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Sharma, Binod Bindu; Loxton, Deborah Joanne; Murray, Henry; Angeli, Giavanna Louise; Oldmeadow, Christopher; Chiu, Simon & Smith, Roger. "A first step to improving maternal mortality in a low-literacy setting; the successful use of singing to improve knowledge regarding antenatal care" Published in *American Journal of Obstetrics and Gynecology*, Vol. 219, Issue 6, p. 615.e1-615.e11, (2018).

Available from: <http://dx.doi.org/10.1016/j.ajog.2018.09.038>

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Accessed from: <http://hdl.handle.net/1959.13/1401639>

**Title:** A first step to improving maternal mortality in a low literacy setting; the successful use of singing to improve knowledge regarding antenatal care.

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**Funding:** University of Newcastle Postgraduate Scholarship and an HMRI Jennie Thomas Project and Travel Grant to BBS.

**Disclosure statement:** The authors report no conflict of interest.

**Word count:** 464 (Abstract), 4675 (Main text)

**Condensation:** Singing bypassed the limitations of literacy in communicating antenatal care knowledge

**Short title:** Improving Antenatal Education Through Singing Health Messages in Rural Nepal

**AJOG at a Glance:**

A. To determine if health messages regarding the importance of antenatal care and skilled birth assistance are effectively transmitted through singing in the limited literacy environment of rural Nepal.

B. Singing health messages in rural villages of Nepal significantly improved the knowledge of villagers regardless of educational status, and changed behavior.

C. Excess maternal mortality is linked to three delays: delay in recognizing a problem, delay in transport to a health facility and delay in the facility before care is given. The first delay is particularly important in illiterate women. This affects disadvantaged people in developed countries such as Native Americans, and rural people in developing countries. This project uses a culturally appropriate singing intervention to bypass the limitations of literacy to provide education on care during pregnancy and childbirth to target the first delay.

**Abstract**

**Background:** Preventable maternal mortality is related to delays in recognizing the problem, transport to a facility and receiving appropriate care on arrival. Reducing maternal mortality in low literacy settings is particularly challenging. In the rural villages of Nepal, the maternal mortality rate is amongst the highest in the world; the reasons include illiteracy and lack of knowledge of the needs of pregnant women. Culturally, singing and dancing are part of Nepalese daily life and present an opportunity to transmit knowledge of antenatal care and care at birth with a view to reducing the first two delays.

**Objective:** We hypothesized that health messages regarding the importance of antenatal care and skilled birth assistance would be effectively transmitted by songs in the limited literacy environment of rural Nepal.

**Study design:** We randomly grouped four rural Village Development Committees comprising 36 villages into two (intervention and control) clusters. In the intervention group, local groups were invited to write song lyrics incorporating key health messages regarding antenatal care to accompany popular melodies. The groups presented their songs and dances in a festival organized and judged by the community. The winning songs were performed by the local people in a song and dance progression through the villages, houses and fields. A wall chart with the key health messages was also provided to each household. Knowledge of household decision makers (senior men and women) was assessed before and after the intervention and at 12 months using a structured questionnaire in all households that also assessed behavior change.

**Results:** Structured interviews were conducted at baseline, immediately post-intervention in the control and intervention areas (intervention n=735 interviews, control n=775), and at 12-

months in the intervention area only (n=867). Knowledge scores were recorded as the number of correct items out of 36 questions at baseline and post-intervention, and of 21 questions at follow-up. Post-intervention, test score doubled in the intervention group from a mean of 11·60/36 to 22·33/36 ( $P<0\cdot001$ ), with no practically significant change in the control population (17·48/36 to 18·26/36). Improvement was greatest amongst the most illiterate members of the community (6·8/36 to 19·8/36,  $P<0\cdot001$ ). At 12 months follow-up, a majority of the participants (63.9%) indicated that they provided information learnt from the songs to their neighbors and friends, and 41.3 % reported still singing the songs from the intervention.

**Conclusion:** The use of songs bypassed the limitations of literacy in communicating health messages that are key to improving maternal care in this low literacy rural setting within a developing country. The improvements were maintained without further intervention for 12 months. With appropriate sociocultural adaptation to local contexts, this low-cost method of community education may be applicable to improving maternal health knowledge and behavior change in other low resource and limited literacy settings that may lead to reductions in maternal mortality.

