FOOD PREPARATION SAFETY EDUCATION OF STREET FOOD VENDORS AROUND PUBLIC ELEMENTARY SCHOOLS TO IMPROVE BACTERIOLOGICAL AND CHEMICAL FOOD SAFETY

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Abstract. Cases of food poisoning have occurred among elementary students after consuming street food from vendors near their schools in southern Cimahi City, Indonesia. We aimed to improve the bacteriological and chemical safety of the food served by these vendors through an education program. In this study we assessed the efficacy of this education program using a quasi-experimental study design. We used a pre-test / post-test design with 27 venders in intervention and 27 venders in control groups. The intervention group consisted of vendors around 4 public elementary schools in southern Cimahi City where the food poisoning cases occurred and the control group consisted of vendors around 4 public elementary schools in northern Cimahi City where no cases of food poisoning had occurred. The vendors were selected through random sampling. Prior to the intervention the bacterial (coliform, *E-coli* and total plate count) and chemical (sodium borate / borax, formaldehyde, rhodamin B and yellow methanol) safety of both groups were assessed. During the intervention, a sanitation officer educated the vendors in the intervention group about food safety for 20-30 minutes a week for 6 months. In the control group, no education was provided. In the control group 14.8% of the vendors had food that was determined to be bacteriologically safe at the beginning of the study and 14.8% of the vendors had food that was bacteriologically safe at the end of the study. The difference in the percentages of food bacteriologically safe did not differ significantly. In the control group 88.9% of the vendors had food that was determined to be chemically safe at the beginning of the study and 88.9% at the end of the study; there was no significant difference in the percentages of chemically safe food. In the intervention group, 11.1% of the vendors had food that was determined to be bacteriologically safe at the beginning of the study and 70.4% of the vendors had food that was bacteriologically safe at the end of the study; this was a significant improvement (p=0.001). In the intervention group,

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70.4% of the vendors had food that was determined to be chemically safe at the beginning of the study and 100% of the vendors had food that was chemically safe at the end of the study; this was a significant improvement (p=0.008). The food safety education program for food vendors was effective in significantly improving the safety of food served by food vendors around the studied primary elementary schools in southern Cimahi City, Indonesia. Further studies are needed to determine if the program can be successfully expanded to other cities.

Keywords: *E.coli*, coliform, borax, formaldehyde, total plate count, food safety

INTRODUCTION

In Asian countries street food plays an important role in the provision of daily food and supplies up to 88% of the energy intake per day (Simopoulus and Bhat, 2000). The number of street food vendors has increased with the population. Studies from South Africa (Kubheka *et al*, 2001), Malawi (Taulo *et al*, 2008), Zimbabwe (Gadaga *et al*, 2008), Bangladesh (Mamun *et al*, 2014), and Hong Kong (Ng *et al*, 2013) revealed most street food contains bacteria. Street vended foods can cause food-borne diseases such as diarrhea and food poisoning (Sofos, 2013). Diarrheal disease is the leading cause of death in children: causing more than 1,400 childhood deaths per day worldwide and about 526,000 childhood deaths per year, mainly among children under age five years (WHO, 2015). One of food borne diseases from contaminated street food and beverages was diarrhea. A study in Indonesia in 2013 of all the households in 33 provinces, 497 districts/cities with 1,027,763 samples using cross-sectional study design reported 35,971 cases of diarrhea (3.5%) (Kemenkes, 2013). In West Java, Cimahi City during 2014 11% of the residents (63,678/578,896) had diarrhea and in 2015 15% of residents (87,987/ 586,580) had diarrhea (Dinkes Cimahi City, 2015). In Cimahi City during 2015, of 87,987 cases of diarrhea reported, 23% were affected infants and 21% were children (Dinkes Cimahi City, 2015).

