1.032
- Goat Milk - 1.028 to 1.030[51]

Microbiological tests [53]

Methylene blue reduction test

Methylene blue solution was used for testing. Test tubes of 20 ml were used 10 ml/marks. They were stoppered with cotton-wool and sterilized in a hot air oven (160^0 C for one hour). A thermostatically controlled covered water bath with a rack to hold the tubes immersed in the water was required, the water should be at 37 - 38^0 C. One ml straight sided pipettes were used for measuring methylene blue solution. They were sterilized in a hot air oven. The sample was mixed thoroughly prior to making bacterial count.

The milk was poured with the usual aseptic precautions, into a test tube up to the 10 ml mark and one ml of methylene blue solution was carefully added. The tube was closed with sterile rubber stopper which was inserted with sterile forceps. It was then inverted slowly once or twice and placed in the water bath. Decolourization was considered complete when the whole column of milk was decolourized or decolourized up to within five mm of the surface. For the purposes of the milk regulations, untreated milk was considered satisfactory, if it failed to decolourize methylene blue in 30 minutes.

Coliform test to detect faecal contamination of milk

The media used for estimating number of viable count was yeast extract milk agar. For testing standard milk under Scottish regulations, one ml of the 1 in 1000 dilutions was plated, duplicate or preferably triplicate plates being made. The diluted milk was placed with a sterile pipette in a sterile petri dish (4 mm in diameter) and 10 ml of melted agar cooled to 45^0 C was added and mixed with milk by rotating the plate carefully first to right, then to the left, so that the organisms were uniformly distributed throughout the agar. After the medium was solidified the plates were incubated in the inverted position for 72 hours at $30^0 \pm 0.5^0$ C. The number including pinpoint colonies were counted. Each plate and the mean calculated multiplied by the dilution was reported as the number of viable bacteria per ml. The standard milk should not contain more than 50,000 bacteria per ml and number of coliform bacteria in 0.001 ml.

Test of coliform bacilli

Varying amounts of milk were added to tubes of bile salt lactose medium. The range of amounts that require to be tested depends on the likely degree of contamination. In case of milk of unknown quality the following series was suggested (1 ml of milk in 9 ml of MacConkey broth)

1.0 ml of a 1 in 10 dilution of milk

1.0 ml of a 1 in 100 dilution of milk

1.0 ml of a 1 in 1,000 dilution of milk

1.0 ml of a 1 in 10,000 dilution of milk

The smallest amount that yields acid and gas was ascertained. Under the Scottish regulations, for standard milk, these tubes were inoculated each with 1 ml of 1 in 1000 dilution. The milk sample was taken to have passed the test if acid and gas were absent from two of the three tubes. Samples were considered positive for coliform test, if showed more than 10^5 bacteria per ml of milk.

Milk Ring test for brucella

The milk was mixed thoroughly and poured into a test tube sufficient to give a column of milk about 1 in high. One drop of stained antigen was added and mixed thoroughly by shaking. Frothing was avoided which could interfere with reading of the test. It was incubated at 37^0 C water bath for about 40 to 50 minutes, which was sufficient time of the cream to rise.

In milk containing brucella agglutins the bacteria were agglutinated and raised with the cream forming a blue cream line, having the skin milk white in samples, in which there were no agglutinins. There was a white cream line and the rest of the milk remained blue.

The results were interpreted as positive (+++). Cream layer formed a deep blue ring on top of a completely white column of milk. This indicated a high concentration of agglutinins. The white cream layer and milk column blue were considered as negative.

RESULTS

This one year community based cross-sectional study was conducted in 20101 in the rural field practice area of Primary Health Center (PHC), Vantamuri, Belgaum and urban field practice area of Urban Health Centre (UHC) Khasbag, Belgaum. The Vantamuri PHC has five sub-centers catering to 18 villages, having total population of 31,510. It is situated by the side of Pune-Bangalore National Highway and is 20 Kms. from Belgaum towards north. Ward No. 21 of Urban Health Centre, Khasbag, Belgaum is situated at old Pune-Bangalore Road and is 6 Kms from Jawaharlal Nehru Medical College, Belgaum towards South. It has about 1,250 households with 7,689 people as per 2001 census.

Five hundred (250 each in urban and rural areas) households consuming informally marketed milk during the period of survey were studied. Information regarding milk consumptions in terms of source, type, quantity (L) and per capita consumption (ml)/ day, knowledge about milk borne diseases, attributes that influence raw milk consumption practices, attitude (especially disease), consumption practice (hygiene of premises and personnel, adulteration), animal sources for milk (hygienic measures while milking) were assessed.

The data was tabulated and master chart was prepared (Annexure IV). Data collected in the questionnaire was coded and entered in Microsoft excel sheet and data was analyzed and tabulated as below:

Table 1: Distribution of study population according to gender

Gender	Urban (n=250)		Rural (n=250)	
	Number	**Percent**	**Number**	**Percent**
Male	2	0.8	4	1.6
Female	248	99.2	246	98.4
Total	**250**	**100**	**250**	**100**

Majority of study participants, 99.2% and 98.4% in urban and rural area respectively, responsible for handling of milk were females.

Age-wise distribution of study participants

The age distribution of the study participants in urban area ranged from 19 to 67 years with mean age ± SD being 41.10 ± 14.09 years and median 41 years. In rural area age ranged from 18 to 75 years with mean age ± SD being 44.30 ± 14.60 years and median 45 years.

Table 2: Distribution of study participants according to religion

Religion	Urban (n=250)		Rural (n=250)	
	Number	**Percent**	**Number**	**Percent**
Hindu	180	72.00	194	77.60
Muslim	53	21.20	48	19.20
others	17	6.08	8	13.20
Total	**250**	**100**	**250**	**100**

Most of the study participants 72% and 77.6% were Hindu, 21.2% and 19.2% were Muslim and 6.08% and 13.20% were from other religion in urban and rural field practice areas respectively.

Category-wise distribution of study participants

32% and 64% belonged to SC category, 4% and 71.6% to ST, 52% and 18.8% to OBC and 12% and 3.2% to other general categories in urban and rural field practice areas respectively.

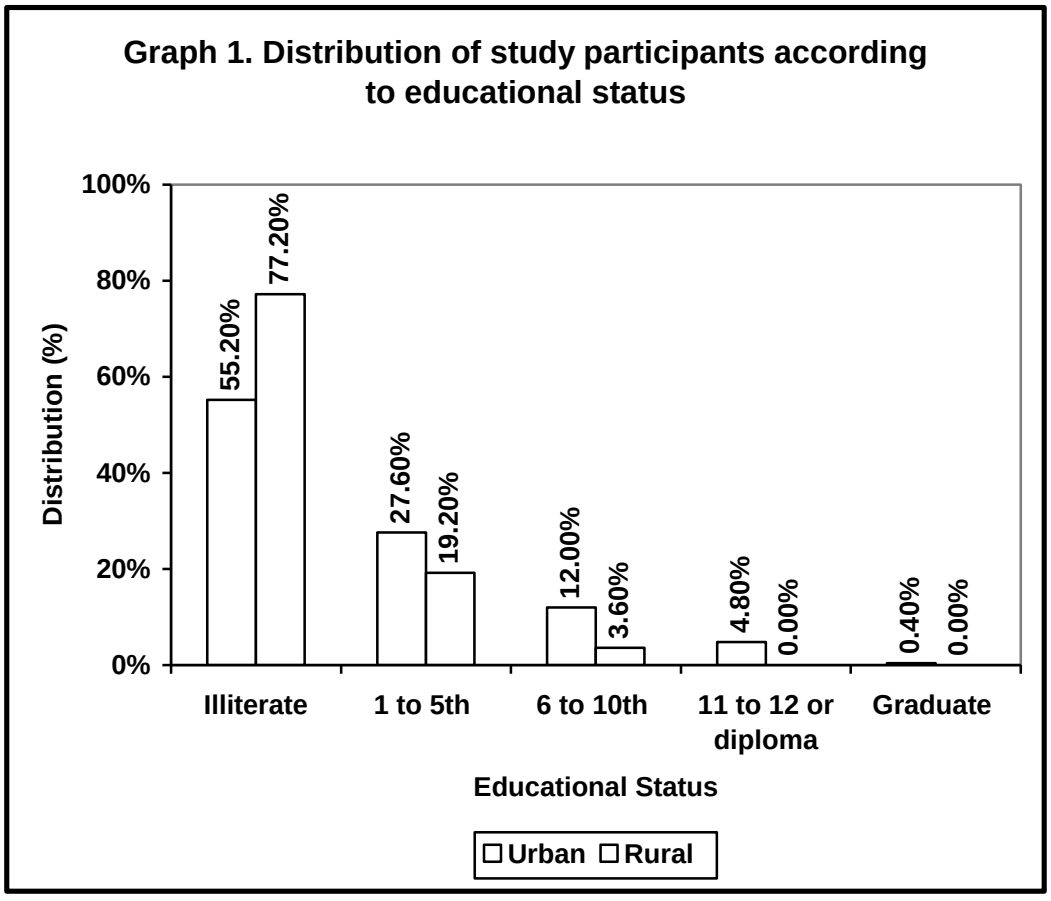
Table 3: Distribution of study participants according to type of family

Type of family	Urban (n=250)		Rural (n=250)	
	Number	**Percent**	**Number**	**Percent**
Nuclear	135	54.00	55	22.00
Joint	47	18.80	174	69.60
Extended	51	20.40	17	6.80
Broken	17	6.80	4	16.00
Total	**250**	**100**	**250**	**100**

Most of the study participants (54%) belonged to nuclear family in urban area, whereas 69.60% of the rural population belonged to joint family. The distribution of other study participants is as shown in table 3.

