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The Implementation of Comprehensive Health Education to Improve Household Contacts' Participation in Early Detection of Tuberculosis

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Abstract

Lack of participation of household contacts is the main problem of early detection of tuberculosis (TB) in Indonesia. A comprehensive health education (CHE) program has been developed to encourage the participation of household contacts. This study aimed to assess the implementation of the CHE to improve participation of household contacts in early detection of TB. This was a quasi-experimental study conducted between November 2018 and June 2019 in Badung District, Bali, Indonesia. Twelve public health centers (PHCs) were randomly allocated to six PHCs implementing the CHE and six PHCs implementing standard health education (SHE). The CHE was developed through a pilot study using the health belief model supplemented with perceived stigma and social support to identify the factors that influence participation. The participation was measured using a TB register with a cross-check to the health care officer until 2 months after health education was provided. Four hundred and twenty-eight household contacts enrolled in this study—216 in the CHE group and 212 in the SHE group. The CHE group's participation was 28.2%, with 10 new TB cases found; in the SHE group, the participation was 15.6%, with 3 new TB cases found. The CHE increased the household contact participation by 1.83-fold (95% confidence interval [1.19, 2.81]) and case findings by 3.13-fold (95% confidence interval [0.85, 11.56]). The CHE implementation should be scaled up to other areas with a high level of TB transmission. The content and technique of the CHE could also be incorporated in contact investigation guidelines and materials for the TB campaign.

Keywords

case finding, comprehensive health education, early detection, Indonesia, participation, tuberculosis

Suboptimal case finding is the main problem of the tuberculosis (TB) control program in Indonesia. To improve case finding, the national TB control program initiated active case finding among the exposed population (Ministry of Health Republic of Indonesia, 2014; National Institute of Health Research and Development, 2015). Household contact is one of the key populations that should be prioritized for TB health services, such as health education, early detection, and prompt treatment (Raviglione, 2010). One of the health services for people with TB and their families is contact investigation. In contact investigation, all index cases are home visited for treatment adherence support, household contact identification, and suggested contacts for TB early detection. Previous studies found that the proportion of positive cases among household contacts was 20% to 40% (Putra et al., 2019). Contact investigation also potentially contributes to finding of TB cases among children (Htet et al., 2018).

The problem during the implementation of contact investigation is the lack of household contacts' participation in

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TB screening and evaluation. A previous study in Indonesia revealed that only 20% of household contacts followed screening. Furthermore, less than 10% followed evaluation for TB completely. The low participation of household contacts following TB screening and evaluation can lead to loss of opportunity of case findings (Putra et al., 2019). Meanwhile, good health education to improve knowledge, awareness, and belief and minimize barriers to health-seeking behavior is essential to optimize early detection of TB (Lönnroth et al., 2014; World Health Organization, 2012).

To improve the household contact participation in early detection of TB, a change in health-seeking care behavior is required. Therefore, health education intervention should be developed using relevant health behavior theories and evidence-based planning (Kok, 2015). A comprehensive health education (CHE) program has been developed based on a pilot study using a multitheoretical model to identify the factors that influence household contact participation in TB early detection. The CHE is a set of contents and techniques used to deliver health information to modify household contact participation factors. This study aimed to assess the implementation of the CHE to improve household contact participation in early detection of TB.

Methods

Study Settings

Badung is one of eight districts in Bali province, Indonesia. The estimated population in 2018 was 656,900 persons, with a density of 1563.7 population per km^2 (BPS-Statistics of Badung Regency, 2019). Most of the revenue come from the tourism sector, particularly from the Southern Badung district (urban area). Meanwhile, the people in the Northern Badung district work primarily in the agriculture sector (rural area). The health facilities in Badung district are well distributed with an established quality assurance system. There are 13 public health centers (PHCs), 54 satellite PHCs, one public hospital, and six private hospitals in Badung district (Health Office of Badung District, 2018). TB control program in Badung district follows the national guidelines, including contact investigation of index cases diagnosed as pulmonary and childhood TB. All index cases were home visited for treatment adherence support, contact identification, and suggested contacts for early detection of TB. Early detection means a systematic screening and examination to diagnose TB at an earlier stage. Screening using chest X-ray was done for adult contacts without cough to find out if there were any abnormalities in the lung parenchymal that is suggestive of TB, and tuberculin skin test was conducted on all children contacts (Putra et al., 2019).

