The effects of health education intervention on promoting knowledge, beliefs and preventive behaviors on brucellosis among rural population in Nagpur district of Maharashtra state, India

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ABSTRACT

Introduction: Brucellosis is one of the most common zoonosis diseases in developing and undeveloped countries, with adverse socio-economic status and animal and human health. The essential element for effective prevention and control of brucellosis is to improve the community’s Knowledge, Attitude, and Practice (KAP) through Health Education Intervention (HEI). Aim: To assess health education intervention’s effect on promoting knowledge, beliefs, and preventive behaviors on brucellosis among rural populations in Nagpur district, Maharashtra, India. Methods and Materials: 382 subjects over 18 years with a history of animal contact or consuming animal products were randomly selected. Data were collected through questionnaires and checklists. The pre-test was implemented and followed by HEI. The post-test was conducted after 45 to 60 days. For the attitude five-point Likert scale and knowledge and practice, a two-point assessment scale [yes, no] was applied. SPSS was used to analyze paired t-test, and \( P < 0.05 \) was considered significant. Result: Of 382 subjects, 300 (78.5%) were male, and the mean age of 42.15 ± 13.72. Before HEI, 18 (5%) subjects heard about brucellosis. After HEI, reduction in the risk behaviors practices like raw milk consumption \( (P < 0.0001) \), assisted animal delivery without gown \( (P = 0.002) \), throwing animal birth products in the dustbin \( (P < 0.0001) \) were statistically significant. After implementing HEI, subjects were more aware of animal and human brucellosis signs/symptoms \( (P < 0.0001) \). Awareness of disease transmission route \( (P < 0.0001) \) and up-gradation in knowledge \( (P < 0.0001) \) were statistically significant among subjects after HEI. Conclusions: HEI substantially affects KAP and changes community behaviors to prevent brucellosis transmission. The authors recommend implementing HEI in the community to prevent brucellosis.

Keywords: Occupational disease, one health, public health, zoonosis

Introduction

Brucellosis is a zoonotic disease. It has public health significance and is a neglected animal disease.⁵ Brucellosis has been eliminated in many industrialized nations.⁶ On the other hand, brucellosis has a consequential impact on animal and human health; and tremendous socio-economic influence in developing countries where rural populations rely mainly on livestock breeding and dairy products.⁷

It is an important human disease in the Mediterranean countries of Europe, the Middle East, South, and Central

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Asia, Africa, Central, and South America. Nevertheless, it is often unrecognized and frequently goes unreported. Global incidence of brucellosis varies widely from <0.01 to >200 per 100,000. The prevalence of human brucellosis varies from the lowest 0.8% in Kashmir, 1.83% in Nagpur in Maharashtra, and 26.66% in Ludhiana in India. Brucellosis is endemic in the cattle population with a prevalence of 1.8% in 19 of 23 states in the Indian Subcontinent and 24.3% in India. The disease is more appended among men than women and is most widely spread in rural than urban areas.

One can acquire brucellosis infection through direct contact through blood, placenta, uterine secretions of infected animals, interruptions in the skin, inhalation, or consuming raw milk and other dairy products. Almost 69% of the Indian population lives in rural areas. Most of them have a close interaction with domestic animals due to their occupation, mainly farming. Hence, they have an amplified hazard of contracting several zoonotic illnesses, including brucellosis. The economic and health aspects are significant because brucellosis causes abortion in cattle, reduced milk production, sterility, and loss of economic value of an animal, severe and incurable infectious diseases in humans. Individuals and societies require awareness in terms of behavior to prevent the transmission of this disease. Therefore, the role of health education is of substantial importance. HEI strategy has been used effectively in USA, Africa, Asia, and the Middle East to reduce many zoonoses.

Further, for effective implantation of the National Control Program on Brucellosis (NCPB), it is essential to understand indigenous KAP about brucellosis to advance information distribution through health education implementation and constitute related control methods. It might also improve the output of NCPB, comprising brucellosis infection and education among community members.