Table 4: Distribution of study participants according to educational status

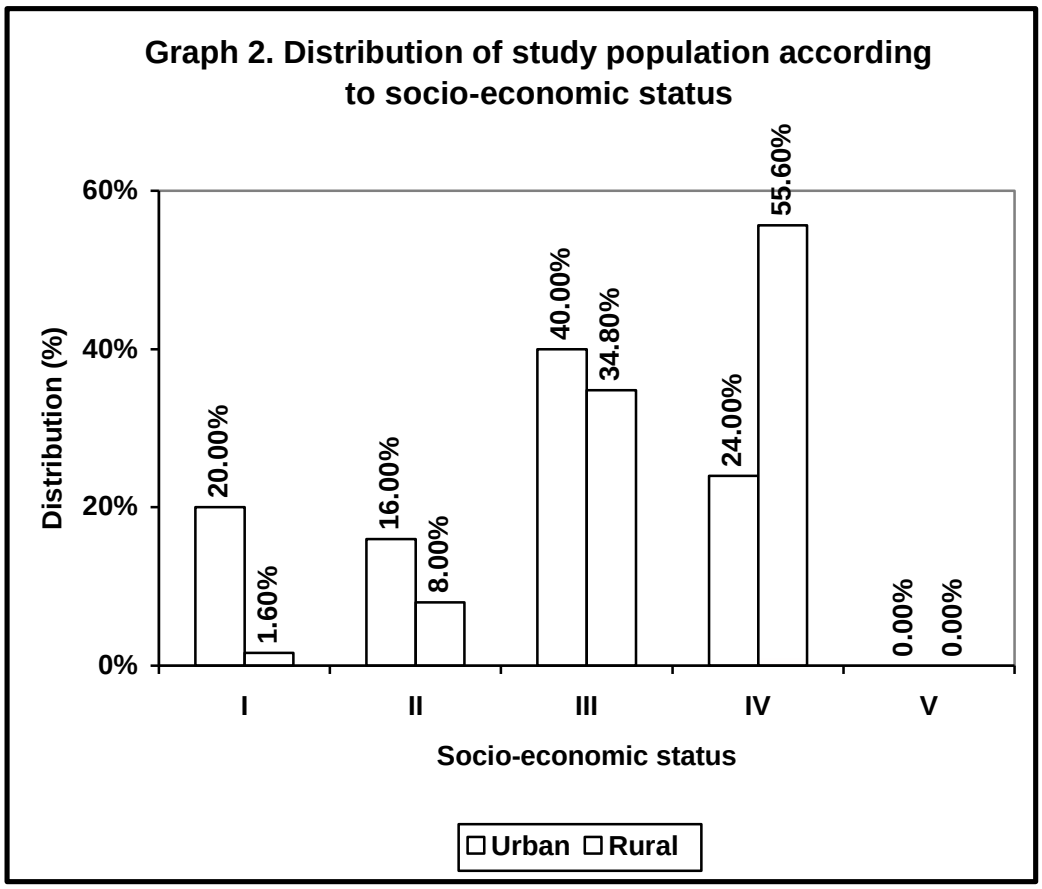
Education	Urban (n=250)		Rural (n=250)	
	Number	**Percent**	**Number**	**Percent**
Illiterate	138	55.20	193	77.20
1^{st}-5^{th} std	69	27.60	48	19.20
6^{th}-10^{th} std	30	12.0	9	3.60
11^{th} -12^{th} or diploma	12	4.80	0	0
Graduate	1	0.40	0	0
Total	**250**	**100**	**250**	**100**



Majority (55.20% urban and 77.20% rural) were illiterates. In urban area 27.6% had studied first to fifth standard, 12% studied sixth to tenth standard, 4.8% studied pre-university or diploma and 0.4% were graduates, whereas in rural area 19.2% and 3.6% studied first to fifth standard and sixth to tenth standard respectively, and none had completed pre-university education / diploma or graduation.

Table 5: Distribution of study population according to socio-economic status

Socio-economic status	Urban (n=250)		Rural (n=250)	
	Number	**Percent**	**Number**	**Percent**
Class I	50	20.00	4	1.60
Class II	40	16.00	20	8.00
Class III	100	40.00	87	34.80
Class IV	60	24.00	139	55.60
Class V	0	0	0	0
Total	**250**	**100**	**250**	**100**



In this study, 20% and 1.6% of the study participants belonged to Class I, 16% and 8% to Class II, 40% and 34.8% to Class III, 24% and 55.6% to class IV, and none of them belonged to class V in urban and rural areas respectively.

Distribution of study participants according to land holding and type of land

Thirty six percent of the study participants possessed land in rural area, whereas 8% possessed land in urban area. Among the urban households, four percent each possessed land with and without irrigation, whereas in rural area 5.2% had irrigated land and 30.8% had non-irrigated land.

Table 6: Distribution of study participants according to possession of ration card

Type of Ration card	Urban (n=250)		Rural (n=250)	
	Number	Percent	Number	Percent
Nil	5	2.00	28	11.20
BPL	244	98.00	222	88.80
APL	0	0	0	0
Total	**250**	**100**	**250**	**100**

In this study majority, 98% in urban area and 88.8% in rural area had BPL ration cards. None of them possessed APL card.

Distribution of study participants according to insurance coverage

With regard to the type of insurance coverage (Life / Health / Individual or group based), none of the participant from rural community had opted for coverage in the year preceding the survey. Four (1.6%) participants from urban community had opted for life insurance in the year preceding the survey.

Table 7: Distribution of study participants according to membership of Self Help Group / Mahila Mandal

Membership of SHG/MM	Urban (n=250)		Rural (n=250)	
	Number	Percent	Number	Percent
Yes	22	8.80	20	8.00
No	228	91.20	230	92.00
Total	**250**	**100**	**250**	**100**

In this study few (8.8% in urban and 8% in rural) enrolled with either Self Help Groups or with Mahila Mandals.

Table 8: Distribution of study participants according to type of House

Type	Urban (n=250)		Rural (n=250)	
	Number	**Percent**	**Number**	**Percent**
Kaccha	20	8.00	74	29.60
Semi-Pucca	210	84.00	176	70.40
Pucca	20	8.00	0	0
Total	**250**	**100**	**250**	**100**

Majority of the study participants, 84% from urban area and 70.4% from rural area stayed in semi-pucca house. In the remaining, 8% each stayed at kaccha and pucca house in urban area, whereas 29.6% stayed in kaccha house in rural area.

Table 9: Distribution of study participants according to source of drinking water supply

Water supply	Urban (n=250)		Rural (n=250)	
	Number	**Percent**	**Number**	**Percent**
Tap	160	64.00	0	0
Bore well	90	36.00	250	100
Total	**250**	**100**	**250**	**100**

Most of the study participants (64%) residing in urban area had access to the tap water facility, whereas in rural households all (100%) used bore well water as source of drinking water supply.

Table 10: Distribution of study participants according to waste management

Type	Mode	Urban (n=250)		Rural (n=250)	
		Number	**Percent**	**Number**	**Percent**
Solid	Outside house / village	136	54.40	250	100
	Municipal Corporation	114	45.60	NA	NA
Total		**250**	**100**	**250**	**100**
Liquid	Outside house / village	140	56.00	250	100
	Municipal Corporation	110	44.00	NA	NA
Total		**250**	**100**	**250**	**100**

In the present study 54.4% households disposed solid waste outside house / village and 45.60% disposed by using facility provided by Municipal Corporation in urban area, whereas in rural area all (100%) disposed solid waste outside house / village. Similarly, 56% households disposed liquid waste outside house / village and 44% disposed by using facility provided by Municipal Corporation in urban area, whereas in rural area all (100%) disposed liquid waste outside house / village.

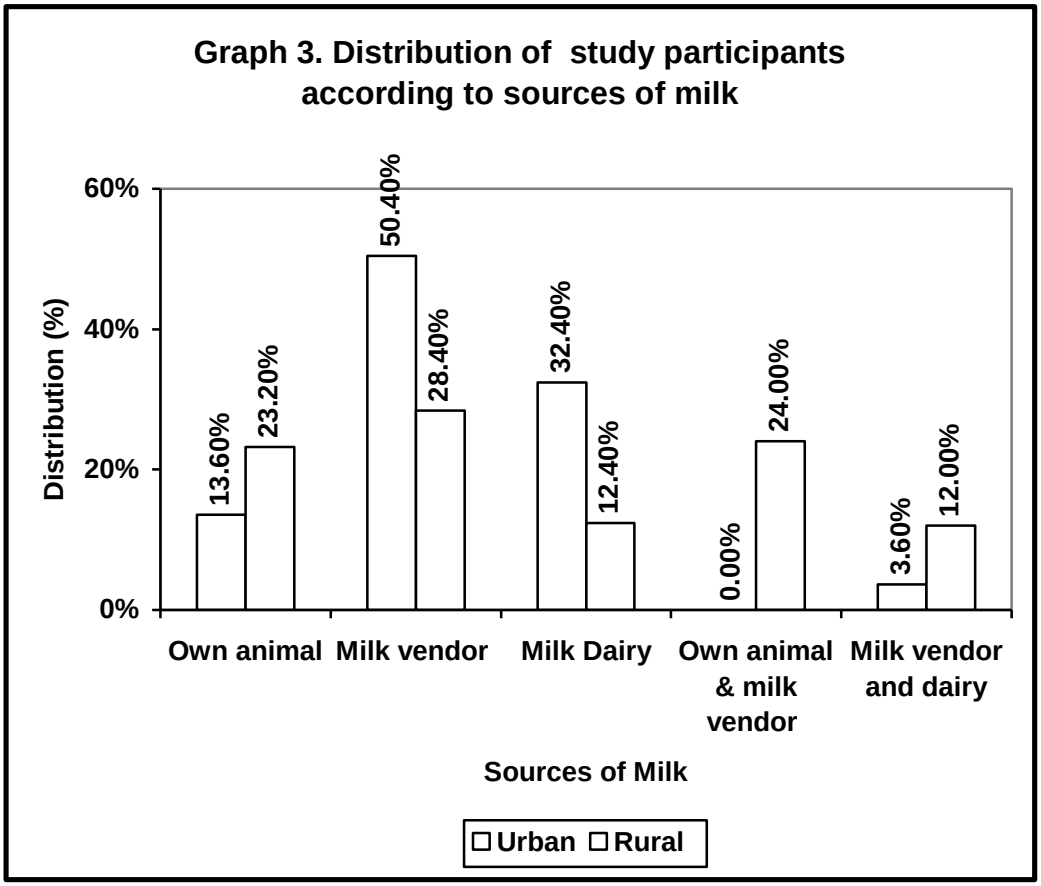
Table 11: Distribution of study participants according to toilet facility

Toilet	Urban (n=250)		Rural (n=250)	
	Number	**Percent**	**Number**	**Percent**
Open field defecation	20	8.00	245	98.00
Common toilet	150	60.00	04	1.60
Separate toilet	80	32.00	01	0.40
Total	**250**	**100**	**250**	**100**

Most households (60%) had common toilet facility in urban area, whereas 32% and 8% utilized separate toilet and open field defecation respectively. In rural area 98% households practiced open field defecation and common toilet and separate toilet facility was available to only 1.60% and 0.4% respectively.