A survey by Indonesian National Agency of Drug and Food Control in 2015 of 13 provinces in Indonesia found 45% of street food sold in the neighborhood of elementary schools out of 2,984 samples tested were physically (15%), chemically (5%) and microbiologically (20%) unsafe (BPOM, 2015). Contamination of prepared food can occur due to contamination with raw food, lack of food handler awareness of proper hygiene, preparing food with dirty hands, lack of water resources, and unhygienic food stalls (Odeyemi, 2016). Studies from Scotland (Ehiri *et al*, 1997), Turkey (Acikel *et al*, 2008), Brazil (Cunha *et al*, 2013), Portugal (Soares *et al*, 2013), China (Bai *et al*, 2014), and Dubai (Abushelaibi *et al*, 2015) showed street food vendors lack adequate knowledge about food safety (Motarjemi *et al*, 2014). Education to improve food safety knowledge of street food vendors was relatively effective. However, it was not able to change their practice and therefore was less effective in improving bacteriological and chemical food safety (Ehiri *et al*, 1997, Acikel *et al*, 2008, Cunha *et al*, 2013, Soares *et al*, 2013, Bai *et al*, 2014, Abushelaibi *et al*, 2015). The ineffectiveness could be due to the training method used in the study, where knowledge regarding street food safety was given in a "formal setting". In this setting the street food vendors gathered in one place (sitting), and trainer conveyed the materials to the street food vendors who might not constantly pay attention.

Food safety education using media such as pictures, videos, and safe street food samples could make street food vendors understand and practice food safety skill. However, it would possibly last for only several days as the trainer could not control the practice continuously. Our study regarding food safety education therefore focused on food preparation education by different approach *ie*, intensive guidance to each street food vendor while they were processing their street food. Our study aimed to improve street food vendors' food safety practice which would be reflected by improved bacteriological and chemical street food safety. The street food vendors of our study were those who sold street food around Public Elementary Schools in Cimahi City, West Java Province, Indonesia where food poisoning cases had occurred.

MATERIALS AND METHODS

Subjects selection

This study was approved by the Ethics Committee for Health Research, School of Public Health, University of Diponegoro: (Ethical Clearance Number 128/EC/FKM/2016). The study population was all of the street food vendors around public elementary schools in Cimahi City. From this study population, two groups (intervention and control) were selected. The intervention group was food vendors around four public elementary schools in southern Cimahi City where a previous food poisoning outbreak occurred. The control group was food vendors around four public elementary schools in northern Cimahi City. Subjects were selected by simple random sampling. Inclusion criteria were: 1) The food vendors had to prepare the food they sold themselves and 2) The food had to be sold in the neighborhood around the selected public elementary schools. The intervention group consisted of 27 street food vendors who were given food preparation safety education. The control group consisted of 27 street food vendors who were given education regarding hypertension. A sample of the food sold was obtained from each vendor at the beginning and then at the end of the study and examined for bacteriological and chemical safety.

The study was conducted for 6 months. The education about food safety was given weekly, each session lasting 20-30 minutes. The education was provided by a sanitarian officer who educated the vendors using food safety guidelines for food vendors: (1) requirements for food handlers when processing food; (2) requirements for food preparation equipment; (3) requirements for food materials; (4) requirements for food additives; (5) requirements for ready to eat food; and (6) requirements for cooking facilities. Vendors were educated about a) how to cook the food properly; b) how to store food safely and at what temperature; c) how to choose fresh, good quality food raw materials; d) how to wash raw food appropriately and the importance of not using expired food ingredient; and e) how to use raw materials safely.

Bacteriological and chemical testing

Food samples were obtained from each vendor at the beginning and the ending of the 6-month intervention and examined for bacteriological and chemical safety following The National Standard for Indonesian (SNI, 2008). Bacteriological and chemical food safety standards from the Indonesian National Agency for Drug and Food Control (BPOM, 2012) were used to determine if the food was safe. To be considered bacteriologically safe the

food had to be safe in 3 areas: coliform, *E.coli*, and total plate counts. If any one of these areas did not meet mandated safety standards, the food was determined to be "not safe". To be considered chemically safe, the food must not contain any of the following: borax, formaldehyde, rhodamin B, or yellow methanil. If the food contained any one of these, it was determined to be "not safe".

Food sample collection and analysis

One hundred grams of each food sample from each studied vendor was collected in a sterile plastic container, and kept in an ice box brought to the Public Health Laboratory (PHL) within 2 hours. Each sample was processed immediately upon receipt.