Study Design and Participants

The research design was a quasi-experimental study conducted between November 2018 and July 2019 in Badung District, Bali, Indonesia. Twelve of the 13 PHCs were selected, and one was excluded because it very rarely notified any pulmonary and childhood TB cases. Selected PHCs were randomly allocated into two groups using the block randomization method, and two block sizes were used. The intervention groups were CHE and standard health education (SHE). CHE included education content and techniques that were developed based on a pilot study regarding the factors that influence contact participation for early detection of TB. The conceptual framework of the participation factors was based on the health belief model supplemented with perceived stigma and social support. The development of the CHE involved involving stakeholders in a workshop to know more about their experience in the TB program. SHE was a routine health education imparted during contact investigation.

The health education in each group was delivered by health officers who were trained previously. In the CHE group, a total of 12 officers (six TB officers and six field officers) were trained regarding the procedure of contact investigation, contents, and techniques of CHE. They practiced in a role-play on how to deliver the main messages and use the media for the education (flip chart and booklet). The CHE aimed to increase knowledge about TB, perceived susceptibility, severity regarding TB, perceived benefits, and self-efficacy and to reduce perceived barriers to follow early detection of TB. The education also provided content and techniques on how to increase social support, motivate, and reduce perceived stigma toward TB through testimonials and sharing TB experiences of popular people in Indonesia. All contents and techniques were written in a guide provided to the officers. In the SHE group, a total of 12 officers (six TB officers and six field officers) were trained in the procedure of contact investigation and routine health education. The routine health education was aimed at increasing knowledge and awareness regarding TB. Both health education programs were implemented during home visits for contact investigation.

The sample size was determined to test the difference of a two-population proportion (one-sided test). The complete participation proportion reported from the pilot study (8.2%) was used as a baseline proportion (Putra et al., 2019). Estimated precision of 5%, 2.5 design effect, 0.03 interclass correlation coefficient, 12 cluster size, and 80% power were considered for total sample size estimation. Consequently, a minimum of 392 (196 for each group) contacts were included in this study. All household contacts of index cases diagnosed between November 2018 and February 2019 in the 12 PHCs were selected. The household contact was defined as a person who lived in the same house, shared enclosed space, and frequently interacted with the index case for 3 months. The household contact had to have no history of TB. The index case was the initial pulmonary and childhood TB identified in a particular household who others may have been exposed to (Fair et al., 2015).

Variables, Definition, and Data Collection

The dependent variable was participation in early detection of TB, which was defined as the participation of the household

contact visiting a PHC or other health facility for screening and evaluation until TB diagnosis confirmation. The participation was measured until 2 months after health education was provided using a TB register with a cross-check to a health care officer and an interview with the representatives of a household contact. The criteria for household contact representatives was that the person should be 18 years or older and belonged to the nuclear family of the index case. The interviewer also assessed the factors that influence participation using a structured questionnaire. Informed consent for health education and the interview were taken from the household contact representative after explaining to them the study objectives, benefits, time loss during participation, and the confidentiality of their information. The interviewers emphasized that participants had the right not to participate in the study if they did not want to. Eight public health students were trained to conduct interviews, collect data from the registry, and data entry.