Table 12: Distribution of study participants according to sources of milk

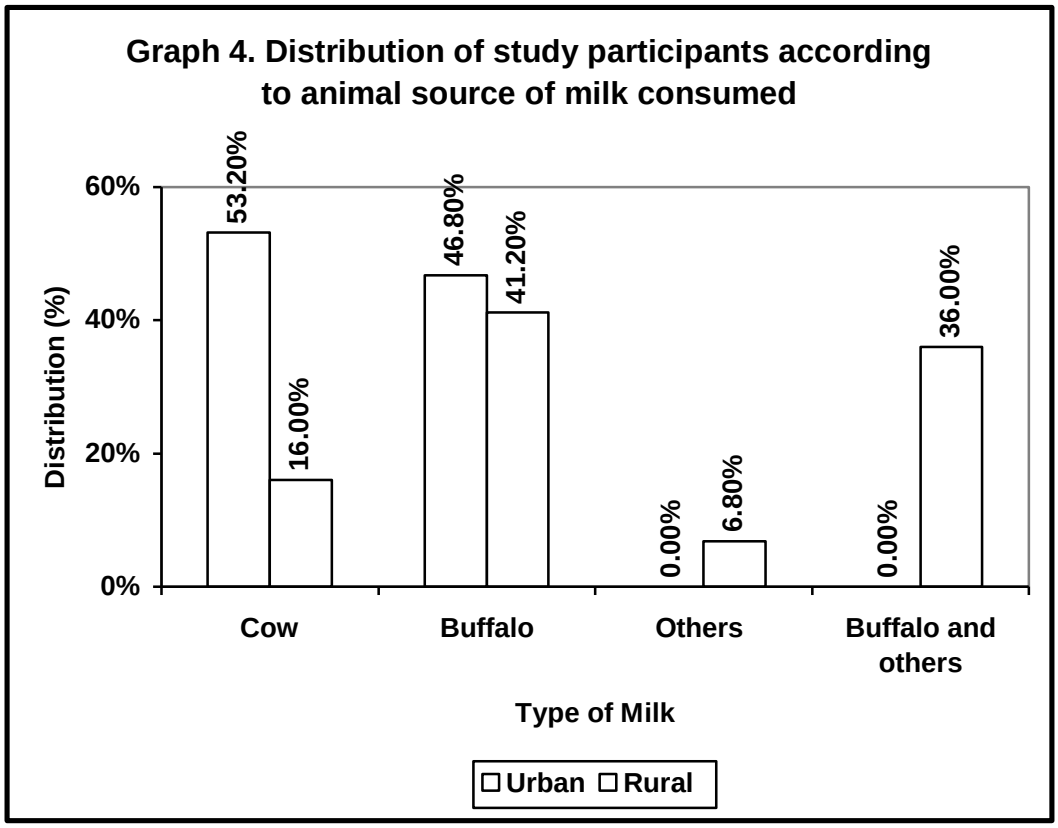
Sources of milk	Urban (n=250)		Rural (n=250)	
	Number	**Percent**	**Number**	**Percent**
Animal from own house	34	13.60	58	23.20
Milk vendor	126	50.40	71	28.40
Milk Dairy	81	32.40	31	12.40
Own house and milk vendor	0	0	60	24.00
Milk vendor and dairy	9	3.60	30	12.00
Total	**250**	**100**	**250**	**100**



In the present study, most (50.4%) preferred milk vendor followed by 32.40% from dairy, 13.60% households used milk of the animal from their own house and 3.60% preferred from milk vendor as well as dairy in the urban area. In rural area, preferred milk vendors (28.4%), animal milk from own house (23.2%), own house as well as milk vendor (24%), dairy (12.4%) and milk vendor and dairy (12%).

Table 13: Distribution of study participants according to animal source of milk consumed

Type	Urban (n=250)		Rural (n=250)	
	Number	**Percent**	**Number**	**Percent**
Cow	133	53.20	40	16.00
Buffalo	117	46.80	103	41.20
Others*	0	0	17	6.80
Buffalo and others	0	0	90	36.00
Total	**250**	**100**	**250**	**100**

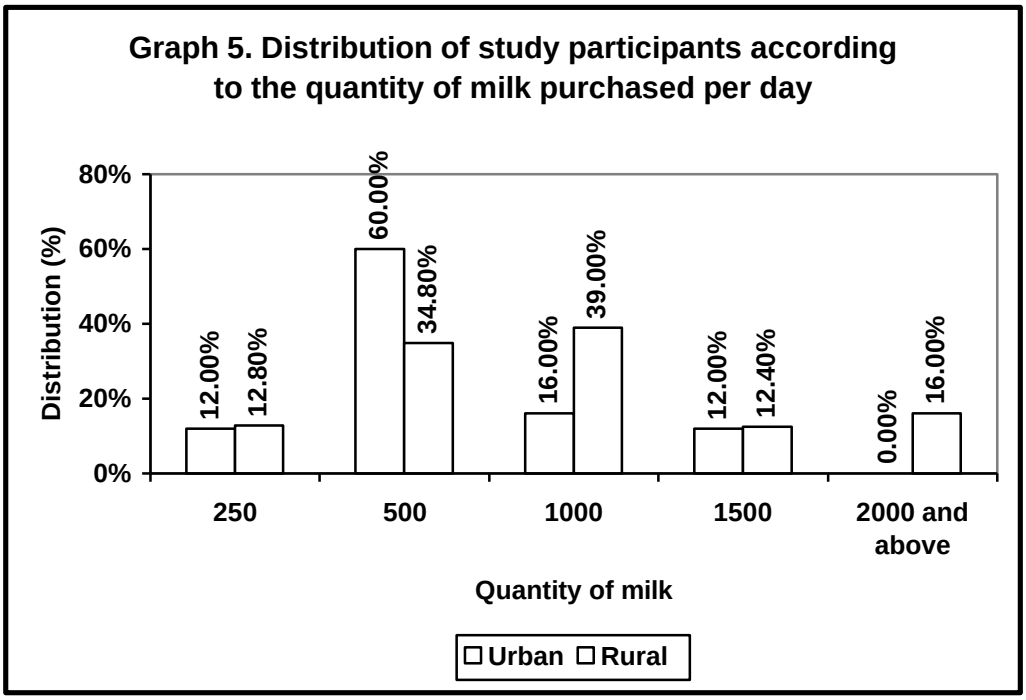


*Other sources of milk – goats.

In this study most (53.2%) used cow's milk and 46.8% used buffalo's milk in urban area, whereas in rural area most (41.2%) used buffalo's milk followed by buffalo and other sources (36%), cow (16%) and other sources of milk (6.8%).

Table 14: Distribution of the study participants according to the quantity of milk purchased per day

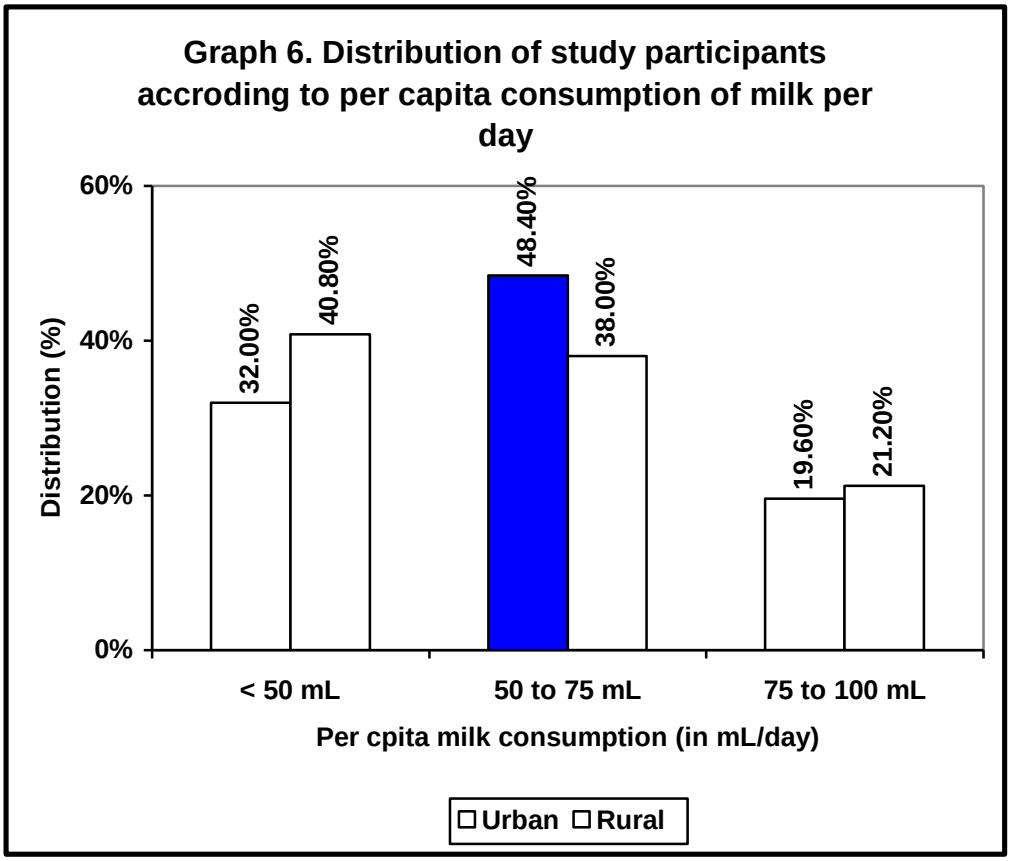
Quantity (ml)/ day	Urban (n=250)		Rural (n=250)	
	Number	Percent	Number	Percent
250	30	12.00	32	12.80
500	150	60.00	87	34.80
1000	40	16.00	85	39.00
1500	30	12.00	31	12.40
2000 and above	0	0	15	16.00
Total	**250**	**100**	**250**	**100**



Most of the households (60%) used 500 ml every day followed by 1000 ml (16%) and 250 ml and 1500 ml (12% each) in urban area, whereas in rural area 39% households used 1000 ml every day, 34.8% used 500 ml, 16% used 2000 ml and above, 12.8% used 250 ml and 12.4% used 1500 ml.

Table 15: Distribution of study participants according to per capita consumption of milk per day

Per capita milk consumption (in ml/day)	Urban (n=250)		Rural (n=250)	
	Number	Percent	Number	Percent
< 50	80	32.00	102	40.80
50 – 75	121	48.40	95	38.00
75 – 100	49	19.60	53	21.20
Total	**250**	**100**	**250**	**100**



In this study most (48.4%) of the urban households per capita milk consumption was 50 to 75 ml per day, whereas in rural households it was less than 50 ml per day.

Distribution of study participants according to knowledge about milk borne diseases

None of the participants knew that diseases can be transmitted by consumption of milk or name of those diseases.

Table 16: Distribution of study participants according to knowledge regarding contamination of milk

Contamination	Sources	Urban (n=250)		Rural (n=250)	
		Number	Percent	Number	Percent
Yes	Added water	10	4.00	16	6.40
	Utensils	20	8.00	30	12.00
	Dairy animal	0	0	1	0.40
	Human handling	20	8.00	17	6.80
	Water and dairy animal	10	4.00	15	6.00
	Added water and utensil	10	4.00	16	6.40
	Total	**70**	**28.00**	**95**	**38.00**
No		180	72.00	155	62.00
Total		**250**	**100**	**250**	**100**

In this study most of the participants in both groups were not aware about the contamination of milk (72% urban and 62% rural). Among the households with knowledge about milk contamination, 8% each from urban area identified

utensil and human handling as causes, whereas in rural area 12% identified utensil as the cause.