### List of abbreviations

ACTRN	Australian New Zealand Clinical Trials Registry
Cnt	Control
HMRI	Hunter Medical Research Institute
HREC	Human Research Ethics Committee
IBM	International Business Machines
Int	Intervention

100	LCL	Lower Control Limit
101	NHRC	Nepal Health Research Council
102	NSW	New South Wales
103	AM	Member of the Order of Australia
104	OAM	Medal of the Order of Australia
105	SPSS	Statistical Package for the Social Science
106	UCL	Upper Control Limit
107	VDC	Village Development Committee
108	VS	Versus

109

## 110 **Introduction**

111 “Maternal death has devastating social, economic, and personal consequences”<sup>1</sup>. CDC data  
 112 indicates a continuing rise in maternal mortality ratios within the US, particularly amongst  
 113 black women<sup>2</sup>, while Native Americans have maternal mortality rates over four times higher  
 114 than non-Hispanic whites<sup>3</sup>. The maternal mortality ratio in the US is the highest amongst high  
 115 income countries<sup>4</sup>. Associations with high maternal mortality in the US context include  
 116 poverty and poor educational attainment<sup>1</sup>. A potential contributor is that black women may  
 117 receive inferior care as they are more likely to deliver in hospitals associated with poorer  
 118 outcomes<sup>5</sup>. Within the Native American community 30 percent of pregnancies occur to  
 119 women with no high school diploma<sup>3</sup>.

120 Part, but not all, of the increase in maternal mortality ratios is likely due to more effective  
 121 reporting of pregnancy related deaths<sup>6</sup>. One strategy to reduce maternal mortality has been to  
 122 focus on near misses as they are more common<sup>7,8,9</sup>. Maternal mortality is also a major health  
 123 problem for low income countries<sup>4</sup>.

124

The high incidence of maternal mortality in low income countries to some extent reflects the same etiologies as seen in the US but with a higher proportion of hemorrhage and hypertensive crises<sup>4</sup>. Amongst low income countries Nepal has been the beneficiary of significant USAID investment since the 1950s, particularly focused on improving women's health and the status of women; additionally, Peace Corps volunteers have been in Nepal since 1962. Despite these efforts Nepal continues to have a high ratio of maternal mortality, the national estimate is 190 deaths per 100,000 live births. The true figure for rural Nepal is likely to be much higher as most births occur at home and remain unrecorded<sup>10,11</sup>. One reason for under reporting is that culturally, death is considered a private issue. Health care workers are also not expected to discuss taboo issues such as death<sup>11</sup>.

Worldwide, in low-income countries, many factors are known to influence maternal death ratios including maternal age, early marriage, parity, birth spacing, family size, malnutrition, poverty and poor literacy<sup>12</sup>. In rural Nepal, these factors are further exacerbated by cultural factors. Women move to their husband's household when married and work for their in-laws, and husbands. A daughter-in-law is expected to hide her face from her senior male in-laws. There is almost no communication between fathers-in-law and daughters-in-law on pregnancy-related issues, yet the father-in-law and husband usually control the family finances needed to access antenatal care<sup>13,14</sup>. Mothers-in-law make the final decisions with respect to all pregnancy and childbirth related issues; these are all considered the domain of women<sup>15</sup>. However, because women do not have the power to authorise decisions associated with financial costs, they may not have the ability to request or obtain the health care, food, and rest required during pregnancy.

The pathway to maternal death in the US and elsewhere usually involves a series of delays<sup>16,17</sup>. These delays are: 1) a delay in the decision to seek help, 2) a delay in getting to help, and 3) a delay in receiving appropriate care when a health facility is reached. Our intervention program aimed to address the first of these delays in the rural Nepalese setting and specifically to raise the level of knowledge of community members regarding the importance of antenatal checks, supplementary diet, rest during pregnancy, planning for childbirth, and the use of skilled birth attendants. Since all members of remote, rural Nepalese communities contribute to maternal mortality outcomes, the study was designed to include all community members in the program, to help increase awareness of the problems and the potential solutions.

Changing cultural attitudes is notoriously difficult but, because of the central role of community singing and dancing in Nepalese rural life, it was hypothesized that the community knowledge of antenatal care, and the value of skilled birth attendants could be improved with a program of writing song lyrics, and singing health messages to traditional music, combined with a wall chart illustrating key points.