Next, brucellosis is not considered a priority infectious disease under Integrated Disease Surveillance Program (IDSP), which acts as public health surveillance and response system in India. However, a lack of knowledge for brucellosis was reported among health care workers (HCW) working in Primary Health Care (PHC). Also, brucellosis was detected infrequently in PHC services due to limited laboratory capacity in rural areas. Hence, the community would not receive knowledge of brucellosis from HCWs.

Therefore, the present study aimed to assess health education intervention’s effect on promoting knowledge, beliefs, and preventive behaviors on brucellosis among rural populations in Nagpur district, Maharashtra, India.

**Materials and Methods**

**Study site and design**

A cross-sectional study was conducted from October 2016 to January 2018 by selecting 15 villages in Umred rural areas of Nagpur district of Maharashtra, India.

**Sampling method and recruitment**

Study subjects were selected by stratified random sampling. As per the population data available from the Taluka office of Umre and Nagpur, six blocks were made with a combination of villages with more and less population. These blocks were labeled from 1 to 6. From these six blocks, three study blocks were selected randomly. From each block, five villages were selected. Thus, a total of fifteen villages were chosen randomly. The unique identification number was given to each screened subject to avoid duplication.

**Inclusion criteria:** 1] Person to be a resident of the selected village for more than six months, 2] to have a history of animal contact or consuming animal products, 3] willing to participate in a research study and sign for written consent, 4] More than 18 years and be present in the village at the time of interview.

**Exclusion criteria:** Pregnant lady, history of antibiotic intake in last two months as calculated from the date of antibiotic intake.

**Sample size estimation**

For the rural population, the sample size was determined by expected 4.5% prevalence in the study population in the study area with alpha =0.0500, power = 0.8000, delta = 0.0400, p0 = 0.0450, pa = 0.0850, with 10% loss to follow up. The final sample size required for the study was 382.

**Institutional and Ethical considerations**

Mahatma Gandhi Mission Institute of Health Science (MGMIHS), Navi Mumbai, approved this study. Further, this study was approved for ethical consideration by the Research Ethics Committee, MGMIHS, Navi Mumbai. (Letter number MGMIHS/RS/2016-17). Before the questionnaire administration interview and sample collection, informed consent was obtained from each eligible subject.

**Questionnaire development and data collection**

The close-ended questionnaire was designed that consisted of two sections for data collection. The first section included sociodemographic questions to collect age, sex, marital status, and education level. The second section was related to risk factors on brucellosis, including questions on the disease transmission mode from animal to human, daily practice for the animal and the handling animal products, and respondents' attitude toward the brucellosis. At first, this questionnaire was developed in English by all authors and later translated into the local language “Marathi” by language specialists.
In the questionnaire, four questions to assess disease prevention knowledge and heard of brucellosis, seven questions to determine knowledge for the disease transmission route, seven questions included on animal brucellosis sign/symptoms, nine questions on human brucellosis sign/symptoms, five questions on risk behaviors practice, and seven questions on attitude. As a reference, all authors reviewed the World Health Organization library catalog on brucellosis 2006\textsuperscript{[27]} and reviewed the questionnaire from the brucellosis KAP survey conducted in rural India.\textsuperscript{[28]}

Two-point assessment for knowledge statement was applied; if the subject responded ‘yes,’ it was scored ‘1’, and ‘no’ response was scored ‘0’. For practice responses, each question was scored ‘1’ for ‘practiced’ or ‘0’ for ‘not practiced.’ A five-point Likert scale [strongly disagree, disagree, neither agree nor disagree, agree, strongly agree] was applied for attitude. Likert scale score was graded as mentioned in Table 1.

The questionnaire was pre-tested on forty subjects and modified according to feedback received from the pre-test. Moreover, the questionnaire was tested for validity among the small subjects (n = 40) who were not interviewed before. Cronbach’s alpha coefficient for internal reliability was 0.78. Cronbach alpha coefficient was reported 0.82 for knowledge, 0.79 for attitude, and 0.74 for practice.