Data was also collected regarding knowledge about symptoms of milk born diseases. None of the participants knew about the symptoms of brucellosis and enteropathogenic E. coli.

Table 17: Distribution of study participants according to consumption of raw milk

Consumption of raw milk	Reasons	Urban (n=250)		Rural (n=250)	
		Number	**Percent**	**Number**	**Percent**
Yes	Good taste	10	4.00	16	6.40
	Health purpose	10	4.00	30	12.00
	Convenience	10	4.00	18	7.20
	Taste and Convenience	20	8.00	15	6.00
	Health & convenience	30	12.00	15	6.00
	Total	**80**	**32.00**	**156**	**62.40**
No		170	68.00	94	37.60
Total		**250**	**100**	**250**	**100**

In this study 68% urban and 37.6% rural study participants did not consume raw milk. Among the households who consumed raw milk most, 12% from urban area said reasons for raw milk consumption is healthy and convenient, whereas 12% in rural area said it is healthy practice.

Distribution of study participants according to attitude about milk borne diseases

None of the participants suffered from milk borne diseases and hence none opted for any treatment in the year preceding the survey.

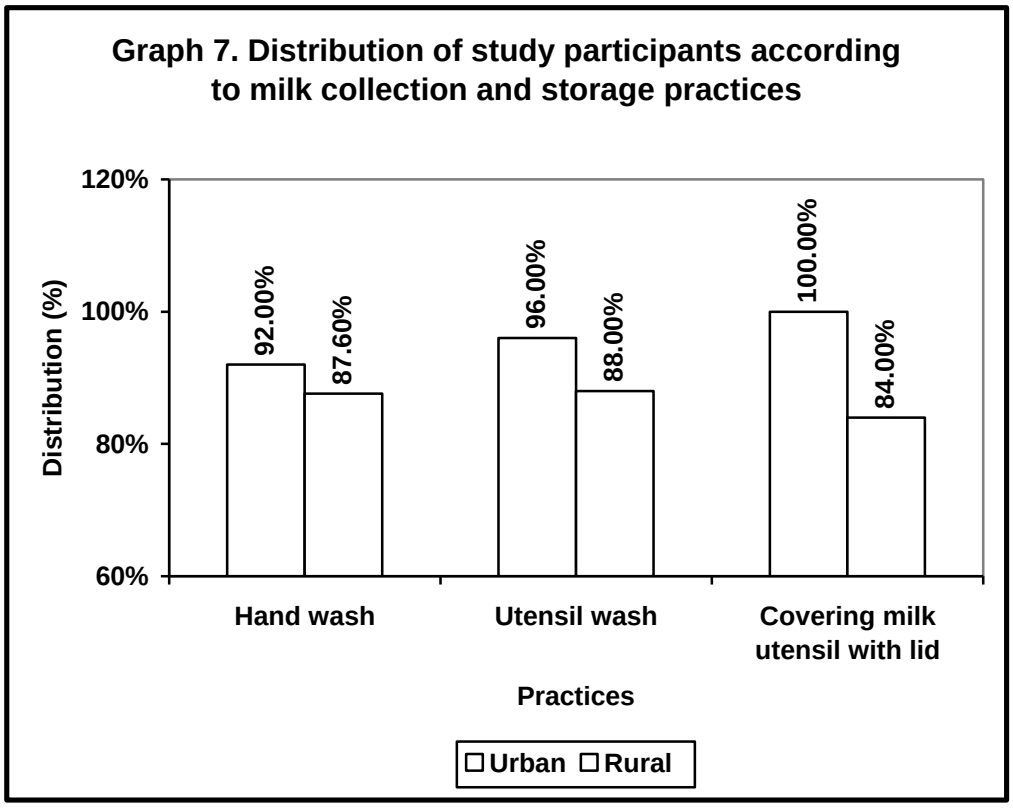
Table 18: Distribution of study participants according to milk collection practice

Milk collection practice		Urban (n=250)		Rural (n=250)	
		Number	**Percent**	**Number**	**Percent**
Frequency of collection/day	Once	221	88.40	158	63.20
	Twice	29	11.60	92	36.80
	Total	**250**	**100**	**250**	**100**
Time of collection	Morning	180	72.00	139	55.60
	Evening	41	16.40	34	13.60
	Both times	29	11.60	77	30.80
	Total	**250**	**100**	**250**	**100**

In this study, most of the participants collected milk once a day (88.40% in urban and 63.20% rural households) and mostly in the morning time (72% in urban and 55.6% in rural households).

Table 19: Distribution of study participants according to milk collection and storage practices

Milk collection and storage practices		Urban (n=250)		Rural (n=250)	
		Number	**Percent**	**Number**	**Percent**
Hand wash before milk collection	Yes	230	92.00	219	87.60
	No	20	8.00	31	12.34
	Total	**250**	**100**	**250**	**100**
Utensil wash before milk collection	Yes	240	96.00	220	88.00
	No	10	4.00	30	12.00
	Total	**250**	**100**	**250**	**100**
Covering milk utensil with lid	Yes	250	100.0	210	84.00
	No	0	0	40	16.00
	Total	**250**	**100**	**250**	**100**



Majority of the participants washed hands before milk collection (92% in urban and 87.6% rural households), washed utensils (96% in urban and 88% in rural households) before collection of milk and covered the milk utensil with lid after collection (100% in urban and 84% rural households).

Table 20: Distribution of study participants according to the practice of addition of water to milk

Addition of water to milk	Quantity (ml)	Urban (n=250)		Rural (n=250)	
		Number	**Percent**	**Number**	**Percent**
Yes	< 50	50	20.00	109	43.60
	50 – 100	20	8.00	52	20.80
	> 100	10	4.00	16	6.40
	Total	**80**	**32.00**	**177**	**70.80**
No		170	68.00	73	29.20
Total		**250**	**100**	**250**	**100**

In this study 68% and 29.20% of participants from urban and rural area respectively did not prefer to add the water to milk after collection. Among the households who added water, majority (20% from urban and 43.6% from rural) added less than 50 ml of water.

Table 21: Distribution of study participants according to practices of boiling milk

Boiling of milk	Frequency	Urban (n=250)		Rural (n=250)	
		Number	**Percent**	**Number**	**Percent**
Immediately (within 30min)	Yes	210	84.00	169	67.60
	No	40	16.00	81	32.40
	Total	**250**	**100**	**250**	**100**
Time interval between collection and boiling	< 1 hour	30	12.00	50	20.00
	1 – 3 hours	10	4.00	17	6.80
	> 3 hours	0	0	14	5.60
	Total	**40**	**16.00**	**81**	**32.40**
Frequency of boiling/day	Once	90	36.00	68	27.20
	Twice	140	56.00	135	54.00
	≥ thrice	20	8.00	47	18.80
	Total	**250**	**100**	**250**	**100**

In this study 84% participants from urban area and 67.6% from rural area preferred to boil the milk immediately after collection. Among the households who were not used to boil immediately, 12% from urban and 20% from rural participants boiled within one hour of duration after collection. Majority of the study participants 56% and 54% from urban and rural respectively used to boil milk twice a day.

Table 22: Distribution of study participants according to practices of consumption of milk next day of collection

Milk consumption next day of collection	Urban (n=250)		Rural (n=250)	
	Number	Percent	Number	Percent
Yes	200	80.00	201	80.40
No	50	20.00	49	19.60
Total	**250**	**100**	**250**	**100**

Majority of the study participants (80%) consumed milk on next day in both urban and rural areas.

Data was also collected among who consumed milk next day of collection, regarding until what time (morning/afternoon/evening) they used to consume. This showed almost all 50 (20%) from urban area and 49 (19.6%) from rural area used to consume same milk till next day morning.

Distribution of study participants according to storage of milk

None of the participants had refrigeration facility to store milk.

Table 23: Distribution of study participants according to animal sources of milk and place for animal keeping

Milk sources			Urban (n=250)		Rural (n=250)	
			Number	**Percent**	**Number**	**Percent**
Animals	Yes	Cow	20	8.00	7	2.80
		Buffalo	14	5.60	34	13.60
		Goat	0	0	17	6.80
		Buffalo & goat	0	0	60	24.00
		Total	**34**	**13.60**	**118**	**47.20**
	No		216	86.40	132	52.80
		Total	**250**	**100**	**250**	**100**
Place for animal keeping	Separate shed		21	8.40	05	12.00
	Within house		13	5.20	113	45.20

Majority of study participants from urban (86.40%) and rural (52.80%) had no milk producing animal sources. Among households possessing milk producing animals, 8% in urban area had cows and 24% in rural area had buffaloes and goats. Most (8.4%) of the urban households preferred to keep animals in separate shed, whereas 45.2% from rural area preferred to keep them within the house.

Data was also collected regarding number of animals present in study participant's houses. In urban population all of them had (34 out of 250) less than five animals. In rural population, 26 out of 118 had less than 5 animals and 92 out of 118 had five or more animals in houses.

Table 24: Distribution of study participants according to milk producing animals

Number of milk producing animals in the household	Urban (n=250)		Rural (n=250)	
	Number	Percent	Number	Percent
NIL	216	86.40	132	52.80
1	24	9.60	66	26.40
2	9	3.60	36	14.4
3	1	0.40	1	0.40
≥ 4	0	0	15	6.00
Total	**250**	**100**	**250**	**100**

Majority of study participants 86.4% from urban and 52.8% from rural area did not possess their own milk producing animals. In those who possessed, 9.60% and 26.4% from urban and rural area respectively, had only one herd giving milk.

Table 25: Distribution of study participants according to quantity of milk produced per day by their own animals

Milk Production (Liters / day)	Urban (n=250)		Rural (n=250)	
	Number	Percent	Number	Percent
Not applicable	216	86.40	132	52.80
< 1	7	2.80	47	18.80
1 – 2	25	10.00	55	22.00
> 2	2	0.80	16	6.40
Total	**250**	**100**	**250**	**100**

Among the study participants having milk producing animals, 10% from urban and 22% from rural used to produce one to two litres of milk per day.

Table 26: Distribution of study participants according to quantity of milk consumption per day in their own household

Milk Consumption (Liters / day)	Urban (n=250)		Rural (n=250)	
	Number	Percent	Number	Percent
Not applicable *	216	86.40	132	52.80
< 1	11	4.40	47	18.80
1 – 2	22	8.80	71	28.40
> 2	1	0.40	0	0
Total	**250**	**100**	**250**	**100**

*Households not having any milk producing animals

Most of the study participants having milk producing animals, 8.8% from urban and 28.4% from rural used to keep one to two liters of milk among total milk produced per day for own household consumption.