The factors that influenced participation were knowledge, perceived susceptibility, severity regarding TB, perceived benefits, barriers, self-efficacy, and perceived stigma toward TB and social support. Knowledge regarding TB included cause, mode of transmission, prevention, TB symptoms, and the importance of TB examination. Perceived susceptibility is the belief that it is more natural to be infected if one has a decreased immune status or is living with family members or workmates with TB. Perceived severity is thinking about the fact that TB causes serious health problems such as chest pain, chronic and bloody cough, decreased productivity, and death. The perceived barrier is the belief that TB examination is a waste of time, painful, uncomfortable, and leads to an unexpected side effect. Perceived benefits highlight the fact that early detection of TB reduces the negative impact of the disease, increases productivity, saves health spending, and gives a sense of security from disease threats. Self-efficacy is having the time, money, transportation facility for TB examination, capable of producing sputum for examination, and confidence to accept any result of the examination (Champion & Skinner, 2008; Hayden, 2014).

Perceived stigma consists of internalized and anticipated stigma. Internalized stigma includes the belief of lost dignity, or inferiority, if diagnosed as having TB; that TB is a disease for low-income people; that one gets TB due to past sins or mistakes; and that it is a disease caused due to hereditary factors. Anticipated stigma is fear of TB examination results, social exclusion, discrimination, lost dignity, and being ridiculed by people around if diagnosed as having TB (Courtwright & Turner, 2010; Craig et al., 2017; Macintyre et al., 2017). Social support consists of emotional, informational, instrumental, and appraisal support received from their family and TB officer. Emotional support is motivation to follow TB examination, and informational support is information regarding TB provided by their family and TB officers. Instrumental support is a willingness to accompany, cover costs, facilitate, and provide transportation support for TB examination. Appraisal support is considerations and suggestions following TB examination (Lakey & Cohen, 2000).

Data Analysis

Descriptive analysis was performed to describe the characteristics and variables base of intervention groups. Descriptive analysis included the presentation of mean, standard deviation, median, and interquartile range for numerical data and frequency relative to categorical data. Multiple Poisson regression was performed to analyze the implementation of CHE to improve the participation of household contacts in early detection of TB and case finding. Independent *t* test and Mann-Whitney test were performed to compare the score of variables knowledge, perceived susceptibility, severity regarding TB, perceived benefits, perceived barriers, self-efficacy, perceived stigma toward TB, and social support by intervention groups.

Results

This study allocated six PHCs into the CHE group (46 index cases notified) and six PHCs into the SHE group (43 index cases notified). In the CHE group, two index cases were excluded, because they refused a home visit and transferred. A total of 216 household contacts identified 44 index cases. In SHE group, one index case was excluded because of a refused home visit. A total of 212 household contacts identified 42 index cases. The intervention succeeded in delivering health education during a home visit in each household for both groups. We evaluated the participation of household contact for early detection of TB until 2 months after health education was provided. In the CHE and SHE groups, we succeeded in interviewing 42 and 39 individuals, respectively.

The participant characteristics, particularly age, sex, and TB classification of index cases by intervention groups, were comparable, while the type of residential area was different. The mean age was 32.9 and 33.9 in the CHE and the SHE groups, respectively. Sex distribution in both groups was relatively equal. In the CHE group, more household contacts lived in urban areas (56.5%) while more individuals in the SHE group lived in rural areas (52.4%). TB classification of index cases in both groups was mostly bacteriologically confirmed (94.0% vs. 86.8%). Contact to index case ratio in both groups was 5:1 (Table 1).

The household contacts participation in early detection of TB and case finding in the CHE group was higher (28.2% and 4.6%, respectively) compared with the SHE group (15.6% and 1.4%, respectively). The participation by age-group was no different; the case finding among those who were below 15 years old (8.9%) was higher compared with those who were 15 to 39 years old (1.2%) and ≥40 years old (1.8%). The participation and case finding were higher among household contact who were living in rural areas compared with those living in urban areas (27.8% and 5.4%, respectively),

Table 1. Participant Characteristics and Contact to Index Case Ratio by Intervention Groups.