## **Materials and methods**

Nepalese Districts are divided into Village Development Committees (VDCs), the smallest local government units in Nepal. To perform a pre-post study, four rural VDCs of the Parbat District were pragmatically selected using a purposive sampling method. The selection criteria included: 1. Rurality – two VDCs selected in each cluster were paired with similar demographic and geographic parameters. 2. Accessibility of health services by a road. 3. Walking distance to the district headquarters, and 4. Inter-cluster distance was maximized to prevent potential contamination of the intervention. Two adjoining VDCs, Chitre



(population-1,740) and Ramja Deurali (1,779), were selected for one cluster which together contained 18 villages, and two VDCs Mudikuwa (1,869) and Falebas Khanigaun (1,925), which also contain 18 villages, were selected for the second cluster (Figure 1). These two clusters were known to be geographically separated by major geological features making communication between the two areas unlikely, thus minimising the likelihood of contamination of the health message outside of the trial intervention area.

### **Randomization and masking**

All four Village Development Committees were asked if they were prepared to be randomized for an intervention. No participant in either cluster was informed of the design of the research; however, the village officials were informed and consent was obtained regarding the planned research activities. Randomization of the two regions to either control or intervention was by coin toss (Figure 2). Chitre and Ramja Deurali VDCs were assigned as the intervention cluster with Mudikuwa and Falebas Khanigaun as the control.

### **Procedures**

Specialist obstetric advice was sought to identify the key health messages to be transmitted and the decision was made to focus on 5 issues: the importance of antenatal visits, the need for supplementary diet, rest during pregnancy, planning for childbirth, and use of skilled birth attendants. A structured online survey questionnaire in the Nepalese language (Prashnawali) was translated by a local language expert. We did not use validated questions; however, we pre-tested the questions at the University of Newcastle, Australia using Nepalese students. The questionnaire was further fine-tuned in Nepal based on the feedback from local interviewers during their data collection training. Eight interviewers were selected by the Village Development Committees (two in each of the four VDCs) from within the local

community. There was a community preference for female interviewers. Interviewers had completed Year 12 education and were assigned for data collection not in their own VDCs but in the adjoining VDCs. Respondents gave written consent with either a signature or fingerprint and were free to decline the interview or terminate it at any time. The baseline surveys were then completed (intervention n=768 and control n=804). Male or female heads of household of all the houses involved were approached. One survey was completed at each household by an adult member of the family who was responsible for household finances and decision making.

The same process was used for the post-intervention survey (intervention n=735 and control n=775). All the heads of the households of the control and intervention clusters were invited for interview. The baseline survey was completed by March 16, 2016. After the baseline survey, the preparations to organize the song competition in the intervention communities started (Table 1) and the events began on June 10th, 2016. Immediately following the community intervention, a follow-up survey using the same questions and methods as the initial survey was conducted. 12 months after the intervention, we carried out a follow-up survey in the intervention cluster only. Due to the absence of robust identification methods and men moving away for work, the respondents may have changed between interviews. For example, if the male of the household was interviewed at baseline, the female head of the household may have been interviewed post-intervention and at the 12-month follow-up. In the follow-up survey, we included questions to measure if participants used the knowledge learnt from the program.

Workshops were set up in the intervention VDCs with village officials, teachers, students, mothers' group members, female community health volunteers, opinion leaders and local

politicians (Table 1). Then orientation sessions were organized which clarified the key message areas for safer pregnancies and childbirth.

### **Song competition**

The local leaders decided the date, venue, judges for the competition, and set criteria for the performance of each song. Song competition criteria and health messages were provided through group orientations and schools, and information about the song competition and singing intervention was taken to isolated areas by health workers, volunteers and the town crier. In schools, internal song competitions were organized to nominate the best songs for the actual competition to be held in the community.

Twenty-six groups of local people in the intervention cluster participated in the development of songs and dances. Each group performed their songs for the community in a festival held in a community hall. The songs were judged by the local teachers and health workers (male and female). The judges created specific judging criteria. The six best songs were selected for the next stage of the intervention.

### **Promoting awareness through singing health messages**

Given the overwhelming participation of the community and the culturally appropriate method of diffusion, the local teachers requested the role of disseminating the health messages throughout the community. The teachers, school management committees, village secretaries and others decided the composition of the singing teams. In the Chitre Village Development Committee, a group of six teachers was identified for the singing intervention. The Chitre intervention progression was conducted from 14<sup>th</sup> to 23<sup>rd</sup> July 2016. In Ramja Deurali, one teacher was nominated to lead the team, other members of the group included a

traditional singer, adolescents, former students, and one local villager. The progression in Ramja Deurali occurred from 5<sup>th</sup> to 12<sup>th</sup> August 2016.