Table 27: Distribution of study participants according to their practices of washing animals and cleaning the udder, washing utensil before milking

Practices		Frequency	Urban (n=250)		Rural (n=250)	
			Number	**Percent**	**Number**	**Percent**
Washing animals	Yes	Daily	3	1.20	80	32.00
		Once in 2 days	11	4.40	16	6.40
		Once in 3 days	0	0	2	0.80
		> 3 days	20	8.00	20	8.00
		Total	**34**	**13.60**	**118**	**47.20**
	No		216	86.40	132	52.80
	Total		**250**	**100**	**250**	**100**
Cleaning udder	**Not applicable**		216	86.40	132	52.80
	Yes		16	6.40	103	41.20
	No		18	7.20	15	6.00
	Total		**250**	**100**	**250**	**100**
Washing utensils before milking	**Not applicable**		216	86.40	132	52.80
	Yes		34	13.60	118	47.20
	No		0	0	0	0
	Total		**250**	**100**	**250**	**100**

1.6% and 32% of study participants used to wash animals daily in urban and rural areas respectively, where as 8% each in both the groups used to wash animals at more than 3 days interval.

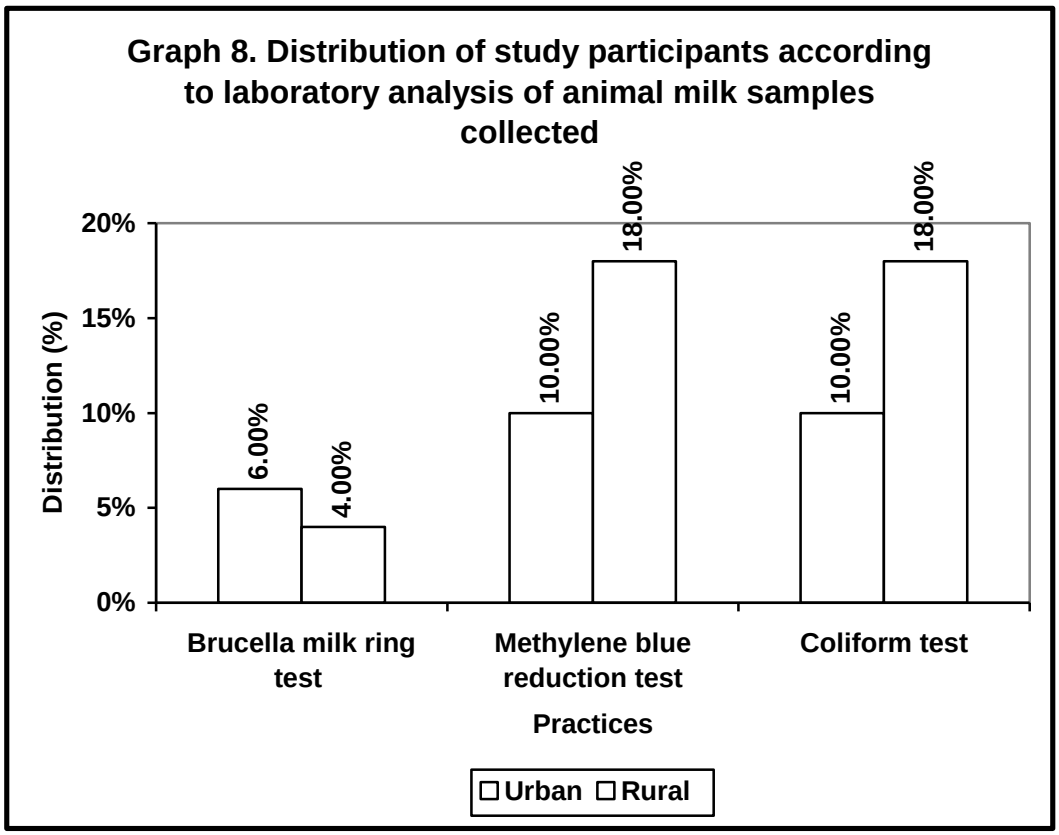
6.4% and 41.2% of the study participants from urban and rural areas respectively, used to clean the animal udder before milking every time, whereas all the participants (13.6% urban and 47.2% rural) washed utensils before milking the animal.

Treatment of animals during illness

All participants having milk producing animals (13.6% in urban and 47.2% in rural areas), sought treatment for illness of their milk producing animals from the veterinary doctor during the year preceding the survey.

Table 28: Distribution of study participants according to laboratory analysis of animal milk samples collected

Tests	Result	Urban (n=25)		Rural (n=25)		Total (n=50)	
		No	**%**	**No**	**%**	**No**	**%**
Brucella milk ring test	Positive	3	6	2	4	5	10
	Negative	22	44	23	46	45	90
Methylene blue reduction test	Positive	5	10	9	18	14	28
	Negative	20	40	16	32	36	72
Coliform test	Positive	5	10	9	18	14	28
	Negative	20	40	16	32	36	72
	Total	**25**	**50**	**25**	**50**	**50**	**100**



Among 50 milk samples collected for laboratory analysis, 10% were positive for brucella milk ring test, where as 28% were positive for both methylene blue reduction test and coliform test.

Mean specific gravity of the milk samples collected were 1.026 ± 0.004 and 1.025 ± 0.007 in urban and rural areas respectively.

Table 29: Association of literacy with consumption of raw milk

Literacy status	Urban (n=250)				Rural (n=250)			
	Yes		No		Yes		No	
	No	%	No	%	No	%	No	%
Illiterate	50	20.0	88	35.2	74	29.6	119	47.6
1 – 5th std	19	7.6	50	20.0	17	6.8	31	47.6
6 – 10th std	9	3.6	21	8.4	03	1.2	6	12.4
11-12/ Diploma and graduate	2	0.8	11	4.4	0	0	0	0
	x^2=3.472; p=0.324				x^2=0.052; p=0.820			

The knowledge about consumption of raw milk, when compared with literacy status of study participants, did not show any statistically significant results in both urban and rural area.

Table 30: Association of literacy with reasons for consumption of raw milk

Area	Reasons	Illiterate		1-5th std		6 – 10th std		11 -12/ Diploma and graduate		Total	
		No	%	No	%	No	%	No	%	No	%
Urban	Tastes good	8	10.0	2	2.5	0	0	0	0	10	12.5
	Health purpose	7	8.7	3	3.7	0	0	0	0	10	12.5
	Convenience	7	8.7	3	3.7	0	0	0	0	10	12.5
	Taste and convenience	11	13.7	2	2.5	7	8.6	0	0	20	25.0
	Health and convenience	17	21.2	9	11.2	2	2.5	2	2.5	30	37.5
	Total	**50**	**62.5**	**19**	**23.7**	**9**	**11.2**	**2**	**2.5**	**80**	**100**
	Significance				x^2=2.702		p=0.609				
Rural	Tastes good	12	12.7	3	3.2	0	0	0	0	16	17.1
	Health purpose	23	24.4	7	7.4	0	0	0	0	30	31.9
	Convenience	16	17.0	2	2.1	0	0	0	0	18	19.1
	Taste and convenience	13	13.8	1	1.0	1	1.0	0	0	15	15.9
	Health and convenience	10	10.6	4	4.2	1	1.0	0	0	15	15.9
	Total	**74**	**88**	**17**	**18.0**	**3**	**3.2**	**0**	**0**	**94**	**100**
					x^2=3.186		p=0.527				

The literacy levels of study participants both in urban and rural areas, when compared with knowledge about reasons for consumption of raw milk, did not show any statistically significant results.

Table 31: Association of socio-economic status with milk consumption practices (n=250)

Practices	SES class	Urban (n=250)				Rural (n=250)			
		Yes		No		Yes		No	
		No	%	No	%	No	%	No	%
Washing hands before collection of milk	**I**	0	0	0	0	0	0	0	0
	II	50	20	0	0	4	1.6	0	0
	III	30	12	10	4.0	20	8.0	0	0
	IV	90	36	10	4.0	75	30.0	12	13.8
	V	60	24	0	0	120	86.3	19	13.7
	Total	**230**	**92**	**20**	**8.0**	**219**	**87.6**	**31**	**12.4**
		x^2=25.815		p=0.000		x^2=3.759		p=0.153	
Washing utensil before collection of milk	**I**	0	0	0	0	0	0	0	0
	II	50	100	0	0	4	0	0	0
	III	40	100	0	0	19	95.0	1	5.0
	IV	90	90	10	10	74	85.1	13	14.9
	V	60	100	0	0	123	88.5	16	11.5
	Total	**240**	**96**	**10**	**4.0**	**220**	**88.0**	**30**	**12.0**
		x^2=15.625		p=0.001		x^2=2.139		p=0.343	
Addition of water to milk	**I**	0	0	0	0	0	0	0	0
	II	20	40	30	60.0	2	50.0	2	50.0
	III	10	25	30	75.0	11	55.0	9	45.0
	IV	20	20	80	80.0	61	70.1	26	29.9
	V	30	50	30	50.0	103	74.1	36	25.9
	Total	**80**	**32**	**170**	**68.0**	**177**	**70.2**	**73**	**29.2**
		x^2=17.923		p=0.000		x^2=4.004		p=0.261	
Consumption of milk next day	**I**	0	0	0	0	0	0	0	0
	II	0	0	50	100	1	25	3	75
	III	10	25	30	75	0	0	20	100
	IV	40	40	60	60	14	161	73	83.9
	V	0	0	60	100	34	24.5	105	75.5
	Total	**50**	**20**	**200**	**80**	**49**	**19.6**	**201**	**80.4**
		x^2=53.125		p=0.000		x^2=6.391		p=0.041	
Covering milk utensil with lid	**I**	0	0	0	0	0	0	0	0
	II	50	20	0	0	4	1.6	0	0
	III	40	16	0	0	17	85.0	3	15
	IV	100	40	0	0	74	85.1	13	14.9
	V	60	24	0	0	115	82.7	24	17.3
	Total	**250**	**100**	**0**	**0**	**210**	**84.0**	**40**	**16.0**
						x^2=0.457		p=0.796	

The milk consumption practices regarding washing hands and washing utensils before collection of milk, addition of water to milk and consumption of milk next day, was better in upper SES class than lower SES class in urban study participants. This result was statistically significant, whereas in rural study participants, the results were not statistically significant.

All urban participants (100%) had good practice regarding covering of milk utensils with lid, whereas only 84% of rural study participants had good practice of covering milk utensils with lid.