Variables	Intervention groups, *n* (%)	
	CHE (*n* = 216)	SHE (*n* = 212)
Age (years), *M* ± SD	32.9 ± 20.2	33.9 ± 19.8
<15 years old	48 (22.2)	42 (19.8)
15–39 years old	85 (39.4)	87 (41.0)
≥40 years old	83 (38.4)	83 (39.2)
Sex		
Female	112 (51.8)	115 (54.2)
Male	104 (48.2)	97 (45.8)
Type of residence area		
Rural	94 (43.5)	111 (52.4)
Urban	122 (56.5)	101 (47.6)
TB classification of index case		
Clinically confirmed	5 (2.3)	22 (10.4)
Bacteriologically confirmed	203 (94.0)	184 (86.8)
Childhood TB	8 (3.7)	6 (2.8)
Contact to index case ratio	5:1	5:1

Note. TB = tuberculosis; CHE = comprehensive health education; SHE = standard health education.

compared with the SHE group (16.6% and 0.9%, respectively). The participation and case findings were higher among households who were contacted with bacteriologically confirmed index cases. However, statistically, information could not be inferred due to sampling distribution by its classification (Table 2).

The implementation of CHE improved participation by 1.8 times (95% CI [1.185, 2.802) compared with SHE after it was adjusted by type of residence area, age-group, and TB classification of the index case. TB case finding in the CHE group improved by 3.1 times compared with the SHE group. However, the 95% confidence interval (95% CI [0.845, 11.557]) shows that this result needs further confirmation in a more substantial area or in a more extended time intervention (Table 3).

The interview with household contact representatives found that the score of knowledge regarding TB did not differ by groups. At the same time, perceived susceptibility, severity regarding TB, perceived benefits, and social support from TB officers for early detection was significantly higher in the CHE group. The median score of self-efficacy and social support from family was equally high for both groups, but the interquartile range was more precise or better in the CHE group. Perceived stigma (internalized and anticipated) and perceived barriers were lower in the CHE group compared with the SHE group (Table 4).

Discussion

The CHE that was developed based on a multitheoretical model using the health belief model supplemented with perceived stigma and social support showed improved household contacts participation in early detection of TB. The implementation of CHE succeeded in modifying the factors that influence participation. Most of the scores for participation factors were better in the CHE group compared with the SHE

Table 2. The Household Contact Participation on Tuberculosis Early Detection and Case Finding by Intervention Groups and Participant Characteristics.

Variables	*n*	Contact participation, *n* (%)	RR	95% CI	Case finding, *n* (%)	RR	95% CI
Intervention groups							
CHE	216	61 (28.2)	1.814*	1.242, 2.650	10 (4.6)	3.272	0.913, 11.722
SHE	212	33 (15.6)		Reference	3 (1.4)		Reference
Age groups							
<15 years old	90	21 (23.3)	1.019	0.598, 1.737	8 (8.9)	4.919	0.305, 18.540
15–39 years old	172	35 (20.3)	0.889	0.562, 1.407	2 (1.2)	0.643	0.108, 3.851
≥40 years old	166	38 (22.9)		Reference	3 (1.8)		Reference
Sex							
Male	227	45 (22.4)	1.037	0.725, 1.483	5 (2.5)	0.706	0.235, 2.123
Female	201	49 (21.6)		Reference	8 (3.5)		Reference
Type of residence area							
Rural	205	57 (27.8)	1.676*	1.160, 2.421	11 (5.4)	5.983*	1.342, 26.671
Urban	223	37 (16.6)		Reference	2 (0.9)		Reference
TB classification of index case							
Clinically confirmed	27	3 (11.1)		Reference	0 (0.0)		Reference
Bacteriologically confirmed	387	85 (22.0)	1.977	0.625, 6.252	12 (3.1)		
Childhood TB	14	6 (42.9)	3.857	0.965, 15.423	1 (7.1)	2.464	0.320, 18.952

Note. CHE = comprehensive health education; SHE = standard health education; TB = tuberculosis, RR = relative risk, CI = confident interval.
*$p < .05$.

Table 3. The Implementation of Comprehensive Health Education to Improve Household Contact Participation and Case Finding Based on Multiple Poisson Regression.