The data were gathered through self-reporting and interviewing. After the initial interview, the HEI program was implemented. The educational program was in the local language “Marathi” and consisted of 150 to 180 minutes of sessions presented through lectures, question and answer method, group discussion, and brainstorming. The content included concepts related to brucellosis in the first session, the causing factors of the disease, and the symptoms presented in the second session. The disease’s prevention and reduction strategies presented in the third session, behavioral obstacles, and the benefits of preventing this disease were explained in the fourth session. Furthermore, correct practical behaviors such as boiling the milk, handling animal birth products, and a wrap-up of all sessions were presented in the final session.

One or two workshops were conducted for each study village as per the subjects who participated from the concerned village. The maximum number of participants was 35 in each workshop. If any subjects still missed the HEI program, they attended the next scheduled workshop in nearby villages. After forty-five to sixty days interval, the post-test was conducted.

All subjects have explained the purpose and method of study. Before data collection, it was assured that all subjects met the eligibility criteria. All interviews were executed verbally during data collection from the subjects.

**Statistical analyses**

Data recorded in questionnaires were entered in Microsoft Excel sheet [Version 2013] and analyzed by Statistical Package for Social Science Version 16.0 English software. The demographic variable and categorical variable were presented in the frequency table. Paired t-test was implemented to know the health education intervention with statistical significance set at $P < 0.05$.

**Result**

There were 300 (78.5\%) males and 82 (21.5\%) females. The ages ranged from 18 to 90 years. The majority of the subjects were between 25-55 years and had primary education (40.6\%) [Table 2].

**Knowledge for brucellosis**

**Table 3: Knowledge for brucellosis among rural population in Nagpur district of Maharashtra, India (Health education intervention)**

**Heard about brucellosis**

The knowledge like heard brucellosis increased from 18 [4.7\%] before HEI to 382 [100\%] after HEI. The mean score increased from 0.05 ± 0.21 before the HEI to 1.00 ± 0.00 after the HEI ($P < 0.0001$), indicating that HEI was statistically significant [Table 3].

**Knowledge for brucellosis kind of disease and prevention by vaccination**

**Table 1: Liker scale to calculate level by distinguishing mean interval**

| Level                  | Scale | Interval length | Lower limit | Upper limit | Mean interval |
|------------------------|-------|-----------------|-------------|-------------|---------------|
| Strongly disagree      | 1     | 0.80            | 1           | 1.80        | 1.18          |
| Disagree               | 2     | 0.80            | 1.61        | 2.60        | 1.61-2.60     |
| Neither agree nor disagree | 3   | 0.80            | 2.61        | 3.40        | 2.61-3.40     |
| Agree                  | 4     | 0.80            | 3.41        | 4.20        | 3.41-4.20     |
| Strongly agree         | 5     | 0.80            | 4.21        | 5.00        | 4.21-5.00     |

**Table 2: Demographic characters of subjects in the rural population in Nagpur district of Maharashtra, India (n=382)**

| Characteristics | n=382 | %   |
|-----------------|-------|-----|
| Sex             |       |     |
| Male            | 300   | 78.5|
| Female          | 82    | 21.5|
| Marital status  |       |     |
| Married         | 352   | 92.1|
| Unmarried       | 30    | 7.9 |
| Education level |       |     |
| None            | 62    | 16.2|
| Primary         | 155   | 40.6|
| Secondary       | 142   | 37.2|
| Tertiary        | 23    | 6   |
Knowledge like brucellosis transmits from animal to human increased from 19 [5%] before HEI to 256 [67%] after HEI. The mean score increased from 0.05 ± 0.22 before the HEI to 0.67 ± 0.47 after the HEI ($P < 0.0001$), indicating that HEI was statistically significant [Table 3].

The knowledge like brucellosis is not vaccine preventive in humans increased from 7 [1.8%] before HEI to 301 [78.8%] after HEI. The mean score increased from 0.02 ± 0.13 before the HEI to 0.79 ± 0.40 after the HEI ($P < 0.0001$), indicating that HEI was statistically significant [Table 3].

The knowledge like brucellosis is vaccine preventive in animals increased from 10 [2.6%] before HEI to 344 [90.1%] after HEI. The mean score increased from 0.03 ± 0.16 before the HEI to 0.90 ± 0.29 after the HEI ($P < 0.0001$), indicating that HEI was statistically significant [Table 3].

