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**DELIVERING WATER, SANITATION AND HYGIENE SERVICES
IN AN UNCERTAIN ENVIRONMENT**

**Food hygiene practices of mothers and level
of contamination in child's food in Nepal:
a formative research**

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*Preventable and treatable food-borne diseases are a major cause of illness globally. Inadequate food hygiene is likely to cause a substantial proportion of foodborne infections including diarrhoea among infants and young children. Although proper food hygiene practices may prevent disease, there is little evidence to support this premise. Very few intervention studies have been carried out and there has been little effort to undertake food hygiene interventions for the reduction of childhood diarrhoea and malnutrition. A simple and replicable food hygiene intervention, which can be implemented by the WASH, health and nutrition sectors at scale has yet to be designed and tested. **The formative research** was conducted in a rural hill setting in Nepal during April-June 2012, examining mothers' food hygiene practices and their environmental and psychological determinants, the level of microbes in the child's food, and critical and behavioral control points. Formative research helped to prioritize five key food hygiene behaviours for the design of an intervention in the next phase of the PhD research.*

Background

Diarrhoeal diseases are the second leading disease cause of death among children under-five globally. In 2010, around 801,000 children died of diarrhoea (Li Liu, 9 June 2012). Up to 70% of diarrhoea in developing countries is said to be caused by pathogens transmitted through food (WHO, 1996, Esrey, January-February 1990). Contaminated weaning foods are potentially a major contributor in low-income settings (Motarjemi Y, 1993), although observational studies were inconclusive (LANATA, 2003). Around 40% of all food-borne infections are thought to originate in the home, even in high-income settings (Bloomfield SF, 2009). However, most of what is known about food-borne infections in low-income settings is based on expert opinion and biological plausibility, rather than field data (Curtis, 2011). The role of contaminated food is still poorly understood and more studies are needed to document its impact and to develop appropriate interventions for application in developing countries, where evidence concerning food-borne disease is scarce (LANATA, 2003). Among recommended strategies for controlling diarrhoeal diseases in developing countries, food hygiene promotion has been under-prioritised. Simple, easily replicable and feasible food hygiene interventions are needed that can be implemented within water, sanitation and hygiene (WASH), health, and nutrition programmes. Gathering field based evidence on food hygiene and developing simple but replicable food hygiene intervention to improve the situation in the developing world is therefore vital. Hence, this 'Formative Research' was conducted as one part of the PhD research work.

Literature review

WHO recommended that infant should be exclusively breastfed for first six months and from six months up to two years or older, they should receive **safe** complementary **food** (WHO, 16 April 2002). However, various factors are contributing to make complementary/child food unsafe and increase the risk of food-borne infection among children. Hot climate, poor storage facilities and environmental faecal contamination make food-borne infections more likely in low-income settings (Curtis, 2011), added to by limited maternal

awareness about the link between diarrhoea and improper food handling, cooking fuel scarcity, time gaps between meal preparation and feeding (Tenssay, 1997 Apr), environmental contamination due to lack of sanitation and washing utensils in contaminated water (Marino, 2007 Nov) and environmental conditions i.e. animals accessing kitchen, no fridge, hard to clean surfaces, lack of running water and cleaning products etc.

Poor WASH is linked to food contamination, because when sanitation facilities are not available, the likelihood of contamination of food increases. Once faecal contamination is present in food, other factors such as temperature and feeding practices contribute to growth of bacteria and/or micro-organisms. The F-diagram shows food as a critical pathway by which faecal pathogens are ingested by a new host (Astier M Almedom., 1997). Food is potentially important for disease transmission because pathogens on food have an easy route into the digestive system, and because some gastro-enteric pathogens can multiply on food and thereby increase the dose ingested (Valerie Curtis, January 2000). Such assumptions, however, are based on expert opinion and observational studies rather than intervention trials (Curtis, 2011). Although various interventions have been implemented to reduce childhood diarrhoea and malnutrition, the role of simple food hygiene intervention in improving practices and reducing childhood diarrhoea has yet to be understood and acted upon in low-income settings.

Objectives (formative research)

- To document current food hygiene behaviour and its environmental and psychological determinants among mothers.
- To assess levels of microbiological contamination in food fed to young children (6-59 months)
- To identify the critical control points of food contamination while preparing, handling, and storing food, and feeding the child at home.
- To prioritize key food hygiene behaviours thereby to design a simple and scalable food hygiene promotion package.

Methods

Study setting

The study is being conducted in the rural hill setting of Kavre District, Nepal. A village development committee (VDC) area, Baluwapati Deupur located approximately 45km east of Kathmandu valley, have been selected taking into account the geographic location, socio-economic variability, population representativity, and diarrhoeal disease prevalence (high).