	Contact participation		Case finding	
Variables (n = 428)	ARR	95% CI	ARR	95% CI
Intervention groups				
CHE	1.822*	1.185, 2.802	3.126	0.845, 11.557
SHE	Reference		Reference	
Type of residence area				
Rural	1.712*	1.122, 2.610	7.467*	1.632, 34.151
Urban	Reference		Reference	
Age groups				
<15 years old	1.086	0.635, 1.859	6.048	1.592, 22.973
15–39 years old	0.955	0.062, 1.514	0.788	0.131, 4.726
≥40 years old	Reference		Reference	
TB classification of index case				
Clinically confirmed	Reference		Reference	
Bacteriologically confirmed	1.418	0.442, 4.548		
Childhood TB	2.406	0.557, 9.807	1.238	0.156, 9.847

Note. CHE = comprehensive health education; SHE = standard health education; TB = tuberculosis, ARR = adjusted relative risk; CI = confidence interval.
*$p < .05$.

group. The CHE improved individual beliefs, reduced perceived stigma related to TB, and increased social support from TB officers. These findings prove that changing behavior for better participation follows social science theories that guide the intervention (Champion & Skinner, 2008; Craig et al., 2017; Riekert et al., 2014).

Table 4. The Score Comparison of Knowledge, Perceived Susceptibility, Severity Regarding TB, Perceived Benefits, Barriers, Self-Efficacy, Perceived Stigma Toward TB, and Social Support by Intervention Groups.

	Intervention groups	
Variable (score)	CHE (n = 42)	SHE (n = 39)
Knowledge, $M \pm SD$	6.0 ± 1.7	5.6 ± 1.2
Perceived susceptibility, $M \pm SD$*	7.5 ± 1.8	5.9 ± 2.8
Perceived severity, $M \pm SD$*	4.2 ± 1.1	3.4 ± 1.5
Perceived barriers, *Mdn* (IQR)	0 (1)	1 (2)
Perceived benefits, *Mdn* (IQR)*	4 (0)	4 (2)
Self-efficacy, *Mdn* (IQR)	5 (1)	5 (2)
Perceived stigma, $M \pm SD$		
Internalized*	1.3 ± 0.34	2.6 ± 0.53
Anticipated	0.6 ± 0.21	1.2 ± 0.29
Social support from TB officer, *Mdn* (IQR)*	7.5 (2)	4 (5)
Social support from family, *Mdn* (IQR)	6 (2)	6 (6)

Note. IQR = interquartile range; TB = tuberculosis; CHE = comprehensive health education; SHE = standard health education.
*$p < .05$.

The household contacts participation in the CHE group was 1.8 times compared with the SHE group. Several studies regarding TB screening and the factors associated with it support our results that found that health education was important to improve screening participation. An educational intervention study in Nigeria implemented focused and targeted health education successfully to improve knowledge and skills of TB patients to bring their contacts for TB screening. The number of TB contacts brought for screening significantly improved among the intervention group compared with the control group (Ekwueme et al., 2014). Health education regarding TB by health care workers is a factor that improves screening adherence of household contact by 2.6 times (Shiferaw et al., 2019). Other studies revealed that health education by health extension workers to household contact was an important factor in improving their participation in TB screening by 4.2 times (Gebretnsae et al., 2020).

A study in Pakistan trained lay workers to conduct active contact investigations and provide treatment support. They succeeded in improving case detection and treatment outcomes. The participation on smear examination, proportion smear-positive, and prevalence smear-positive TB among contacts was significantly higher among rural areas than urban areas, which is similar to our findings (Shah et al., 2013). A quasi-experimental study implemented educational intervention based on the health belief model to improve behavior of people with smear-positive TB. The study found that all perceived issues and self-efficacy increased significantly after the intervention compared with the control group (Jadgal et al., 2015). A previous study used the health belief model to guide psychological counseling and educational