### Knowledge of the disease transmission route

| Table 3: Knowledge for brucellosis among the rural population in Nagpur District in Maharashtra state (n=382) |
|---------------------------------------------------------------|-----------------------------|-------------|-------------|
| **Indicators**                                               | **Before n (%)** | **After n (%)** | **Mean and SD** | **Paired t-test** |
| Heard brucellosis                                            |                      |                |                  |                |
| Yes                                                          | 18 (4.7)             | 382 (100)      | 0.05±0.22        | <0.0001        |
| No                                                           | 364 (95.3)           | 0 (0)          | 1.00±0.00        |                |
| Transmit from animal to human                                |                      |                |                  |                |
| Yes                                                          | 19 (5)               | 256 (67)       | 0.05±0.22        | <0.0001        |
| No                                                           | 363 (95)             | 126 (33)       | 0.67±0.47        |                |
| Vaccine preventive disease in human                          |                      |                |                  |                |
| Yes                                                          | 7 (1.8)              | 301 (78.8)     | 0.02±0.13        | <0.0001        |
| No                                                           | 375 (98.2)           | 81 (21.2)      | 0.79±0.40        |                |
| Vaccine preventive disease in animal                         |                      |                |                  |                |
| Yes                                                          | 10 (2.6)             | 344 (90.1)     | 0.03±0.16        | <0.0001        |
| No                                                           | 372 (97.4)           | 38 (9.9)       | 0.90±0.29        |                |

| Table 4: Knowledge for the disease transmission route for brucellosis among the rural population in Nagpur District in Maharashtra state in India (n=382) (Health education intervention) |
|---------------------------------------------------------------|-----------------------------|-------------|-------------|
| **Indicators**                                               | **Before n (%)** | **After n (%)** | **Mean and SD** | **Paired t-test** |
| Drinking raw milk                                            |                      |                |                  |                |
| Yes                                                          | 7 (1.8)              | 343 (89.8)     | 0.01±0.13        | <0.0001        |
| No                                                           | 375 (98.2)           | 39 (10.02)     | 0.9±0.30         |                |
| Consuming product made from raw                             |                      |                |                  |                |
| Yes                                                          | 1 (0.3)              | 65 (17)        | 0.00±0.05        | <0.0001        |
| No                                                           | 381 (99.7)           | 317 (83)       | 0.17±0.37        |                |
| Milking animal                                               |                      |                |                  |                |
| Yes                                                          | 6 (1.6)              | 314 (82.2)     | 0.01±0.12        | <0.0001        |
| No                                                           | 376 (98.4)           | 68 (17.8)      | 0.82±0.38        |                |
| Eating raw meat ($n=382$)                                    |                      |                |                  |                |
| Yes                                                          | 7 (1.8)              | 255 (66.8)     | 0.02±0.13        | <0.0001        |
| No                                                           | 375 (98.4)           | 127 (33.2)     | 0.67±0.47        |                |
| Handling birth product without gear                          |                      |                |                  |                |
| Yes                                                          | 8 (2.1)              | 296 (77.5)     | 0.02±0.14        | <0.0001        |
| No                                                           | 374 (97.9)           | 86 (22.5)      | 0.77±0.41        |                |
| Assisted in animal delivery without gear                     |                      |                |                  |                |
| Yes                                                          | 7 (1.8)              | 299 (78.3)     | 0.02±0.13        | <0.0001        |
| No                                                           | 375 (98.2)           | 83 (21.7)      | 0.78±0.41        |                |
| Slaughtering animal without gear                             |                      |                |                  |                |
| Yes                                                          | 95 (24.9)            | 262 (68.6)     | 0.25±0.43        | <0.0001        |
| No                                                           | 287 (75.1)           | 120 (31.4)     | 0.69±0.46        |                |
After HEI; the knowledge for disease transmission routes like consuming the products made from raw milk ($P < 0.0001$), milking animals ($P < 0.0001$), eating the raw meat ($P < 0.0001$), handling birth products without gear ($P < 0.0001$), assisted in animal delivery without protective gear ($P < 0.0001$), slaughtering animal without equipment ($P < 0.0001$), indicating that HEI was statistically significant [Table 4].