The microbiological tests for each sample were determination of coliform count, *E.coli* count, and total plate count following SNI (2008). To detect and quantify coliform counts, *E.coli* counts, and total plate counts, violet red bile agar (CM0463) (Oxoid, Hamshire, UK) and brilliant green lactose bile broth (Oxoid) were used. *E.coli* was detected by diluting the food sample with peptone water (0.5 ml) and plating it onto sterile Tryptone Bile X-glucuronide (TBX) agar (Oxoid) and incubating it at 45^{o}C for 24 hours. The following counts were determined safe by the Indonesian Nation Agency for Drug and Food Control (BPOM, 2015): a coliform count of less than 20 bacteria per gram of food tested, an *E. coli* count of less than 3 bacteria per gram of food tested, and a total plate count count $<10^5$ bacteria per gram of food tested.

For chemical safety, borax was examined using the Easy test kit (ET Group, Jakarta, Indonesia). We examined for formaldehyde using the Merckoquant test kit (ET Group Indonesia). We examined for yellow methanil and rhodamin B using paper chromatography method (ET Group Indonesia).

Statistical analysis

We used the Mc Nemar test to determine differences in bacteriological and chemical safety between the control and intervention groups pre- and post-intervention.

RESULTS

The profile of street food vendors is precented in Table 1. There were 54 vendors included in the study; 27 vendors in each group. The number of vendors according to age (>40 years *vs* <40 years) were not different in both groups. There were more male than female vendors in the two groups. Regarding education level, most vendors (66.7% in the control and 77.8% in the intervention group) had finished elementary/junior highschool. Most vendors in both groups earned ≤Rp.2,275,715/month. The majority of vendors in both group had no information exposure on food safety, had length of saling food >1 year, and had incompete cooking facilities.

The bacteriological examination of street food samples are shown in Fig 1. Twenty-three food sample (85.2%) of the control groups proved unsafe both pre- and post- study. There were 24 food samples (88.9%) of the intervention group proved to be unsafe before the six month education and 8 food samples (29.6%) were unsafe after the six month education. In the control group there was no significant difference in bacteriological street food safety both pre- and post-study (p=1.000). In the intervention group there was significant improvement in bacteriological food safety post-education (p=0.001). After the six month education,

Table 1
The profile of street food vendors (n= 54) around public elementary schools in Cimahi City.

Variables	Control group, n = 27 Number (%)	Intervention group, n = 27 Number (%)
Age		
< 40s	14 (51.8)	15 (55.6)
≥ 40 year	13 (48.2)	12 (44.4)
Gender		
Male	17 (63.0)	25 (92.6)
Female	10 (37.0)	2 (7.4)
Education level		
Senior High school	9 (33.3)	6 (22.2)
Elementary / Junior High school	18 (66.7)	21 (77.8)
Income		
>Rp.2,275,715 per month	10 (37.0)	6 (22.2)
≤Rp.2,275,715 per month	17 (63.0)	21 (77.8)
Information exposure on food safety		
Yes	5 (18.5)	6 (22.2)
Not yet	22 (81.5)	21 (77.8)
Length of sale		
> 1 year	24 (88.9)	21 (77.8)
≤ 1 year	3 (11.1)	6 (22.2)
Cooking facilities		
Complete	9 (33.3)	7 (25.9)
Incomplete	18 (66.7)	20 (74.1)

the percentage of street food samples which proved to be bacteriologically safe increased significantly (p=0.001) from 11.1% (pre-intervention) to 70.4% (post-intervention).

Results of the chemical examination of street food are shown in Fig 1. Three food samples (11.1%) of the control group proved unsafe both pre- and post-study. Eight food samples (29.6%) of the intervention group were unsafe before the six-month education but no food samples proved to be unsafe after the six-month education. In the control group there was no significant difference in chemical food safety both pre- and post-study (p=1.000). In the intervention group there was significant improvement in chemical food safety post-education (p=0.008). After the six month education, the percentage of street food samples proved to be chemically safe increased significantly (p=0.008) from 70.4% (pre-intervention) to 100% (post-intervention).