A total of 80 singing sessions were organized covering all the households in the intervention cluster. The sessions were held wherever people were found: in individual houses, in villages and schools, on the roads and even in the fields where people worked (Figure 3). An estimated 2,400 (68.20%) people out of a total of 3,519 estimated population heard the health messages. A small portion of the audience attended multiple singing and dancing sessions.

#### **Distribution of the Holy Duty wall chart**

During the singing intervention progression through the villages and farms, each household was provided with a Holy Duty wall chart (Figure 4) which illustrated the key health messages of the songs: the antenatal check-up, the importance of diet (sufficient food) and rest during pregnancy, the importance of planning for childbirth, and use of skilled birth attendants. The chart incorporated pictures of local gods to encourage the villagers to value the health messages and preserve the wall chart. Development of the charts had been completed in consultation with and with the approval of the Nepalese government.

#### **Outcomes**

The primary outcome was knowledge of antenatal care, the importance of rest and diet during pregnancy, planning for delivery and the value of skilled birth attendants. A secondary outcome was evidence of behavior change linked to the messages within the songs.

#### **Quality control of data**

Survey data were collected verbally by the interviewers who entered the data via tablets (iPads). Responses were later uploaded to a remote, secure online survey system. Quality checks were undertaken during data upload and cross-checked at the time of data analysis. Cases with missing data were retained in the data set, however they were excluded from the analysis at the modelling stage of the analysis.

### **Statistical analysis**

Statistical analyses were conducted using IBM SPSS version 24. Four subdomains of the knowledge survey: (1) antenatal care, (2) supplementary diet and rest during pregnancy, (3) planning for childbirth, and (4) need for skilled birth attendants, were used to create a total score. Due to the difference in the individual subjects in the first two surveys, the analysis was conducted as a repeated cross-sectional study.

Differences in the change from baseline in knowledge score between intervention and control regions were assessed using linear regression models. The independent variables in the model included time (pre-vs post), group (intervention vs control), and the interaction between group and time. The variance of the comparison groups was not considered equal, therefore, Huber-White sandwich-based estimators were used. Bonferroni corrections were used to adjust for multiple comparisons. Means and percentage change are presented for intervention and control regions at baseline and post-intervention with corresponding standard deviation, p-values and 95% confidence intervals.

### **Results**

A total of n=1,572 (intervention=768 and control=804) participants at baseline and n=1,510 (intervention=735 and control=775) at post-intervention completed the survey, no subject

who was approached refused to participate (Table 2). At baseline, the control group had 548 (68.2%) females and 256 (31.8%) males compared to the intervention group which had 584 (76.0%) females and 184 (24.0%) males. The post-intervention control group included 554 (71.4%) females and 221 (28.5%) males, while the intervention group had 584 (79.5%) females and 151(20.5%) males. The participants' ages ranged from 18 to 97 years with the median age 48 years at baseline and 47 years at post-intervention. Knowledge scores were assessed as the number of correct items out of 36 questions.

The intervention was associated with a significant test score increment in the intervention group ( $P<0.001$ ). The knowledge of antenatal care ( $P<0.001$ ), supplementary diet and rest during pregnancy ( $P<0.001$ ), and planning for childbirth ( $P<0.001$ ) improved. The total knowledge score in the intervention group nearly doubled from 11.60 to 22.33/36 a 92.50 percent increase. There was almost no change in the control group.

The greatest improvement in knowledge ( $P<0.001$ ) was observed among the illiterate cohort ( $P<0.001$ ) (Figure 5). For example, the women with no education improved from 7.54 at baseline to 20.62/36 post-intervention( $P<0.001$ ). Women with higher education improved from a baseline of 15.86 to a post-intervention score of 24.17/36 ( $P<0.001$ ). A similar response was observed in the knowledge among men with no education which improved from a baseline of 7.43 to a post-intervention score of 19.55/36 ( $P<0.001$ ), men with higher education improved from a baseline of 16.77 to a post-intervention score of 24.68/36 ( $P<0.001$ ).