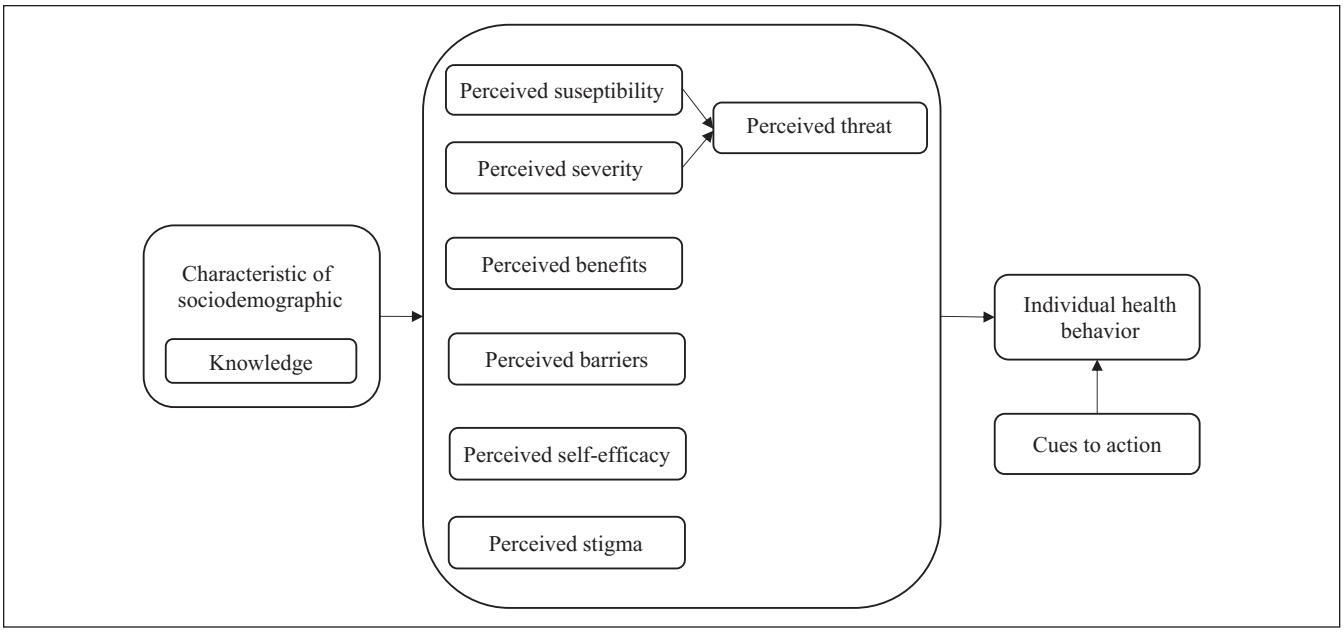

Figure 1. The research model diagram of health belief model recommended based on the study.

intervention to improve TB treatment adherence in Addis Ababa. Psychological counseling and health education significantly decreased nonadherence in the intervention group compared with the control group (Tola et al., 2016). Even the participant and target of behavior change of both studies differed; the findings supported the results of our study. Good health education improved not only knowledge and awareness but also the psychological aspect (Ogden, 2007).

Previous interventional studies on TB health-seeking behavior used a single social science theory to develop their interventions (Ekwueme et al., 2014; Jadgal et al., 2015; Shah et al., 2013; Tola et al., 2016). However, none of them used the multitheoretical model. Those studies are diverse on the dependent variable, method, and underlying theory even though the results are in concordance with our findings. The magnitude of the intervention to increase behavior could not be compared with each other, but more factors were adopted, leading to a better result. Multicomponent intervention is effective to improve self-management precursor, behavior belief, plan, and self-efficacy among adults with TB (Chen et al., 2020).

The intervention in this study already involved individuals, families, and TB officers. The next step should be expanded to include the community. TB stigma in the communities and social discrimination is a major problem that hinders health-seeking behavior. The content of CHE could be used for the TB campaigns to increase public awareness and decrease stigmatization (Alvarez et al., 2014; Khan et al., 2020; Yadav & Rawal, 2016). Social support should be expanded, involving community leaders, public figures, and influencers. They have an important role in changing public perception regarding TB (Baxter et al., 2017; Macintyre et al., 2017).