**Knowledge about the animal brucellosis sign/symptoms**

Table 5: Knowledge about the *animal brucellosis* sign/symptoms among rural population in Nagpur district of Maharashtra state of India (Health education intervention)

After HEI, awareness among the subjects for animal brucellosis sign/symptoms were increased. After HEI, understanding of the subject for animal sign/symptoms like animal abortion ($P < 0.0001$), stillbirth ($P < 0.0001$), joint pain ($P < 0.0001$), udder swelling ($P < 0.0001$), unable to stand ($P < 0.0001$), serotum swelling ($P < 0.0001$), and unable to walk ($P < 0.0001$), indicating that HEI was statistically significant [Table 5].

**Knowledge about the human brucellosis sign/symptoms**

Table 6: Knowledge about the *human brucellosis* sign/symptoms among rural population in Nagpur district of Maharashtra state of India (Health education intervention)

After HEI, awareness among the subjects for human brucellosis signs/symptoms were increased. After HEI, understanding of the subject for human brucellosis sign/symptoms like fever ($P < 0.0001$), night sweating ($P < 0.0001$), joint pain ($P < 0.0001$), anorexia ($P < 0.0001$), chilling ($P < 0.0001$), headache ($P < 0.0001$), weakness ($P < 0.0001$), red spot on the skin ($P < 0.0001$), elbow itching ($P < 0.0001$), indicating that HEI was statistically significant [Table 6].

**Risk behaviors practice for brucellosis**

Table 7: Risk behaviors practice for brucellosis among rural population in Nagpur district of Maharashtra state [N = 382] (Health education intervention)

Risk behaviors practice as raw milk consumptions decreased from 82 [12.5%] before HEI to 41 [10.7%] after the HEI ($P < 0.0001$). Product consumption made from raw milk decreased from 21 [5.5%] before HEI to 11 [2.9%] after the HEI ($P < 0.0001$). Subjects were milking the animal a little reduced from 59 [15.4%] before HEI to 56 [14.7%] after the HEI ($P = 0.08$). Raw meat handling decreased from 137 [35.9%] before HEI to 93 [24.3%] after the HEI ($P < 0.0001$). Raw meat consumption decreased from 6 [1.6%] before HEI to 1 [0.3%] after the HEI ($P < 0.0001$) [Table 7].

**Change in the attitude after HEI**

Table 8: Change in the attitude among rural population in Nagpur, Maharashtra state of India toward the brucellosis after HEI (N = 382)

| Indicators                  | Before n (%) | After n (%) | Mean and SD Before | Mean and SD After | Paired t‑test |
|-----------------------------|--------------|-------------|--------------------|-------------------|--------------|
| Animal abortion             |              |             |                    |                   |              |
| Yes                         | 24 (6.3)     | 347 (90.8)  | 0.06±0.24          | 0.90±0.29         | <0.0001      |
| No                          | 355 (93.7)   | 35 (9.2)    |                    |                   |              |
| Still birth                 |              |             |                    |                   |              |
| Yes                         | 14 (3.7)     | 219 (57.3)  | 0.04±0.19          | 0.57±0.49         | <0.0001      |
| No                          | 368 (96.3)   | 163 (42.7)  |                    |                   |              |
| Joint pain                  |              |             |                    |                   |              |
| Yes                         | 15 (3.9)     | 269 (70.4)  | 0.04±0.19          | 0.70±0.45         | <0.0001      |
| No                          | 337 (96.1)   | 113 (29.6)  |                    |                   |              |
| Udder swelling              |              |             |                    |                   |              |
| Yes                         | 13 (3.4)     | 216 (56.6)  | 0.04±0.18          | 0.57±0.49         | <0.0001      |
| No                          | 369 (96.6)   | 166 (43.5)  |                    |                   |              |
| Unable to stand             |              |             |                    |                   |              |
| Yes                         | 7 (1.8)      | 234 (61.3)  | 0.02±0.13          | 0.61±0.48         | <0.0001      |
| No                          | 375 (98.2)   | 148 (38.7)  |                    |                   |              |
| Serotum swelling            |              |             |                    |                   |              |
| Yes                         | 8 (2.1)      | 294 (77)    | 0.02±0.14          | 0.76±0.42         | <0.0001      |
| No                          | 374 (97.9)   | 88 (23)     |                    |                   |              |
| Unable to walk              |              |             |                    |                   |              |
| Yes                         | 213 (55.8)   | 322 (84.3)  | 0.55±0.49          | 0.83±0.36         | <0.0001      |
| No                          | 169 (44.2)   | 60 (15.7)   |                    |                   |              |
After HEI, the current study reported the changes in the attitude for animal brucellosis could prevent by vaccination ($P < 0.0001$), animal brucellosis can prevent by vaccinating and isolating animals until it gets cured improved ($P < 0.0001$), animal brucellosis can prevent by isolating aborted animals ($P < 0.0001$), human brucellosis treatable ($P < 0.0001$), the homemade remedy can not treat animal brucellosis ($P < 0.0001$) were statistically significant [Table 8].

