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## Article

# Determinants of hepatitis A infection among students: A case study of an outbreak in Jember, Indonesia

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## Abstract

**Background:** Hepatitis A often occurs in school among students in the form of an outbreak. The transmission was through fecal-oral (common source) provided that the epidemic curve is close to propagated. The aim of the current study was to analyze the determinants of Hepatitis A infection among students.

**Design and methods:** This study was a case-control study which was conducted at SMAN Plus with a sample size of 80 students chosen by using simple random sampling. The data obtained were then analyzed using logistic regression with 95% confidence level ( $\alpha = 0.05$ ), while the strength of the relationship between variables was identified using odds ratio (OR).

**Results:** Most of the students were at the age of 17 to 19 years old (65%) and male (57.5%). The average age in the case group was 17.1 years old, while in the control group was 16.75 years old. The habit of consuming raw foods ( $p=0.001$ ) as well as eating and drink at the same time during an activity ( $p=0.000$ ) had a significant influence on the outbreak of Hepatitis A in the curve epidemic of common source.

**Conclusion:** The outbreak is confirmed as a transmission occurs through fecal-oral which the common source epidemic curve. Risk factors that have been proven to be related to hepatitis A include consuming raw food, eating shared meals during an activity, and drinking with shared drinking utensils.

## Introduction

Hepatitis A is generally transmitted through food and drinking contamination and person to person transmission of faecal-oral transmission route. This is significantly related to the behaviour of clean and healthy life.<sup>1</sup> Hepatitis A virus (HAV) is thermostable, acid resistant, and resistant to bile. HAV can survive in room temperature for more than a month.<sup>2,3</sup> Hepatitis A in Indonesia occurs more frequently in rural area than urban area.<sup>4</sup>

Hepatitis A can cause extraordinary event (outbreak). There were 6 outbreaks with 279 sufferers in 2010, 9 outbreaks with 550 sufferers in 2011, 8 outbreaks with 369 sufferers in 2012, and 13 outbreaks with 504 cases in 2013.<sup>3</sup> In terms of the outbreak in

2013, there were 6 districts in East Java in which outbreaks occurred, including Jombang, Lamongan, Pacitan, Sidoarjo, Ponorogo, and Pasuruan with total 462 cases. In 2014, the outbreaks occurred in three districts, including Sidoarjo, Kediri and Surabaya with 59 cases. In 2015, KLB occurred in three districts as well, those are Probolinggo, Lamongan and Jember with 78 cases.<sup>5</sup>

Hepatitis A among school-aged children often occurred in the form of an outbreak. The transmission is faecal oral (common source) with epidemic curve approaches propagated. The transmission of hepatitis A at school often related to drinking water and raw foods contaminated by HAV.<sup>6,7</sup> On school-aged children, hepatitis A can occur asymptotically. The outbreak of hepatitis A on school-aged children in China was asymptomatic by 55.5.<sup>8</sup> This is proven by IgG antibody result which was HAV positive on school-aged children without hepatitis A symptoms during an outbreak of hepatitis A in China.

The outbreak of Hepatitis A in school environment in 2010-2020 in East Java occurred in Probolinggo, Jember, Bondowoso, Lamongan, Pacitan, and Surabaya.<sup>9</sup> The causes of Hepatitis A outbreak in the school environment are due to insufficient hand washing facilities and drinking water sources which are close to septic tank. In addition, it is also significantly related to the hygiene and sanitation of food seller in the school environment.<sup>10</sup>

Jember District is one of the districts which have high prevalence of hepatitis A in 2013, which is almost the same as the prevalence of hepatitis A in East Java of 1%. In 2012, hepatitis A outbreak occurred in Puger with 22 cases. Meanwhile, in 2013, hepatitis A outbreak also occurred in Sumbersari Sub-District (39 cases), Patrang Sub-District (37 cases), and Kaliwates District (19 cases). In 2015, there was another hepatitis A outbreak in Sukowono Sub-District.<sup>11</sup>

Repetitive outbreaks indicates that the primary preventive efforts are implemented poorly. This is caused by the determinants of the outbreak which are not identified yet. Therefore, this research aimed to analyse the risk factor of hepatitis A outbreak on school-aged students in Jember District. Based on the initial assumption obtained from outbreak epidemiology investigation at SMAN Plus Sukowono on 7 October 2015, it was known that most of the students had poor personal hygiene. Most of them did not wash their hand after defecating and often consumed raw food.

## Significance for public health

Hepatitis A still frequently occurs in Indonesia. Several hepatitis A outbreaks have occurred in schools or Islamic boarding schools. The results of this research are expected to be an effort to provide scientific input to the Health and School Offices to prevent an outbreak of hepatitis A in the school environment in the future.

In addition, the hand washing and food utensils facilities at the canteen were also poor because the water is limited and did not use running water.