Table 32: Association of socio-economic and literacy status with practices regarding animal sources of milk (place to keep animals) (n=152)

Parameter		Separate animal shed		Within house		Total	
		No	**%**	**No**	**%**	**No**	**%**
Literacy status	**Illiterate**	14	9.2	98	64.4	112	73.6
	1st to 5th	9	5.9	23	15.1	32	21.0
	6th to 10th	1	0.6	5	3.2	6	3.9
	11-12/ Diploma Graduate	2	1.2	0	0	2	1.2
	Total	**26**	**17.1**	**126**	**82.9**	**152**	**100**
	Significance		x^2=6.366		p=0.012		
Socio economic class	**I**	0	0	0	0	0	0
	II	1	0.6	13	8.5	14	9.2
	III	3	1.9	8	5.2	21	13.8
	IV	12	7.9	48	31.7	60	39.4
	V	10	6.5	57	37.5	67	44.1
	Total	**26**	**17.1**	**126**	**82.9**	**152**	**100**
	Significance		x^2=2.361		p=0.501		

The good practice regarding animal sources of milk (i.e. place to keep them) was found more in literates when compared to illiterates. The results were statistically significant, whereas the practices regarding animal sources of milk did not show any statistically significant results, when compared with socio - economic status.

Table 33: Association of socio-economic status and literacy with practices of animal owners regarding animal sources of milk (frequency of washing animals) (n=152)

Parameter		Daily		Once in two days		Longer period	
		No	**%**	**No**	**%**	**No**	**%**
Literacy	**Illiterate**	62	40.7	18	11.8	32	21.0
	1st to 5th std	17	11.1	8	5.2	7	4.6
	6th to 10th std	4	2.6	0	0	2	1.2
	11-12/ Diploma graduate	0	0	1	0.65	1	0.65
	Total	83	54.6	27	17.7	42	27.6
	Significance		x^2=0.866		p=0.649		
Socio economic class	**I**	0	0	0	0	0	0
	II	2	1.2	2	1.2	10	36.5
	III	5	3.2	4	2.6	2	1.2
	IV	40	26.3	4	2.6	16	10.5
	V	36	23.6	17	11.1	14	9.2
	Total	83	54.6	27	17.7	42	27.6
	Significance		x^2=25.720		p=0.000		

The practices (frequency of washing animals), of study participants who were animal owners, when compared with socio-economic status showed statistically significant results (p= 0.000); whereas it was not significant with literacy level (p= 0.649).

Table 34: Association between knowledge and practice (Milk contamination and washing hands and utensils before milk collection)

Knowledge and practice		Milk contamination							
		Urban (n=250)				Rural (n=250)			
		Yes		No		Yes		No	
		No	%	No	%	No	%	No	%
Washing hands before collection	**Yes**	32	12.8	2	0.8	102	40.8	16	6.4
	No	198	79.2	18	7.2	117	46.8	15	6.0
	Total	**230**	**92.0**	**20**	**8.0**	**219**	**87.6**	**31**	**12.4**
		x^2=0.845		p=0.358		x^2=0.877		p=0.349	
Washing utensil before collection	**Yes**	34	13.6	0	0	103	41.2	15	6.0
	No	206	82.4	10	4.0	117	46.8	15	6.0
	Total	**240**	**96.0**	**10**	**4.0**	**220**	**88.0**	**30**	**12.0**
		x^2=3.473		p=0.062		x^2=5.572		p=0.018	
Addition of water to milk after collection	**Yes**	2	0.8	32	12.8	78	31.2	138	55.2
	No	78	31.2	138	55.2	82	32.8	50	20.0
	Total	**80**	**32.0**	**170**	**68.0**	**160**	**64.0**	**188**	**75.2**
		x^2=63.658		p=0.000		x^2=22.316		p=0.000	
Cover milk utensil with lid after collection	**Yes**	34	13.6	0	0	99	39.6	19	7.6
	No	216	86.4	0	0	111	44.4	21	8.4
	Total	**250**	**100**	**0**	**0**	**210**	**84.0**	**40**	**16.0**
		x^2=4.87		p=0.027		x^2=36.570		p=0.000	

The knowledge regarding milk contamination with that of practice of addition of water to milk and covering milk utensils with lid was better in participants of urban area, compared to rural area. This result was found statistically significant. The knowledge regarding milk contamination with that

practice of washing hands and utensils before collecting milk, when compared among urban and rural study participants, was not statistically significant.

Table 35: Association of laboratory tests with different types of milk samples

Laboratory tests	Result	Cow and goat's milk		Buffalo's milk	
		Urban (n=7)	Rural (n=12)	Urban (n=18)	Rural (n=13)
Specific gravity	Normal	0 (0%)	8 (66.7%)	5 (27.7%)	1 (7.7%)
	Diluted	7 (100%)	4 (33.3%)	13 (72.3%)	12 (92.3%)
Brucella milk ring test	Positive	0 (0%)	1 (8.4%)	3 (16.7%)	1 (7.7%)
	Negative	7 (100%)	11 (91.6%)	15 (83.3%)	12 (92.3%)
Methylene blue reduction test	Positive	3 (42.8%)	2 (16.7%)	2 (11.2%)	7 (53.8%)
	Negative	4 (57.2%)	10 (83.3%)	16 (88.8%)*	6 (46.2%)
Coliform test	Positive	3 (42.8%)	2 (16.7%)	2 (11.2%)	7 (53.8%)
	Negative	4 (57.2%)	10 (83.3%)	16 (88.8%)*	6 (46.2%)

* $p<0.05$ statistically significant using fisher exact test
** Specific gravity – normal is non-adulterated and diluted is adulterated with water
Adulterated cow and goat's milk – < 1.028; non-adulterated milk - ≥ 1.028[51]
Adulterated buffalo's milk – < 1.030; non-adulterated milk - ≥ 1.030

Methylene blue reduction test (MBRT) and coliform test (CT) showed statistically significant results, when compared in urban and rural buffalo's milk ($p=0.017$); whereas MBRT and CT did not show any significant results, when compared in urban and rural cow and goat's milk ($p=0.305$). Specific gravity and brucella milk ring test did not show any significant results, when compared in urban and rural buffalo milk, as well as cow and goat's milk.

DISCUSSION

The present study was conducted in 250 households each from rural field practice area under PHC, Vantamuri and urban field practice area under UHC, Khasbag, of Department of Community Medicine, J. N. Medical College, K.L.E. University, Belgaum during the period January 2010 to December 2010.

Socio-Demographic characteristics of study population (Tables 1-5)

In the present study, majority (99.2% from urban and 98.4% from rural areas) of study participants responsible for handling of milk were females.

Similar study done in Ghana in 2003, reported that 46% respondents were males and 54% were females and in Tanzania 73% respondents were males compared to 27% females.[54]

In the present study age of study participants ranged from 19 to 67 years with mean age 41.10 years in urban area and 18 to 75 years with mean age 44.30 years in rural area. Majority (72% in urban and 77.6% in rural) of study participants were Hindus. Half of them belonged to nuclear family in urban area, whereas two thirds belonged to joint family in rural area. Among the study participants, 55.20% in urban area and 77.2% in rural area were illiterates.

In the present study, 20% and 1.6% of the study participants belonged to SES Class I, 16% and 8% to Class II, 40% and 34.8% to Class III, 24% and 55.6% to Class IV and none of them belonged to Class V in urban and rural areas respectively.

Assets and liabilities (Tables 6 and 7)

36% and 8% of study participants possessed land in rural and urban field areas respectively. Majority (98% in urban and 88.8% in rural area) of study participants had BPL ration card. None of the study participants had opted for any type of insurance (Life/health/individual/group based) coverage in rural area, whereas 1.6% participants from urban area had opted for life insurance in the year preceding the survey.

A study conducted at New Delhi in 2000 reported that, as for health insurance, most Indians are not covered by any insurance schemes, but among small minority that was covered, most belonged to organized urban sector, the rural population had almost no insurance coverage at all.[55]

In the present study, 8.8% and 8% of study participants among urban and rural areas respectively were enrolled with Mahila Mandals.

Environmental history (Tables 8 to 11)

In the present study, 84% from urban area and 70.4% from rural area stayed in semi-pucca houses, 8% and 29.6% from urban and rural area respectively stayed in kutcha houses, only 8% of urban participants stayed in pucca houses.

All the study participants among rural area used bore well water as source of drinking water supply; whereas among urban area, 64% had access to tap water and 36% used bore well water.

A study done in Tanzania in 2004 reported, 63% of farm families had tap water as source of drinking water and 37% had bore well / pond water.[56]

All the rural study participants disposed solid and liquid waster outside the house or village, whereas 45.6% and 44% of urban study participants disposed solid and liquid waste respectively using facility provided by Municipal Corporation. 98% rural participants practiced open field defecation; where as 92% households in urban area had access to toilet facilities.

General information regarding milk sources (Tables 12 to 15)

In the present study, 50.4% and 28.4% of study participants preferred milk sources from milk vendors, followed by 32.4% and 12.4% from dairy, 13.6% and 23.2% from animals from own house, none and 24% from both own house and milk vendors and 3.6% and 12% from milk vendors and dairy, in urban and rural areas respectively.

A study done in Tanzania in 2006 showed, 86% of milk sources were from small holder produces and 14% from milk collection centres.[47] Similar study done in Kenya in 2000 reported, milk sources as 20% form dairy, 28% from vendors and 12% from shops.[57]

Another study done in USA in 2006 reported, 71.4% of milk sources were from own farm and 31.4% from grocery stores.[25]

The present study showed 53.2% and 16% preferred to consume cow's milk as source of milk, followed by 46.8% and 41.2% used buffalo milk in urban

and rural areas respectively, 6.8% of rural study participants consumed goats' milk and 36% consumed both buffalo milk and goats' milk.

60% of the study participants purchased 500 ml of milk per day, followed by 16% (1000 ml), 12% each (250 ml and 1500 ml) every day in urban area, whereas in rural area 39% purchased 1000 ml of milk per day followed by 34.8% purchased 500ml, 16% purchased 2000ml and above 12.8% purchased 250 ml and 12.4% purchased 1500 ml every day.

In a study done at Kenya in 2000, 29% of households purchased approximately 200 ml / day in one city and 93% of households purchased 750 ml / day in urban area and 800 ml / day in rural area.[58]

In the present study, most of the study participants (48.4%) consumed 50 to 75 ml/capita/day (1.69 oz to 2.5 oz / or 47.8 gms to 71.7 gms) in urban area and 40.8% of rural participants consumed < 50ml /capita/day (< 1.69 oz or < 47.8 gms) assuming 1000ml = 33.8oz = 956.5 gms.[59]

Similar studies reported per capita milk consumption per day was 136 gms and 252 gms.[7 & 60]

Knowledge about milk borne diseases (Tables 16 to 17)

In the present study, none of the participants knew that diseases can be transmitted by milk or could name the milk borne diseases.

Various studies showed that 23% to 68.5% of the study participants were aware of diseases transmitted from milk. [25 & 61]

Present study showed that 28% and 38% from urban and rural study participants respectively, had knowledge about contamination of milk, of which 8% each from urban area quoted utensils and human handling as sources for contamination, whereas in rural are 12% quoted utensils as the source. None of the participants knew about symptoms of milk borne diseases like E. coli or brucellosis.

32% of urban and 62.4% of rural study participants used to consume raw milk, 12% from urban area reported health and convenience as primary reason for choosing to consume raw milk, and 12% from rural area reported health purpose only.