**Table 6: Knowledge about the human brucellosis sign/symptoms among rural population in Nagpur district of Maharashtra state of India (Health education intervention)**

| Indicators                        | Before n (%) | After n (%) | Mean and SD | Paired t-test |
|-----------------------------------|--------------|-------------|-------------|---------------|
| Fever                             |              |             |             |               |
| Yes                               | 72 (18.8)    | 319 (83.5)  | 0.19±0.39   | 0.83±0.37     | <0.0001       |
| No                                | 310 (81.2)   | 63 (16.5)   |             |               |
| Night sweating                    |              |             |             |               |
| Yes                               | 60 (15.7)    | 311 (81.4)  | 0.16±0.36   | 0.81±0.39     | <0.0001       |
| No                                | 322 (84.3)   | 71 (18.6)   |             |               |
| Joint pain                        |              |             |             |               |
| Yes                               | 63 (16.5)    | 269 (70.4)  | 0.37±0.02   | 0.70±0.45     | <0.0001       |
| No                                | 319 (83.5)   | 113 (29.6)  |             |               |
| Anorexia (loss of appetite)       |              |             |             |               |
| Yes                               | 94 (24.6)    | 254 (66.5)  | 0.25±0.43   | 0.66±0.47     | <0.0001       |
| No                                | 288 (75.4)   | 128 (33.5)  |             |               |
| Chilling                          |              |             |             |               |
| Yes                               | 28 (7.3)     | 228 (59.7)  | 0.07±0.26   | 0.5±0.49      | <0.0001       |
| No                                | 354 (92.7)   | 154 (40.3)  |             |               |
| Headache                          |              |             |             |               |
| Yes                               | 54 (14.1)    | 184 (48.2)  | 0.14±0.35   | 0.48±0.50     | <0.0001       |
| No                                | 328 (85.9)   | 198 (51.8)  |             |               |
| Weakness                          |              |             |             |               |
| Yes                               | 61 (16)      | 234 (61.3)  | 0.16±0.37   | 0.61±0.48     | <0.0001       |
| No                                | 321 (84)     | 18 (48.7)   |             |               |
| Red spot on skin                  |              |             |             |               |
| Yes                               | 59 (15.4)    | 229 (59.9)  | 0.16±0.36   | 0.6±0.49      | <0.0001       |
| No                                | 323 (84.6)   | 153 (40.1)  |             |               |
| Elbow itching                     |              |             |             |               |
| Yes                               | 40 (10.5)    | 314 (81.7)  | 0.10±0.31   | 0.82±0.38     | <0.0001       |
| No                                | 342 (89.5)   | 68 (18.3)   |             |               |

This study showed that HEI could promote preventive behaviors against brucellosis and improve people’s knowledge, beliefs, and performance. Other studies also revealed that HEI could upgrade health by providing health education. The results mentioned in this study indicated that few participants heard about brucellosis. The underlying reasons can be the inadequate understanding and lack of awareness about the disease. Further, the results also highlighted the need for continuous health education interventions to promote preventive behaviors against brucellosis, improve people’s knowledge, beliefs, and performance.
dissemination of information by health authorities or the public’s unwillingness to learn about health issues. In the current study, after the HEI, the subject’s knowledge and awareness enhanced significantly compared to before HEI.