## Design and methods

This study was an analytic observational study with a case-control design. This research was conducted at SMAN Plus Sukowono. The population in this study consisted of case population of all SMAN Plus Sukowono students who suffered from Hepatitis A after the New Student Orientation and Basic Leadership Training activities in August 2015 and control population of all SMAN Plus Sukowono students who did not suffer from hepatitis A after the New Student Orientation and Basic Leadership Training activities in August 2015. Based on the sample calculation using the *unmatched case-control* by using Epi Info 7, it obtained case samples of at least 40 students, with the comparison between the case and control sample was 1:1. Therefore, the minimum samples needed for the research were 80 students taken using simple random sampling technique. The independent variables in this research were knowledge, defecation behaviour at school and at home, latrine at home, water consumption at school and at home, eating habit at canteen, raw food consumption habit, habit of buying food from mobile vendor, the use of shared of shared cutlery, room density, and shared eating and drinking activities during extracurricular activities. Meanwhile, the dependent variable was the incidence of hepatitis A.

The data collected in this study were primary data in the form of students' knowledge and behaviour. The variables were measured through interviews with students and questionnaires filled by the respondents. Furthermore, the respondent characteristics are then presented in percentage form. Results of the study were analysed using Logistic Regression with a 95% confidence level ( $\alpha=0.05$ ) to analyse the significant relationship between hepatitis A and the independent variables as well as to interpret the relationship strength between the variables using odds ratio (OR).

## Results

The distribution of respondent characteristics in this study is presented in the following Table 1. The respondents in the case group were mostly aged 17 to 19 years old (65%), male (57.5%) and in class XII (42.5%). The average age of the case group was 17.1 years old, while the control group was 16.75 years old.

The epidemic curve (Figure 1) based on case data shows that this outbreak is a common source. The total number of students who suffered from the clinical symptoms of Hepatitis A was 48 students. Reports said that the first time a student experienced symptoms was at 11 September, while on 1 October, there was no report of new cases.

The results of multivariable analysis found two independent variables that had a significant effect on hepatitis A outbreak, they are raw food consumption ( $p=0.001$ ) as well as eating and drinking habits together during extracurricular activities ( $p=0.000$ ). Meanwhile, the independent variables which were not significant are knowledge, defecating behaviour at school, poor category of water drinking at school, often wearing cutlery together, hand-washing after defecation, handwashing before meals, the low-income parent/guardian of the respondents, and the respondents' density room Table 2.

## Discussion

The Ministry of Health of Indonesia stated that Hepatitis A can be spread through contaminated food, food and drinks which were not cooked as well as poor hygiene and sanitation.<sup>12</sup> Risk factors affecting the hepatitis A outbreak in the second High School is the consumption of raw food without being washed and eating together activities which have potential for food exchange. Open defecation behaviour was also frequently done by the students, especially outside school hours. Students generally do not have a latrine at home so they often did it at the river or in the garden. Open defecation is still prevalent in East Java. Open defecation can certainly increase the transmission risk of hepatitis A.<sup>7</sup> Open defecation done by students is in line with their latrine ownership at home. Students who did not have a latrine will tend to do open defecation. Open defecation behaviour will pollute rivers and even have the potential to pollute groundwater sources. This incident will cause hepatitis A transmission if there is HAV in the faeces.<sup>13,14</sup>

Raw food consumption without being washed by using clean water and cooked is one of the factors of hepatitis A.<sup>15</sup> The contamination of water and food, vegetables and fruits that are not ripe, is one of the factors often occurred in Europe ten years ago.<sup>16</sup> At present, they are no longer face this problem. Good sanitation, personal hygiene, and comprehensive HAV vaccination make the country immune to HAV. It is different from particular regions in Indonesia

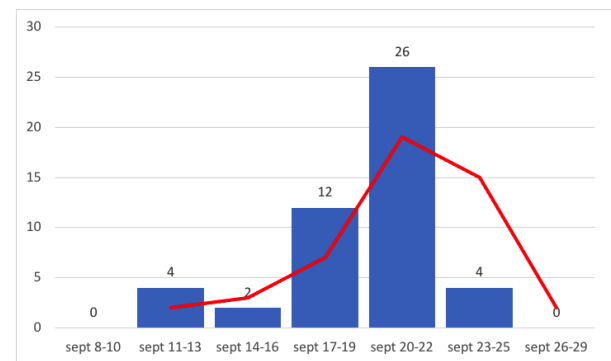


Figure 1. Epidemic curve of hepatitis A outbreak in Jember Senior High School.

Table 1. Characteristics of respondents.

Variable	Status		n (%)
	Case	Control	
Age			
15- <17	14 (35%)	21 (52.5%)	35 (43.7%)
17-19	26 (65%)	19 (37.5%)	45 (52.3%)
Total	40 (100%)	40 (100%)	80 (100%)
Average	17.1 years	16.75 years	
Gender			
Man	23 (57.5%)	18 (45.0%)	41 (51.2%)
Women	17 (42.5%)	22 (55.0%)	19 (44.2%)
Total	40 (100%)	40 (100%)	80 (100%)
Class			
X	13 (32.5%)	16 (40.0%)	29 (36.2%)
XI	10 (25.0%)	15 (37.5%)	25 (31.2%)
XII	17 (42.5%)	9 (22.5%)	26 (32.5%)
Total	40 (100%)	40 (100%)	80 (100%)

which have bad sanitation and even aggravated by poor personal hygiene. One of them happened at the research location. In the case population, the unavailability of family latrine, do not wash hands after defecating, consuming raw food without washing and cooking it first, and consuming raw water are the behaviour they do every day. The consumption of raw food which is the cause of the outbreak also occurred in Hawaii. This study encourages the main allegation of hepatitis A outbreak which is caused by the consumption of raw foods. Studies<sup>17,18</sup> stated that the incidence of Hepatitis A outbreaks occurred after universal vaccination in these states. The main assumptions were derived from scallops, poke, sushi, raw tomatoes, and raw fish. The investigation suggested that the possible contamination originated from scallops imported from the Philippines.<sup>18</sup>