DISCUSSION

Our results showe 6 months of intensive food preparation safety education of street food vendors improved bacteriological and chemical safety of street food around public elementary schools in Cimahi City, West Java, Indonesia. The percentage of samples proved safe bacteriologically increased by 59.3% and

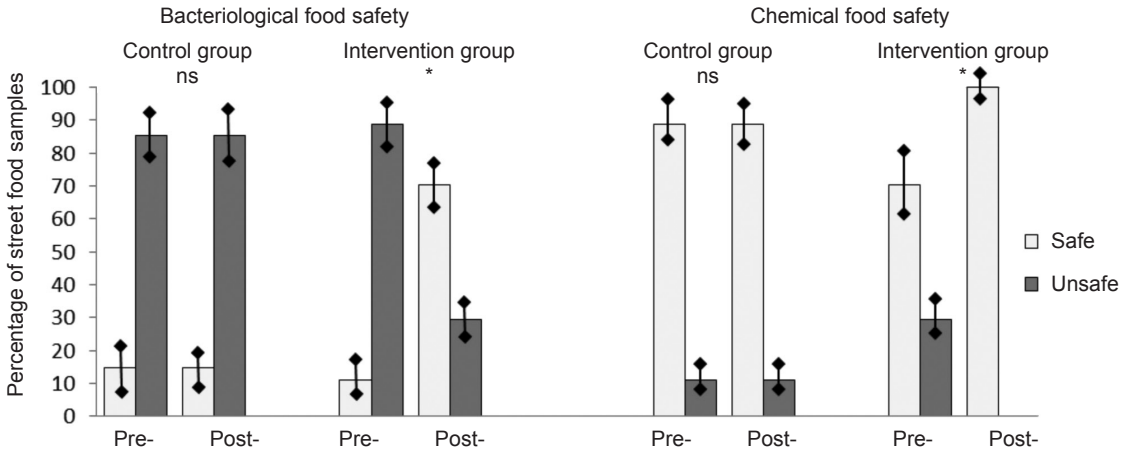

Fig 1–Bacteriological and chemical food safety comparison between control group and intervention group pre- and post-education. Bars, means and their 95% confidence intervals), ns, non-significant; *$p<0.05$.

chemically increased by 29.6%, higher than a study from Portugal (24%) (Soares *et al*, 2013). This difference may be caused by different training method used. The results of our study was similar to a study from Egypt which reported improving food safty by 55.6% (Saudi *et al*, 2013). Another study from Indonesia found no improvement in street food safety (Ningsih, 2014). Food preparation safety education can improve street food vendors' knowledge and attitudes which can change their behavior when preparing food (Green, 2000). Having a sanitarian officer providing education in our study helped street food vendors to be more compliant during the education, because sanitarian officers of health centers (Puskesmas) having health authority.

This study, focusing on food preparation safety education by intensive guidance to each street food vendor while they were processing their street food proved that the applied approach was able to improve street food vendors' food safety practice which was indicated by improved bacteriological and chemical street food safety. Our study proved that intensive education was more effective than other method such as training which was only effective to improve street food vendors' knowledge (Ehiri *et al*, 1997; Acikel *et al*, 2008; Cunha *et al*, 2013; Soares *et al*, 2013, Bai *et al*, 2014; Abushelaibi *et al*, 2015). Thus, intensive food preparation safety education is more effective than training in which it did not only improved vendors' knowledge but also their practice in preparing the food.

Chemical street food safety had increased after food preparation safety education. The improvement was due to behavioral changes of the street food vendors who no longer used borax and formaldehyde to preserve food. The food preparation safety education resulted in the behavioral change (Skinner, 2014).

In our study, 66.7% and 77.8% of vendors had an elementary or junior highschool education level. This fact showed despite a low formal education level, street food vendors could be edu-

cated effectively using our approach to improve food safety. The education levels of our food vendors were lower than other studies from Scotland (Ehiri *et al*, 1997), Turkey (Acikel *et al*, 2008), Portugal (Soares *et al*, 2013), Dubai (Abushelaibi *et al*, 2015), Ghana (Annor and Baiden, 2011), and Brazil (Cunha *et al*, 2014), in which the majority of vendors had a post-secondary education level.

In conclusion, food preparation safety education given to street food vendors for six months improved street food safety (bacteriologically and chemically) around public elementary schools in Cimahi City, West Java Province, Indonesia. The problem of street food safety must be prevented and intensive education regarding food safety of street food vendors must be conducted continuously to improve the behavior of street food vendors.

CONFLICTS OF INTEREST

We declare no conflicts of interest.

ACKNOWLEDGMENTS

We would like to express our gratitude to the head of The Health Department of Cimahi City, elementary school principals, the head of the health centers for Cimahi City, The Community Health Center (Puskesmas) and the street food vendors.

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