We also related the income of participants to knowledge scores (Figure 6). Participants were divided into two groups: those with an annual income of 299,999 Nepalese Rupees

(US\$2600) or less were categorised as the low-income, while those earning more than 300,000 Nepalese Rupees were grouped as high-income. Low-income women scored 12.58 at baseline and 22.31/36 at the post-intervention survey ( $P<0.001$ ). The high-income women scored 12.58 at baseline and 22.94/36 post-intervention ( $P<0.001$ ). A similar trend was observed among males, low-income men scored 10.88 at baseline and 22.14/36 ( $P<0.001$ ). While high-income men scored 14.11 at baseline and 23.01/36 post-intervention ( $P<0.001$ ) (Figure 6). The improvement in the knowledge among males and females was similar with no gender specific pattern of change.

The 12-month follow-up data on the questions that were common to the baseline and post-intervention survey (21 questions) indicated that the mean score was 8.38 at baseline, 15.29 at post-intervention and 15.34 at the 12-month follow-up survey. Participants who found the songs helpful were more likely to indicate they provided additional food ( $P<0.016$ ), rest ( $P<0.004$ ) and planned properly for a birth ( $P<0.005$ ). The majority of participants (63.9%) indicated that they provided information learnt in the intervention to their neighbors and friends, with 357 (41.3%) of the participants still singing the songs from the program.

#### **Comment**

Our singing and dancing intervention was associated with a doubling of the knowledge score regarding pregnancy care from 11.60 to 22.33 out of a possible 36 marks. This increase was statistically significant and much greater than the mean 0.78 marks increase observed in the control group. The intervention and control villages had similar rurality and demographic characteristics. However, after data analysis, differences between the intervention and control groups were noted in the initial knowledge of respondents regarding the importance of antenatal visits, supplementary diet, rest during pregnancy, and the importance of planning

for childbirth. Respondents in the control cluster had a higher level of knowledge on these issues prior to the intervention. Slight differences existed between the control and intervention clusters in terms of ethnicity and socioeconomic status. In the control area there was a college for higher education and a private hospital which were not present in the intervention cluster. These factors might have contributed to the higher knowledge level observed in the baseline survey of the control group compared to their intervention counterparts. The post-intervention scores were more tightly clustered around the mean indicating that a large proportion of the study population had acquired the key health messages contained in the singing and dancing program. In all sub-domains, the intervention group nearly doubled their score from baseline.

Our data indicate that prior to the intervention knowledge of antenatal and delivery care was equally poor in both men and women. Further, the groups that benefited most from our intervention were the illiterate women and men whose knowledge levels increased to be very similar to those seen in the most educated members of the society. Wealth had less of an effect than educational attainment on the levels of knowledge of community members. Both young and older members of the community improved their knowledge scores. We were surprised that older community members, both men and women, were prepared to change long-held beliefs (Figure 7).

The key health messages were established by expert opinion supported by the literature. Antenatal visits are thought to be critical in predicting the likelihood of complications enabling preventative action<sup>18,19</sup>. At least four antenatal visits at the 4th, 6th, 8th and 9th month of pregnancy are recommended by the Nepalese Ministry of Health<sup>20</sup>. However, only 50 percent of the pregnant women in Nepal have the recommended visits and only 36% of



women had skilled assistance at birth<sup>21</sup>. The nutritional state of Nepalese women in rural settings is known to be compromised, and severe anemia and other malnutrition-related complications are common<sup>22</sup>. A wide variety of foods (rice, vegetables, meat and maize) during pregnancy are known to positively influence the size and health of the baby,<sup>23</sup> while women who have an inadequate diet during pregnancy experience a higher rate of poor pregnancy outcomes<sup>24</sup>. Working long hours and lifting heavy weights during pregnancy is associated with preterm birth and retarded fetal growth<sup>25</sup>. Disturbed sleep and lack of adequate rest is also known to be associated with poor pregnancy outcomes<sup>26</sup>. Finally, skilled care at birth is associated with significant reductions in the risk of complications and death of mother and baby<sup>27,28</sup>.

Using health songs to disseminate messages regarding pregnancy and childbirth in the community was a new practice in the Nepalese rural setting. The program was successful in engaging and bringing the community together to achieve a coordinated effort to organize both the song competition and the musical procession effectively (See Video). The intervention involved activities such as rapport building, facilitating the community to take the leading role, and engaging the whole community and were time-consuming but effective. Our intervention was designed to improve knowledge about pregnancy and birthing care amongst the individuals who would be decision-makers regarding the acceptance of antenatal care in a rural Nepalese community. In the pregnancy context five people are particularly important, the mother, father-in-law, mother-in-law, husband, and the female community health volunteer; a successful outcome requires all five to be involved in childbirth planning. Male engagement, in particular, is essential because of the involvement of men in managing issues such as seeking skilled care, finance, and transportation<sup>24</sup>. Our intervention therefore targeted the first of the three delays that are associated with maternal death. In future work

we will endeavor to tackle the delays associated with transport and the timely access to effective treatment on arrival at a health care facility.