In an outbreak occurred in a high school, hepatitis A only occurred on school-aged children. Meanwhile, the community outside the school did not have any symptoms of hepatitis A. Based on the calculation of common source epidemic curve and the environment conditions, especially school canteens, the causative narrowed to raw food consumption at one school event. The food consumed was *pecel* and *lalapan* which had raw vegetables. *Lalapan* called for raw food in local language which consist of bean, mus-

tard, cabbage, cucumber, eggplant and long beans. Field investigation to catering providers revealed that there were indeed raw vegetables given to participants. ELISA test results showed that among the 10 samples taken, 5 of them had HAV. Food samples cannot be taken for further testing, this is because the events that caused the outbreak had been occurred more than 1 month and the incubation period for hepatitis A is 15-50 days with an average incubation period of 28-30 days.<sup>19</sup>

The FDA states that hepatitis A often causes outbreaks, which are generally caused by HAV contamination in food and beverages, neighbourhoods, and catering.<sup>20</sup> Generally, there was differences between developed countries and developing countries. This is related to sanitation, hygiene, and HAV vaccination. In developed countries, hepatitis A outbreaks generally occur due to imports of raw materials, frozen food, and fruits. The latest research stated that person-to-person transmission was found, especially among homeless people.<sup>21</sup> Meanwhile, in developing countries, this transmission is generally caused by inadequate food processing, hygiene, and sanitation.<sup>22-24</sup> Vaccination of hepatitis A at a particular group still needs to be done to prevent hepatitis A in the future.<sup>21</sup>

**Table 2. Multivariate analysis of the determinants of hepatitis A outbreak in SMA Plus Jember.**

Variable	Status		n	p-value	Significance OR (95% CI)
	Case	Control			
Knowledge				0.823	0.904 (0.375-2.179)
Bad	21 (52.5%)	22 (55%)	43		
Good	19 (47.5%)	18 (45%)	37		
Defecation behaviour at school				0.218	2.250 (0.619-8.184)
Bad	8 (20%)	4 (10%)	12		
Good	32 (80%)	36 (90%)	68		
Water consumption at home				0.999	1
Bad	0 (0%)	2 (5%)	2		
Good	40 (100%)	38 (95%)	78		
Water consumption at schools				0.496	0.733 (0.300-1.791)
Bad	22 (55.0%)	25 (62.5%)	47		
Good	18 (45.0%)	15 (37.5%)	33		
Eating habits in the canteen				1.000	1 (0.293 -3412)
Often	34 (85.0%)	34 (85%)	68		
Rarely	6 (15.0%)	6 (15%)	12		
Eating raw foods ( <i>lalapan</i> )				0.001*	4.846 (1.882-12.482)
Often	27 (67.5%)	12 (30%)	39		
Rarely	13 (32.5%)	28 (70%)	41		
Food buying habits at mobile vendors				1.000	1 (0.414 -2.413)
Often	18 (45%)	18 (45%)	36		
Rarely	22 (55%)	22 (55%)	44		
Use of shared cutlery				0.179	1.842 (0.755- 4.493)
Often	25 (62.5%)	19 (47.5%)	44		
Rarely	15 (37.5%)	21 (52.5%)	36		
Hand washing behaviour after defecating				0.606	1.307 (0.473- 3.609)
Bad	11 (27.5%)	9 (22.5%)	20		
Good	29 (72.5%)	31 (77.5%)	60		
Wash hands before eating				0.629	1.269 (0.487- 3.3311)
Bad	13 (32.5%)	11 (27.5%)	24		
Good	27 (67.5%)	29 (72.5%)	56		
The habit of eating and drinking together during extracurricular activities				0.000*	7.000 (2.615 -18.738)
Not good	30 (75%)	12 (30%)	42		
Good	10 (25%)	28 (70%)	38		

\*p<0.000.



## Conclusions

Hepatitis A outbreak that occurred in Jember only occurred in one high school. The outbreak was confirmed through faecal-oral transmission of a common source epidemic curve. The risk factors proven to be significantly related to hepatitis A are defecation behaviours, latrine ownership, raw food consumption and shared eating and drinking.

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**Key words:** hepatitis A; outbreak; high school; student.

**Contributions:** SA, FSR, research design, questionnaire creation, manuscript drafting; FSR, collected, cleaned and analyzed data. All the authors have read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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