There are some limitations in our study. Intervention groups did not differ in the knowledge score comparison in our study. This might be due to the topics that were measured and the probability of household contacts searching for information from other sources. This study could not ensure that household contacts only receive TB information from the intervention. Social support from family was equally high in both groups. This may show that the support of family members was high before the intervention due to the cultural aspect of the study setting. Furthermore, since the interview was at their own home, the contact representatives tended to answer "yes" to most questions regarding family support. The health motivation variable was not included in this study because it was determined by the expectation regarding the benefits of the observed health behavior (Glanz et al., 2008).

Despite the limitations, this study has several important implications for strengthening TB control programs. In term of active case finding, it was discovered that the higher the contacts participation the higher the probability to identify additional TB cases. This study found that the TB case finding among household contacts increased more than three times in the CHE group compared with the SHE group. More household contacts detected in the earlier stages implied better prevention action (Lönnroth et al., 2013). The implementation of CHE in our study was easily adopted by local TB control programs and highly sustainable; this is because it was designed during the home visit and did not change the contact investigation procedure. Also the CHE contents could be added to the contact investigation guidelines to expand its use at the national level. This study also has important implications for TB case finding intensification by optimizing the participation of presumptive TB to perform diagnostic tests.

The education was delivered to household contacts and others exposed and high-risk populations (Mhimbira et al., 2017). The use of health officers to deliver CHE during the study also has good further implications for the TB program. This experience can help them provide social support for patients, household contacts, and other high-risk populations (Ayakaka et al., 2017).

The findings of this study show the importance of the health belief model. Perceived stigma should be added to the model to provide a comprehensive understanding of individual health behavior. The supplementation of the health belief model with perceived stigma is based on the argument that perceived stigma could not be included in perceived severity. That has the opposite association with the behavior of stigmatized diseases. Perceived severity encourages health behavior, while perceived stigma hinders health behavior. Perceived stigma could not be included in the perceived barriers because those came from a different source. Perceived barriers came from negative beliefs regarding the health action, while perceived stigma came from stigma regarding TB in the community or stigma as a social determinant of health (Champion & Skinner, 2008; Craig et al., 2017). The health belief model is recommended based on this study, as shown in Figure 1.

Conclusions

The implementation of CHE improved household contacts' participation in early detection of TB. Higher participation is consistent with better perceived susceptibility, severity, benefits, self-efficacy, stigma, and social supports among CHE groups. The CHE implementation should be scaled up to other areas with a high number of TB transmission. The content and technique of CHE could be incorporated in contact investigation guidelines and materials for the TB campaign.

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Authors' Contributions

IWGAEP designed the study, developed the methodology and data collection tools, conducted the data analysis, and drafted the manuscript. NPEPD provided data regarding study setting and TB program performance in Badung district and contributed to coordinate data collection and administrative and technical support. ANP critically reviewed all aspects of the study and assisted in drafting the manuscript. HBN assisted in developing the methodology and data analysis and drafting the manuscript, and CUW critically reviewed all aspects of the study, developed the methodology, and assisted in drafting the manuscript. All the authors have approved the final manuscript.

Declaration of Conflicting Interests

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Ethical Issues

The research proposal was presented and discussed by the ethical committee board. A formal approval was obtained prior to randomization of PHCs into the CHE and SHE groups. Participation in this study was voluntary. All eligible household contacts were explained the study details through a written informed consent form prior the health education and interview. Ethical clearance was granted from The Ethical Committee of Faculty of Medicine, Universitas Udayana, Indonesia, under the ethical approval letter 1842/UN14.2.2.VII.14/LP/2018. Formal permissions were obtained from the Community Protection Body, Local Government of Badung District under the permission letter 070/1126/Kesbang/2018.

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