Community engagement in health interventions is thought to be important in embedding knowledge into local cultures<sup>25</sup>. We could not find any prior evidence regarding the use of programs using singing and dancing to transmit obstetric health messages in low-income environments that have been robustly assessed. In Moyamba, Sierra Leone, songs created by students and performed as drama were found to be associated with a reduction in teenage pregnancy<sup>27</sup>, and in Bangladesh a village theatre used to educate the community about eclampsia was effective in maintaining the interest of the audience and improving knowledge<sup>23</sup>. Previous studies using cultural media regarding other health problems have demonstrated positive results, for example, in Papua New Guinea, a trained theatre group was used to educate the school community on local health problems and a high level of engagement was demonstrated<sup>22</sup>. The findings of our study echo evidence from India and Pakistan in which hard to reach families were accessed for polio eradication programs through folk media interventions<sup>28,29</sup>. Published data suggest that the more the interventions are designed and constructed with consideration given to local culture, the greater the likelihood of success in long-term behavioral change<sup>30</sup>.

Our study supports the use of folk media especially in illiterate and financially deprived communities<sup>31</sup>. Social networks strongly re-enforce cultural behaviors. In this study we were able to expose almost all members of the community to new ideas on the management of pregnancy at the same time; this may have generated a new cultural norm within the community leading to the preservation of the new knowledge over the 12-month period<sup>32</sup>.

In the Netherlands, a significant rise in maternal mortality ratio has been observed from 9.7 per 100,000 livebirths (1983-1992) to 12.1 (1993-2005). In addition to the direct causes such as thromboembolism, (pre-) eclampsia, sudden death in pregnancy, obstetric hemorrhage, sepsis and amniotic fluid embolism, indirect deaths caused by an increase in cardiovascular disorder also increased. An especially high maternal death ratio was recorded among the nonwestern immigrant population. These populations were at high risk of maternal death as they were provided with substandard care<sup>33</sup> The maternal mortality ratio in the USA, particularly among African American women is rising<sup>2</sup>. These data indicate that even in developed countries, the standard care designed for the general population may not address the health needs of populations that are from different sociocultural, economic and geographic backgrounds. Therefore, programs need to specifically address the needs of disadvantaged population subgroups such as Native American women. The multicultural nature of the US population may require the design of group specific maternal health programs to address the rising maternal mortality ratio.

The 12-month follow-up data indicate a sustained intervention effect of improved knowledge test scores after 12 months (Figure 5). This knowledge is likely to be a crucial intermediary in the pathway to improving maternal mortality by reducing the first of the delays leading to maternal death, the delay in initial decision making. In the 12-month follow-up, we also document that villagers changed behavior based on the knowledge learnt, informing neighbors, relatives and friends of the appropriate care of pregnant women including providing rest, additional food and the need for antenatal care.

This report offers evidence to policy makers, planners, strategists, program managers and researchers to consider the local context and the importance of community embedding and community leadership in increasing knowledge outcomes on health issues. The experience of

using local resources, for example, talent to develop songs, musical instruments, performers and leadership in organisation of the community education program, not only made the intervention low-cost but also implanted the concept that the community itself can lead and achieve sustained improvements.

Some limitations of the study should be noted. Our study addressed knowledge change but was not designed to detect potential consequential changes in maternal mortality. Although there was no loss of knowledge at 12-month follow-up, it is unknown how long the acquired knowledge will be retained within the community and whether it will translate into altered maternal health outcomes. Similarly, the intervention and control group turned out to be not completely comparable, with a difference in knowledge pre-intervention.

#### **Evidence before this study**

Worldwide, maternal health is poor in rural settings. This is also true of rural Nepal where maternal mortality rates are double the national Nepalese estimates (190/100000 live births). Poor health infrastructure, a non-supportive sociocultural environment for pregnant women and tough topography combine to challenge maternal health development efforts as does a lack of awareness of the measures needed for safer pregnancy and childbirth. Lack of community ownership and knowledge regarding existing health services also leads to poor utilization of such programs. When preparing for this project, little evidence was available regarding the impact of engaging a rural Nepalese community in the design, development and execution of health promotion programs that are both culturally appropriate and led by local people.