Similar study done in USA in 2006, 42.3% of dairy produces surveyed reported the taste and convenience as primary reason.[25]

In present study, none of the participants reportedly suffered from any milk borne diseases in the year preceding the survey.

Milk consumption practices (Tables 18 to 22)

In the present study, majority (88.3% in urban 63.2% in rural) households collected milk daily once and preferably in morning time. 92% and 87.6% of study participants washed their hands, 96% and 88% washed utensils before milk collection, in urban and rural areas respectively.

100% of urban study participants had good practice of covering milk utensils with lid, whereas only 84% of rural participants practiced the same.

A study done at north-east India in 2006 revealed that 100% of consumers washed milk utensils with soap before collection.[62]

In the present study, 32% urban and 70.8% rural participants added water to milk prior to boiling.

Various studies reported that 20% to 83% of milk samples were adulterated with water. [8,43,47,54 & 62]

Present study showed that 84% from urban and 67.6% from rural households reported to boil milk immediately after collection and 56% and 54% form urban and rural respectively, preferred to boil milk twice in a day.

Various studies reported 95% to 100% households boiled milk before consumption. [58 & 62]

In the present study, 80% of study participants from both urban and rural areas consumed milk on next day of collection; of which 20% from urban and 19.6% from the rural said, they consumed milk only till next day morning. None of the households had refrigeration facility for milk storage.

Various studies reported that 23% to 61% of respondents stored milk in refrigerator. [47, 54, 62]

Animal sources of milk and practices (Tables 23-27)

In the present study, 13.6% and 47.2% from urban and rural area respectively, possessed milk producing animals, of which 8.4% and 12% had

separate shed for animals, and 5.2% and 45.2% kept animals within the house in urban and rural areas respectively.

A study done in Ghana and Tanzania in 2003 showed, 68% and 14% of the households had milk sourced from own animals. [54]

In the present study, 13.6% study participants in urban area had less than 5 animals, whereas in rural area 10.4% had less than 5 animals and 36.8% had 5 or more milk producing animals in houses. 9.6% and 26.4% from urban and rural respectively had only one herd, which used to give milk.

A study done in India in 1962, showed that average 2-4 animals in rural households and 10 animals in urban households. [60] Another study in Tanzania in 2004 showed, 35% households had 1 to 5 animals, 42% had 6 to 10 animals and 23% more than 11 cattle in their farms. [56]

In the present study, most (10% from urban and 22% from rural) having milk producing animals, used to produce one to two liters of milk per day; Out of which 8.8% from urban and 28.4% from rural area used to keep 1to 2 liters of milk among total production per day for their own household consumption.

Similar results were found in Denmark study done in 2004.[63]

Present study showed, 1.6% and 32% of study participants reported to wash animals daily once in urban and rural areas respectively, whereas 8% each in both groups washed animals at more than 3 days interval period. It may be because of difficulties in procuring sufficient of water.

In the present study, 6.4% and 41.2% from urban and rural respectively reported to clean udder before milking every time, whereas all the participants (13.6% and 47.2%) washed utensils / hands before milking from urban and rural areas respectively.

A study in India in 1962 reported, rarely animals were washed before milking and utensils were not washed properly.[60] Another study in India in 2006 revealed, 92 out of 100 farmers used to wash their hands before and after milking each cow.[62]

All the participants having milk producing animals (13.6% in urban and 47.2% in rural area) sought treatment for illness of animals from the veterinary doctor in the year preceding the survey.

Laboratory analysis of milk samples (Table 28)

Present study showed mean specific gravity for collected milk samples were 1.026 ± 0.004 and 1.025 ± 0.007 in urban and rural areas respectively.

Various studies showed that specific gravity of milk samples ranged from 1.027 to 1.030.[8, 54]

In the present study, 5 (10%) milk samples were positive for brucella milk ring test and 14 (28%) were positive for methylene blue reduction test as well as coliform test.

Various studies reported that 37% to 56% of milk samples were positive for Brucella milk ring test.[8 & 54]

Various studies reported that 20% to 100% of milk samples were positive for E coli bacteria by coliform test. [48, 57, 58, 63 & 64]

High E. coli count may indicate milk samples with fecal contamination or adulteration with contaminated water.[9] A study done in north-east India in 2006 showed that 70% of milk samples were positive for methylene blue reduction test.[27]

Associations of demographic variables with knowledge regarding milk consumption practices (Tables 29 - 31)

In the present study, literacy was not associated with consumption of raw milk. Similar results were found in a study in USA in 2006. [25]

Present study showed, there was no association with educational level and reasons for consumption of raw milk in urban (p=0.609) and rural areas (p=0.527) respectively.

Present study showed significant association between the socio-economic status and milk consumption practices (washing hands / utensils before milk collection, addition of water, and consumption of milk next day) among urban study participants, but not among rural participants. 100% and 84% of study participants in urban and rural respectively, had good practice of covering milk utensil with lid.

Association of demographic variables with the practice regarding animal sources of milk: (Tables 32 and 33)

In the present study, significant association (p=0.012) was found between illiteracy and practice of placing milk yielding animals i.e. within house /separate shed for them, whereas results were not significant (p=0.501) with the socio-economic status. Present study showed significant association (p=0.000) between the socio-economic class and frequency of washing animals; whereas it was not significant (p = 0.649), when compared with educational status.

Association between knowledge and practices (Table 34)

In the present study, the knowledge of milk contamination with that of practice of addition of water to milk and covering milk utensils with lid was better in urban study participants than rural; whereas washing of hands and utensils before collection milk did not show significant results with the knowledge of contamination of milk.

Association of laboratory tests with different types of milk (Table 35)

Significant results were found (p=0.017) between urban and rural buffalo milk with the methylene blue reduction test and coliform test.

CONCLUSION

This community based cross sectional study among 500 (urban and rural) households revealed that none of them had knowledge about milk borne diseases.

Many (32% urban and 62.4% rural) study participants consumed raw milk, primary reason being more healthy and convenience (12% in urban), healthy purpose (12% in rural). Majority of the study participants had good practices of washing hands (92% of urban and 87.6% of rural), washing utensils (96% of urban and 88% of rural) before milk collection, and covering utensils with lid (100% of urban and 84% of rural). Majority (32% of urban and 70.8% of rural) had practice of adding water to milk. Present study revealed 13.6% of urban and 47.2% of rural participants possessed milk producing animals and all of them had good practice of washing hands, washing utensils prior to milking each time and seeking treatment for animals during illness.

Laboratory analysis of 50 informally marketed raw milk samples revealed 5 (10%) were positive for brucella milk ring test and 14 (28%) were positive for both methylene blue reduction test and coliform test.

Low socio-economic status was associated with poor hygienic practices (i.e. not washing hands, utensils, addition of water and consuming milk on next day of collection) among urban participants. Awareness regarding addition of water to milk and covering milk utensils with lid was better among urban than rural participants. Urban and rural buffalo milk showed significant association with methylene blue reduction test and coliform test.

LIMITATIONS

The limitations of the study were:

1. Since pooled milk samples from each household were studied, it was realized that findings do not directly reflect status of individual milk producing animals.

2. Laboratory analysis was limited to only 50 milk samples, due to operational constraints.

RECOMMENDATIONS

Based on the findings of the present study, following recommendations are being suggested for consumption of quality milk and milk products:

1. IEC activities need to be strengthened in order to generate a favorable opinion among rural and urban population regarding milk handling practices.
2. Creating awareness regarding milk borne diseases and milk hygiene.
3. Regular health check up camps for milk producing animals and persons handling those animals for the improvement of their health.
4. Creating awareness regarding ill effects of consumption of raw milk. Discourage consumption of raw milk and encourage use of pasteurized milk or packaged milk.
5. Creating awareness about benefits of self help group / mahila mandal membership.
6. Creating awareness about benefits of toilets and harms of open field defecation and effective implementation of Nirmal gram yojana.
7. Animal owners can form their associations and send collected milk to small cooperative dairy, so that formal marketing can be made available to them.
8. Milk samples should be collected from each individual milk animals, so that animals with positive brucella milk ring test can be subjected to treatment.

SUMMARY

The present study was a community based cross sectional study conducted in rural field practice area of PHC, Vantamuri and urban field practice area of UHC Khasbag, Belgaum, using pre-designed and pre-tested questionnaire to assess knowledge regarding milk borne diseases and to test quality of informally marketed milk.

The study consisted of 500 households, 250 each in urban and rural field practice areas. The duration of study was one year from 1st January 2010 to 31st December 2010.

Socio-Demographic characteristics

The socio-demographic characteristics of study participants showed that majority were females, responsible for handling of milk, with mean age of 41.1 years in urban and 44.3 years in rural area and two third were Hindu's.

Half of the participants in urban area belonged to nuclear family, two third in rural area belonged to joint family. Almost half in urban and four fifth in rural areas were illiterates, two fifth of urban households belonged to class III; whereas three fifth of rural households belonged to class IV socio-economic status.

Assets and liabilities

Very few participants possessed land and majority possessed below poverty line (BPL) ration card. None of them had opted for any type of insurance

(life / health / individual / group based) in rural area; where as 1.6% in urban area had opted for life insurance, one in ten participants were enrolled with mahila mandals.

Environmental history

Majority of the participants stayed in semi-pucca house, all participants among rural area used bore well water as drinking source, whereas in urban area two thirds used tap water and the rest used bore well water.

Majority of urban households had toilet facility and almost half of them had facility for disposing solid and liquid waste provided by Municipal Corporation, whereas most of the rural households practiced open field defecation and all used to dispose solid and liquid waste outside house or village.

General information regarding milk sources

Almost half of urban households preferred milk source from milk vendors and mostly cow's milk, majority purchased 500 ml of milk per day and per capita milk consumption was 50-75 ml / day. One third of rural households preferred milk source from their own milk producing animals and mostly buffalo as well as goat's milk, two fifth purchased 1000 ml of milk per day and per capita milk consumption was less than 50 ml per day.

Knowledge about milk borne diseases

None of the participants knew that milk can transmit diseases or symptoms of those diseases and none suffered from any milk borne diseases in

the year preceding the survey. One third of urban and two fifth of rural participants were aware of contamination of milk, mostly through utensils or human handling. One third of urban and two third of rural participants used to consume raw milk, most of them quoted primary reason as health and convenience or health purpose only.

Milk consumption practices

Most of urban and two thirds of rural households collected milk daily once, preferably in the morning. Majority had good practice of washing hands, utensils before milk collecting and covering milk utensils with lid after collection.

One third of urban and two third of rural participants had practice of adding water to milk prior to boiling. Majority of urban and two third of rural participant's boiled milk immediately after collection, half of them boiled two times in a day, four fifth of them consumed milk next day of collection and mostly till morning only. None had refrigeration facility for milk storage.