Study design

Formative research, primarily qualitative and microbiological testing methods supplemented with anthropological and quantitative (survey) methods.

Data collection and instruments

Altogether, 68 households with a mother having a child aged 6-59 months were included in the study. Various tools were used including observation of daily routines; 30 video recordings; 68 in-depth interviews/household surveys/observation; 11 focus group discussions; 5 'teach the researcher' sessions; quantification of level of microbes (E.coli and Coliforms) in child food from 105 food samples and in milk (13 samples) and water (30 samples) at different times; and documenting critical and behavioural control points and mechanisms practiced by the mother.

Results

Socio-demographic characteristics of the study participants

Respondents ranged in age from 17-43 years (mean 28 years). ~74% of respondents had some formal or informal education. The majority of the respondents (75%) belonged to the Hill Aadiwasi/Janajaati ethnic group (part of the historically deprived *Tamang* group) and 74% were Buddhist. Most of the respondents were housewives (50%). The 68 households included in the study had a total of 84 children aged 6-59 months (mean 28 months). The main source of households income was agriculture (57%) and 84% of the households only earned up to NRs. 10,000 (~GBP75) per month. Around 89% households had a piped water connection (unprotected spring sources) and around 50% practiced open defecation. 99% of households did not have a refrigerator.

Daily routine of mothers (day life analysis)

The key food hygiene behaviours related to child food are overshadowed by mothers' daily work. Most mothers followed a similar daily routine of rising at 5am, followed by defecation, fetching water, lighting fire, cleaning animal shed, feeding animals, sweeping inside/outside, preparing tea and feeding light snacks to children. This is followed by either doing domestic or field work (~3hrs). The majority of mothers belonging to the *Brahmin* and *Chhetri* cast groups started cooking lunch at around 9am-10am, while *Tamang* families cooked at around 10-11am. Most mothers (82%) needed at least one hour to prepare food. After feeding the child and eating lunch, afternoon work included domestic work such as sweeping, laundry, feeding animals, caring for animals or work in the field (~3-4hrs). Only 50% of the mother mentioned one hour leisure time in-between. Food given to children in the afternoon comprised of leftover food cooked in the morning and often stored un-hygenically at ambient temperature and offered at around 3-4pm by family members such as grandmothers. Most mothers cooked dinner between 6-7pm and fed child accordingly. After dinner, the day ended at around 8-9pm for all mothers. Most mothers necessarily did not link their daily routine with the food hygiene behaviours because those are yet to be formed.

Common children's food including weaning food

Age group	Food type*			Total
	Liquid	Semi-solid	Solid	
6 – 24 monthys	1 (2)	8 (19)	33 (79)	42 (100)
>24 – 59 months	0 (0)	0 (0)	42 (100)	42 (100)
Total	1 (1)	8 (10)	75 (89)	84 (100)

*value in parenthesis are percentage

Traditionally, female children are weaned at 5 months and male children at 6 months. Weaning starts with a small rice feeding ceremony (*pasne*), mostly using rice pudding. After the first day of weaning, the majority of households started feeding their children the same food that they themselves consume daily. Of 84 children, 1% consumed liquid food, 10% semi-solid (Jaulo) food and 89% solid food (rice with curry/milk). Amongst those aged 6-24months (50%), 79% consumed solid food. During or immediately after feeding, all mothers offered water to their children to drink (100%) and sometimes milk (43%); several Tamang families also offered Jad (homemade alcoholic brew). The most commonly used semi-solid (weaning) and solid child foods and their ingredients are as follows:

Food Types	Name of food	Ingredients
Solid food	Rice with curry or rice with milk	<ul style="list-style-type: none"> Rice, water and Milk Curry: Oil, onion, potatoes, spices (turmeric powder, ginger, garlic, salt, chilli), green vegetables
Semi-solid food	Jaulo	<ul style="list-style-type: none"> A porridge made with oil/ghee, fenugreek, turmeric powder, onion, rice, water and salt

In addition to commonly used solid food, mothers also fed other solid food such as *dhindo* (maize- or wheat-flour porridge), *roti* (maize- or wheat-flour flatbread) and *dal* (pulses). In addition to commonly used semi-solid food, mothers also fed *lito* (roasted rice-, maize or millet-flour with ghee and sugar), *khichari* (rice, pulses, turmeric powder and vegetables), breastmilk, fruits (banana, orange etc), and boiled eggs. Offering certain foods to the child (such as rice with curry, jaulo) more often symbolized a higher social status of a family; this has gradually become a social norm, resulting in the majority of mothers preferring to feed rice with curry to children.