#### **Added value of this study**

The whole program for this study in rural Nepal was discussed, developed and implemented with all sections of the community under the leadership of the local people. As singing plays a central role in rural lives in Nepal, in this study, key maternal health messages regarding safer pregnancy and childbirth were promoted through song. This study demonstrates that community education programs that encourage local people to engage in the design, development and implementation of the programs, suitable to their local culture can transmit essential knowledge regarding antenatal and delivery care to illiterate members of a community.

### **Implications**

The result of the research has already been considered by the government of Nepal. The government announced funding for an air ambulance specifically for evacuations of obstetric emergencies to address the second delay; transport to a suitable facility. The government has also announced increased financial incentives for institutional delivery, four antenatal visits and improved recording and reporting of maternal mortality. The findings of this study will facilitate planning and implementation of programs to reduce maternal mortality in settings with low levels of literacy and poor use of health services. This report offers evidence to all policy makers, planners, strategists, program managers and researchers to consider the local context and the importance of community embedding and community leadership in improving health knowledge transfer.

### **Conclusions**

This study demonstrated that promoting pregnancy and birthing health care messages through culturally appropriate songs and poster distribution was an effective means of improving knowledge in a low literacy environment. This increased knowledge should help the women

of those villages to access better care during pregnancy and childbirth, resulting in safer pregnancies and childbirth. The successful outcomes of this study can be used to encourage other rural areas and minority groups to use tailored, culturally appropriate models of health information transfer.

## **Declarations**

## **Ethics**

Ethics approval was obtained from the Human Research Ethics Committee (HREC) of the University of Newcastle (Reference No: H-2015-0451, January 22, 2016) and the Nepal Health Research Council (NHRC), Nepal (Registered No: 92/2016, April 27, 2016). The consent for publication of the results and the images from the institutions and individuals involved has been sought. All the materials used, evidence of approvals obtained and the data before during and after intervention are available.

## **Availability of data**

The data set used and analysed during the current study are available from the corresponding author on reasonable request.

## **Role of funding source**

The sponsors had no role in the design, development of the protocol, data collection, data analysis, interpretation or presentation of the report.

## **Authors' contributions**

All of the authors were involved in the design of the study and provided feedback on drafts of the paper. BBS, DJL, and RS conceived and organized the research project. HM

recommended the key messages incorporated in the songs. DJL and RS were responsible for the overall supervision of the project. BBS, RS and GLA worked on the ethics requirements. CO and SC were responsible for statistical analysis. BBS organized the baseline survey, the interventions, the post-intervention survey, and the one year follow up survey. All authors had access to all the data in the study. BBS, DJL, RS, and GLA wrote the first draft of the report.

### Acknowledgements

The authors would like to thank the Ministry of Health and Nepal Health Research Council Nepal, local Nepalese VDCs, schools, health and government authorities, the University of Newcastle, Jennie Thomas AM, David Young OAM and the villagers of the intervention and control areas. The authors acknowledge Jenny Halman, Ryan Tuckerman and Natalie Townsend from the Research Centre for Generational Health and Ageing for their assistance in setting up the survey and the Hunter Medical Research Institute especially the Mothers and Babies Research Centre for their support.

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Intervention / activities	Control region	Intervention region
Contact with people and village officials	Yes	Yes
Selection of local interviewers	Yes	Yes
Training interviewers for data collection	Yes	Yes
Baseline data collection	Yes	Yes
Intervention - orientation on the theme- Orientation for local students, teachers, mothers group members, female community health volunteers and village officials	No	Yes
Song competition	No	Yes
Training intervention team on the selected songs	No	Yes
Engaging town crier to inform villagers of the intervention	No	Yes
Singing and dancing through the villages and distribution of the Holy Duty wall chart to all households	No	Yes
Post-intervention data collection	Yes	Yes
12-month follow-up data collection	No	Yes