Low socio-economic status was associated with poor hygienic practices (i.e. not washing hands / utensils, addition of water and consuming milk on next day of collection) among urban participants. Awareness regarding addition of water to milk and covering milk utensils with lid was better among urban than rural participants.

Animal sources of milk and practices

One fifth of urban and half rural households had their own milk producing animals; of which few used to place their animals in separate shed. Most of them possessed less than 5 animals in urban and 5 or more animals in rural area; of which only one animal used to produce milk at any given time in most of the households, milk production was around 1-2 liters / day, and half of households used to keep all the milk produced for their own household consumption.

One fifth of urban and two fifth of rural households used to wash animals daily, most of them cleaned udder every time before milking. All washed their hands and utensils before milking and sought treatment from veterinary doctor during illness of animals in the year preceding the survey.

Laboratory analysis of milk samples

Mean specific gravity of milk samples were 1.026 ± 0.04 and 1.25 ± 0.007 in urban and rural area respectively. 10% samples (5 / 50) were positive for brucella milk ring test and 28% (14 / 50) samples were positive for both methylene blue reduction test and coliform test. Buffalo milk showed significant association with methylene blue reduction test and coliform test in both urban & rural areas.

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ANNEXURE I - ETHICAL CLEARANCE CERTIFICATE

K.L.E.SOCIETY'S
JAWAHARLAL NEHRU MEDICAL COLLEGE,
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Ref. No. :MDC/DOME/

Date: 14/10/2009

To,

Dr. Neeta K. Hatapaki,
Postgraduate student in
Department of Community Medicine,
J.N.Medical College,
Belgaum.

Dear Dr. Neeta K. Hatapaki,

The JNMC – Institutional Ethics Committee on Human Subjects Research met on 12th October, 2009 to consider your application for approval of the research project **"A CROSS SECTIONAL STUDY OF KNOWLEDGE, ATTITUDE & PRACTICES ABOUT MILK BORNE DISEASES AND ASSESSMENT OF QUALITY OF INFORMALLY MARKETED MILK IN URBAN & RURAL FIELD PRACTICE AREAS OF J.N.M.C., BELGAUM."**.

After review of the documents submitted by you and satisfactory explanations provided to the members, the committee has provided approval date through October 11th, 2010 at which time the study will be reviewed by the committee.

If you have any questions concerning the above, please feel free to contact the committee office.

Sincerely,

(Dr.V.P.Patil)
Chairman,
JNMC Institutional Ethics Committee on
Human Subjects Research

ANNEXURE II – INFORMED CONSENT FORM

K.L.E. UNIVERSITY, BELGAUM, INFORMED CONSENT FORM

"A CROSS SECTONAL STUDY ON KNOWLEDGE, ATTITUDE, AND PRACTICES ABOUT MILK BORNE DISEASES AND ASSESSMENT OF QUALITY OF INFORMALLY MARKETED MILK IN RURAL AND URBAN FIELD PRACTICE AREAS OF J.N.M.C., BELGAUM".

Investigator: Dr. Neeta K. Hatapaki **Guide: Dr. Shivaswamy M. S.**

INTRODUCTION

You are being invited to participate in this study to find out knowledge attitude and practices about milk borne diseases and analysis of quality of milk in rural and urban field practice areas of Belgaum.

EXPLANATION OF PROCEDURE

In this study you will have to answer a few prepared questions which include information on socio-demographic variables, consumption of raw milk, total consumption/ capita/ household, boiling practices, usage, storage and handling methods and knowledge about milk borne infections. The entire procedure may take about 20 to 30 minutes.

If you agree to participate, you will be continued asking questions; but the moment you don't want to continue, then you can leave.

POSSIBLE BENEFITS

The investigator does not promise or guarantee that you will receive direct benefit being in the study. It will benefit for whole community to acquire knowledge, attitude, and practices about milk borne diseases. This study will surely help in future for preventive measures to take for milk contamination in community.

CONFIDENTIALITY

Your identity will not be revealed. All information will be collected and coded, so that no one will know your identity.

WITHDRAWAL

Participation in this study is voluntary. If you don't wish to participate in this study; you will not lose benefits to which you are enrolled.

COST OF PARTICIPATION

The cost of study will be borne by the researcher. There will be no additional cost to you for participation in this study.

QUESTIONS

If you have any questions about this study, you can contact **Dr. Neeta K. Hatapaki,** Postgraduate student in Community Medicine, J.N.Medical College, Belgaum, - 590010 Cell: 9844190501 or **Dr. Shivaswamy M.S.,** Professor, Community Medicine, J. N. Medical College, Belgaum – 590010 Cell:

9448294702 or **Dr. (Mrs.) S. C. Metgud**, Professor, Microbiology, J.N.Medical College, Belgaum – 590010, Cell No: 9448161998

If you have any questions about your rights as a study participant, you may also contact **Dr. V. D. Patil,** Principal, J. N. Medical College & Chairman, Institutional Ethics Committee on Human Subjects' Research, J.N.M.C, Belgaum- 590010, Ph. No: 0831-2471702 (O)

ALTERNATIVES

The participant's willingness, to participate or not to participate in this study, will not influence the care being provided at P.H.C, Vantamuri and U.H.C. Khasbag by the staff of J. N. Medical College, Belgaum.

LEGAL RIGHTS

By signing this consent form, you are not waiving off any of your legal rights.

PUBLICATION RIGHTS

The result of survey will be used for teaching and medical publication; however the participant's identity will be kept confidential.

CONSENT STATEMENT

"I volunteer and consent to participate in this study. I have read the content or it has been read to me in the language I can understand. The study has been fully explained to me and I may ask any questions at any time."

1. Signature or Left hand thumb impression _____

(Volunteer subject) and Name_____

2. Signature of person (obtaining consent) _____

And name _____

3. Signature of witness _____

And name _____

Date: _____ Place: _____

ANNEXURE III – PROFOMA

RESEARCH QUESTIONNAIRE

Investigator: Dr. Neeta K Hatapaki **Guide: Dr. Shivaswamy M. S.**

"A CROSS SECTONAL STUDY ON KNOWLEDGE, ATTITUDE, AND PRACTICES ABOUT MILK BORNE DISEASES AND ASSESSMENT OF QUALITY OF INFORMALLY MARKETED MILK IN RURAL AND URBAN FIELD PRACTICE AREAS, J.N.M.C., BELGAUM".

[Note: All the personal information provided during this study will be kept confidential. Only aggregated data will be published.]

I] GENERAL INFORMATION

Sl. No._____ Date of survey._____

Urban / Rural Village / Ward: _____

Name: Age: _____years Sex: M / F

House no: Galli: _____

Religion: Hindu / Muslim / Others: Caste: _____

Category: SC / ST /OBC /Others:

Type of family: Nuclear / Joint / Extended / Broken Family size: _____

Total income: Rs_____ / month Per capita Income: Rs_____ / month

Education: Illiterate / 1-5th std. / 6-10th std. / 11-12th std or Diploma / Graduation

Socio Economic Status (Modified BG Prasad's classification): - I / II / III / IV / V

II ASSETS AND LIABILITIES

Land holding: - Yes / No

If yes: Irrigated land: _____acres, Crops / Year: _____

Non-irrigated land: _____acres, Crops / Year: _____

Milk producing Animals Yes / No If yes: Cow / Buffalo / Sheep / Goats

Presence of Ration card – APL Card / BPL Card / No ration card

Insurance in last year: Life insurance Yes / No

Health insurance Yes / No

Individual / Group based Yes / No

Are you member of any self help group / Mahila Mandal? Yes / No

III. ENVIRONMENTAL HISTORY

Housing:-

Water supply:-

Sanitation: a) solid waste b) Liquid waste

Toilet: Open air defecation / Common Toilet / Separate toilet

IV. General Information about milk consumption

1. Source of milk a. Animals from own house

b. From milk vendor

c. From dairy

2. Type of milk a. Cow b. Buffalo c. Others

3. Quantity of milk ---------- litres

4. Per capita consumption ---------- litres

V. Assessment of knowledge about milk borne diseases

1. Do you know that diseases can be transmitted from the milk? Yes / No

2. If yes, what all diseases can be transmitted?

_____ _____

_____ _____

3. Do you know that milk can be contaminated? Yes / No

4. If yes, sources of contamination a. Water Yes / No

b. Utensils Yes / No

c. The dairy animals (cow/buffalo) Yes / No

d. Human handler Yes / No

5. Do you know the symptoms of brucellosis?

_____ _____

_____ _____

6. Do you know the symptoms of enteropathogenic E. coli?

_____ _____

_____ _____

7. Do you attribute these symptoms to be because of consumption of raw milk?

Yes / No

8. Do you consume raw milk? Yes / No

9. If yes, reasons

Tastes good / Health purpose / Convenience / Other reasons, _____

VI. Attitude

1. Did any of the family members suffered from these diseases? Yes / No

2. If yes, how many members were affected in the past one year? _____

3. How many times, have they suffered from the same disease? _____

4. What are the major measures taken for these symptoms?

a. None b. Home remedies c. Local doctor d. unqualified / traditional healers

VII. Milk consumption Practices

1. How many times do you collect milk? _____

2. At what time do you collect milk? _____

3. Do you wash your hands before collecting milk from the vendor? Yes / No

4. Do you wash the utensil in which the milk is collected? Yes / No

5. Do you add water to milk? Yes / No

6. If yes, approximately how much? _____

7. When do you boil milk? a. Immediately after collecting milk from vendor

Yes / No

b. Time lag from collection to boiling of milk _____

8. How many times do you boil the milk on the same day? _____

9. Do you consume the same milk the next day? Yes / No

10. If yes, until what time? Morning / afternoon /evening

11. How do you store the milk? a. In the refrigerator / b. Outside

12. Do you keep the milk utensil covered with a lid? Yes / No

VIII. Information about Animal sources for milk

1. Where do you keep them? a. In a separate cow- shed b. Within the house

2. How many animals do you have? _____

3. Among them how many give milk? _____

4. How much is the total production by those animals? _____

5. Among total milk produced, how much you keep for your house? _____

6. How frequently do you wash the animals?

Once in, a day/ two days/ three days/ longer period

7. Do you clean the udder every time before milking? Yes / No

8. Do you thoroughly wash your hands before milking? Yes / No

9. Do you thoroughly wash utensils used for collection of milk? Yes / No

10. Do you take any measures when the animals are ill? Yes / No

IX. Lab Analysis of Raw milk

Raw milk Sample Collected from the household Yes / No

If Yes, Date of Report_____ Lab Serial No: _____

(1) Specific gravity by Lactometer _____

(2) Methylene blue reduction test to test presence of bacteria.

Positive / Negative

(3) Coliform test to detect milk dilution by contaminated water.

Positive / Negative

(4) Brucella milk ring test to know the infection of cow's udder

Positive / Negative