The current study showed that despite the importance of knowledge in brucellosis prevention, the participants were almost unaware of the disease transmission routes, symptoms, and signs. However, this current study showed a significant increase in awareness for brucellosis prevention methods ($P < 0.0001$) after the HEI implementation. The studies conducted in the few states of India like New Delhi, Uttar Pradesh, and Kolkata city in West Bengal reported increased awareness and sensitivity ultimately lead.

Although the death rate related to brucellosis is relatively low, it must be noted that the disease can be costly, considering the period the patient has to stay in bed. Therefore, knowledge and awareness of disease prevention practices are essential. The mean scores knowledge, disease transmission route, and signs and symptoms after HEI on the benefits of learning and steps to prevent disease transmission increased after HEI ($P < 0.0001$). Identifying disease prevention benefits can prepare the ground for further steps toward disease prevention. After the HEI implementation, the score was improved among the subjects in the present study.

Center for Disease Control USA reported that communicating the threat of infectious disease to the public reduced the risk behaviors. The current study used the same strategy during the HEI campaigning. As a result, this research showed that risky behaviors like assisted animal delivery without gown were reduced among the subjects. One study conducted in the Middle East reported that 66% of subjects were not used gloves while dealing with animal slaughtering and assisting animal delivery. In the current study after HEI, there was increased use of gown, mask, and gloves while assisting animal delivery ($P = 0.002$), the decline in the animal birth products thrown into the dustbean ($P < 0.0001$), and increased in the good practiced like buried the animal birth products ($P < 0.0001$).

The studies conducted in Kolkata in India, Tanzania, Iran, and China reported that increased awareness and sensitivity ultimately lead to self-care to prevent any disease. Finally, preventive behaviors against brucellosis can be encouraged by using the HEI paradigms. Sustainable long-term planning is needed for comprehensive brucellosis awareness and educational campaigning to modify community behaviors and practices. HCW who were working in the PHC reported a lack of knowledge of brucellosis. Therefore, HCW in PHC required the training to provide health education to the communities residing in rural areas.

Though considerable gain in knowledge and health education practice has been achieved in combating the disease, it is well known that indeed the One Health approach is required to control the program to be effective and successful.

**Limitation**

At the time of the subjects’ interview, it was reassured that subject was not from the previous interviewed group, and maximum subjects were selected at each site to avoid selection bias. However, subjects less than 18 years, a portion of the study population, were omitted because they were not qualified to give informed consent. Therefore, our results cannot be generalized to the whole population of subjects in the Nagpur district of Maharashtra and India. However, subjects under 18 years may not be a significant portion of the study population.

**Conclusion**

This study showed that HEI significantly affects knowledge, attitude, and altered community behaviors to prevent brucellosis transmission. Therefore, we recommend implementing HEI regarding the above-reported results, the cost-efficiency of HEI programs, and people empowerment in disease prevention.

IDSP, a public health surveillance system in India required to train the HCW, works in PHCs for the brucellosis health education intervention program. Therefore, the PHC can be considered
the health education unit to provide training to the communities residing in the rural area. Further, social media, local radio, and posters with the mentioned warning and benefit can be used for this health education program for brucellosis. Health education components should include: 1] mode of disease transmission, 2] consumed pasteurized dairy products cooked meat, 3] used the personal protective equipment while assisting the animal delivery, and 4] vaccination for animals.

Educational material teaching should entirely bring out the economic benefit expected from the control of brucellosis, which was an integrated part of the HEI campaigning of this study. In addition, long-term health education intervention should be planned to achieve a sustainable and successful outcome.

What is known about this topic?
• HEI program is helpful to increase awareness and reduce the harmful practice to prevent the disease transmission for brucellosis.

What does this study add?
• After HEI, there is a significant reduction in the practice of the risky behaviors, increased substantial awareness about the disease transmission route, all subjects heard the brucellosis, and increased awareness for signs/symptoms in human and animal for brucellosis among the subjects in the rural area of Nagpur district in the Maharashtra state of India.

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Conflicts of interest
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