Environmental (physical, biological and social environment) factors associated with mothers' food hygiene practices

The study took place within a typical rural hill setting (2,195m elevation), with a multi-ethnic/lingual society comprising different caste and ethnic groups. All houses were made of mud and stone, with kitchen surfaces made of mud, and most households cooking on the floor. Firewood was the main source of cooking fuel (94%).

Animal faeces were observed in 79% of compounds. Flies were present throughout the village, particularly in kitchens. More than 50% of households keep animals (goats, chickens, cows/buffalos) in the same house/compound in which they live, cook and eat. Chickens and goats often enter the kitchen. Almost 67% of utensils and 57% of kitchen surfaces appeared clean (according to our operational definition).

Almost all households placed animal feeding containers in the kitchen for wastewater collection, which attracted flies that also landed on kitchen surfaces/utensils and food. Hands could not be washed in this water because mothers felt that animals could not be fed soapy water. Ash and soap were available in 100% and 94% households respectively but only 7% of mothers used soap to wash hands before child feeding, and 16% cleaned serving utensils thoroughly using those agents before serving food to children.

The social environment and rooted traditions affected behaviours; certain Tamang mothers washed cooking vessels/pot once a day but a few did so twice a day. None reported washing the milk storage container frequently (usually twice a month). A wooden spoon was used to mix flour while cooking *dhindo* but was never washed; instead, remnants were peeled or scraped off before use. Mothers were multitasking while cooking, making cross-contamination of food likely. Such tasks included feeding animals, sweeping/wiping kitchen, washing utensils, using the toilet, laundry, cleaning child's bottom, breastfeeding, wood/water collection, etc. It was observed that certain actions that could lead to food contamination were performed by mothers within the specific environment, such as placing cleaned utensils on the mud floor and then using them without cleaning, covering food without a tight lid so that flies could land on food, tasting curry using hands instead of a spoon, allowing child to carry food around while eating, using toilet during food preparation and washing utensils but continuing to work without washing hands with soap, grinding spices without cleaning the grinding stone or washing hands, and re-using unwashed cooking vessels. The certain food hygiene behaviours were performed ritually/habitually without awareness of the benefits; only 6% knew the advantages of cooking food thoroughly, despite 77% of mother thoroughly cooking food and maintaining proper temperature during cooking (mean 66^oC, maximum temperature 84^oC, minimum 52^oC).

Food hygiene behaviour, its determinants and level of microbes in food

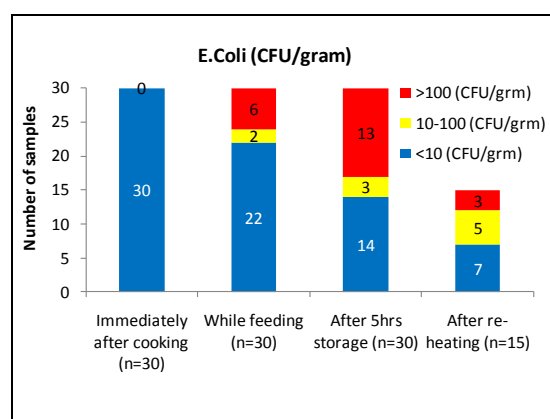
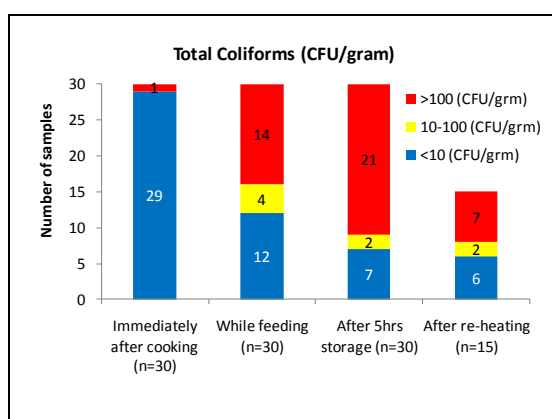
Food hygiene behaviours are underpinned by social, physical and biological settings, including level of awareness, cultural beliefs and individual psychology. Positive behaviours help prevent contamination, but can also lead to contamination if performed inadequately. The study found that most households served solid food to children, including those being weaned (5/6-23months). Cooking is done 2-3 times a day, but children are fed 4-5 times a day; hence all households fed stored/leftover food to children. The reason for not cooking every feeding time were; i) following traditions-habit (two times a day), ii) time constraints, iii) saving cooking fuel, iv) child eating the same food as others so no need for additional cooking etc. The majority of households practice traditional cooking methods that result in food being thoroughly cooked (cooking long and maintaining temperature >70^oC). Although food was likely to contaminate/re-contaminate during cooking due to the multi-tasking behaviours of mother, thorough cooking defeated such circumstances. Food samples tested immediately after cooking (samples taken directly from a vessel) were less contaminated than samples taken at other times. Of 30 samples tested, coliforms were isolated from only one sample.

Flies, animal faeces and dust/dirt cause contamination and re-contamination of utensils and cooked food, yet many mothers missed opportunities to properly wash the utensils used to serve the child's food. Despite 94% of households owning soap, only 7% of mothers used soap to wash their hands before cooking and feeding to child (more than half used water only). Up to 91% of the available handwashing opportunities were missed by mothers. 80% of mothers fed the child using their hands by dipping their fingers in the food to mix it/test the temperature before feeding, thereby contributing to food contamination whilst feeding. Food samples taken immediately after cooking from plates/bowls after hand contact showed Coliforms counts >100 CFU/gram in 14 samples out of 30 samples with geometric-mean 30CFU/gram from the level of 1CFU/gram in the first sample, and the E.coli count exceeded 100 CFU/gram in 6 samples with geometric-mean 5CFU/gram from an initial level of 1. This shows that promoting thorough cooking alone is not enough to prevent the ingestion of bacteria during feeding hence it is necessary to promote handwashing before

feeding and touching cooked food and cleanliness of serving utensils. As revealed from exercises, disgust, nurture and respect/status were motivational factors for mothers to wash hands which can be used in next phase.

Cooked food stored up to 12hrs is considered as fresh by mothers. Food cooked in the morning and stored at ambient temperatures, typically with inadequate storage practices (without tight-fitting lid) was served to children multiple times during the day. Food samples tested after five hours of storage had a Coliform count >100 CFU/gram in 21 samples out of 30 with mean 51CFU/gram and E.coli count exceeded >100 CFU/gram in 13 samples with mean 11CFU/gram. The temperature, the environments (flies/dust/dirt/storage location), storing utensils and storing w/o tight fitting lid all make possible to contaminate food up to that level.

Observation revealed that only half of the households reheated stored food, and that only 19% of food reheated reached an adequate temperature. Reasons given by mothers for this included time and energy required, difficulty in lighting the fire multiple times, don't need to re-heat in summer, fear of burning food, not having adequate pots for re-heating, and fears of destroying nutritious value. When 15 food samples were tested immediately after re-heating, the Coliforms bacteria count exceeded >100 CFU/gram in 7 samples with geometric-mean 25CFU/gram and E.coli count exceeded >100 CFU/gram in 3 samples with geometric-mean 9CFU/gram implying that reheating practices were not adequate. Out of 30 ready-to-feed water samples tested, 93% were contaminated with Coliform and 50% with E.coli. Milk was also heavily contaminated; of 13 milk samples tested, 92% were heavily contaminated with Coliforms and 31% with E.coli. The obvious reasons were unhygienic milking (locations, washing, using contaminated water etc), inadequate boiling, inadequate storage (storing in ambient temperature without covering it) and handling, not re-boiling before serving etc.



Of 84 children, 39 (46%) were reported to have been sick in the past month, of which 31% had diarrhoea. Of these, 20 (24%) had diarrhoea in the last week. The perceived causes of diarrhoea varied among mothers. One third (31%) of mothers mentioned flies/dust and 25% mentioned contaminated food, 13% mentioned not washing hands with soap before feeding child, and 6% mentioned the evil eye.

Identification of critical control and behavioural control points

The study utilised behavioural outcomes and microbial contamination of child food to identify critical and behavioural control points. A detail food flow/supply diagram was developed and likely hazards as well as critical & behavioural control points were identified. Although the extent to which poor food hygiene is practiced varies, the study concludes that the moments and associated practices of thorough cooking (maintaining adequate temperature), proper storage (using tight-fitting lid, covering and protecting from flies/dust), proper feeding (washing mother's hands before feeding and washing child's hands before serving food, washing serving utensils) and adequate re-heating (maintaining adequate temperature) are critical control and behavioural control points where corrective measures can be applied. This study identified 'feeding' as one additional behavioural control measure point which often ignored by many studies to protect from actual ingestion of microbes.

Priority behaviours

Based on the above and behaviours that are in currently practiced, it is recommended that an intervention is designed around five behaviours: i) proper re-heating practices of stored/leftover food, ii) cleanliness of utensils used to serve a child's food, iii) handwashing with soap before touching any cooked/stored food,

before feeding a child (mother) and before eating (child), iv) proper storage of cooked food (covered in tight-fitting lid, flies not accessing food), and v) boiling milk and water before serving. The study also concludes that, while designing an intervention, the objects associated with each behaviour, the physical, biological and social environment, and the motives behind each practice should be taken into consideration. Designing of a simple intervention based on prioritized behaviours and its introduction to measure the effect of the intervention will be done in next phase of the PhD research work.

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