627 Table 1 Intervention and Control protocols

628

Knowledge Mean (sd)	Control			Intervention		
	Baseline	Post-intervention	Percentage increase	Baseline	Post-intervention	Percentage increase
	n = 804	n = 775		n = 768	n = 735	
Importance of antenatal examination (out of 7)	3.66 (1.6)	3.86 (1.36)	5.46%	2.12 (1.74)	4.89 (1.55)	130.66%
Importance of supplementary diet and rest during pregnancy (out of 9)	5.43 (1.3)	5.79 (1.17)	6.63%	3.71 (1.92)	6.84 (1.63)	84.37%
Importance of childbirth planning (out of 8)	4.04 (1.23)	4.18 (1.2)	3.47%	2.81 (2.23)	5.50 (1.54)	95.73%
Importance of delivery care (out of 12)	4.35 (2.21)	4.43 (2.06)	1.84%	2.95 (2.21)	5.09 (1.81)	72.54%
Overall knowledge (out of 36)	17.48 (4.4)	18.26 (3.9)	4.46%	11.60 (6.6)	22.33 (4.97)	92.50%

629 Table 2 Baseline and post-intervention knowledge related to key message areas and delivery  
630 care.

631

## 632 Figure titles and legends

### 633 Figure 1

634 Title: Map of Globe, Nepal and Parbat district showing the intervention and control areas

Legend: One of the villages within the intervention area. People depend on locally grown corn, finger millet, and rice. Firewood is the main source of household energy.

**Figure 2**

Title: Trial Structure

**Figure 3**

Title: A group of teachers singing health messages in a paddy field

Legend: This was a typical setting for the community education program. The education sessions through the songs were held wherever people were found, in individual houses, in villages and schools, on the roads and in the fields where people worked.

**Figure 4**

Title: Antenatal Holy Duty wall chart

Legend: The Holy Duty wall chart was developed to help family members to understand their specific roles during the 9 months of pregnancy.

**Figure 5**

Title: Total knowledge score by education and gender

**Figure 6**

Title: Total knowledge score by income and gender

**Figure 7**

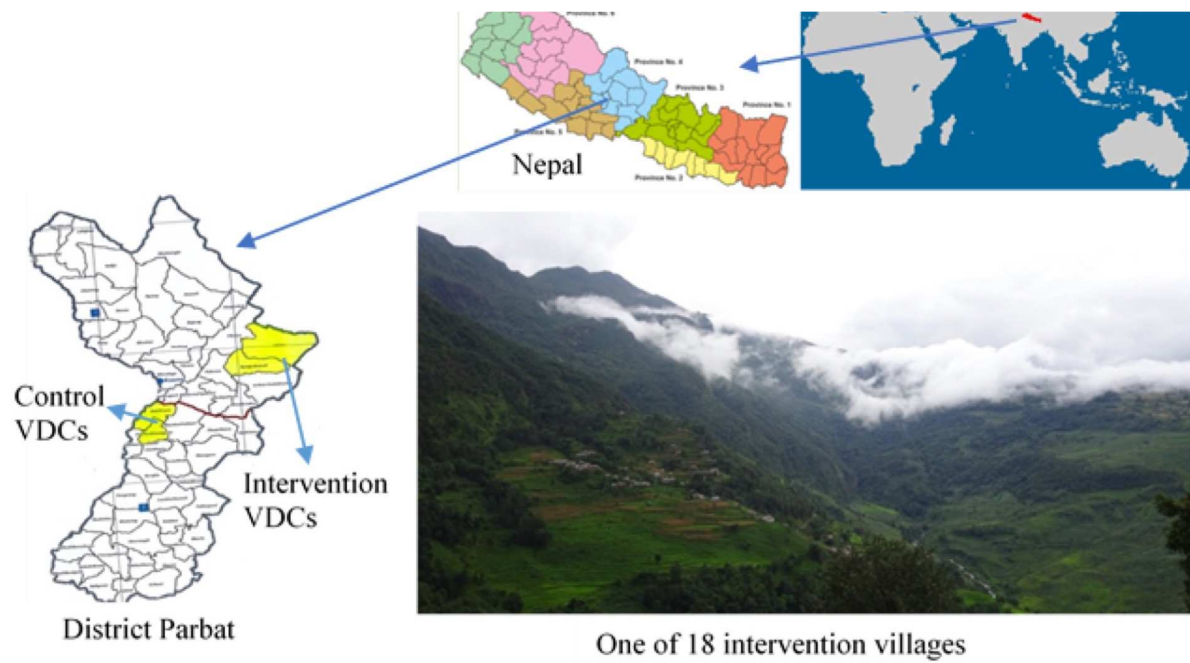
659 Title: Knowledge improved in intervention population at post-intervention and was retained  
660 at 12-month follow-up

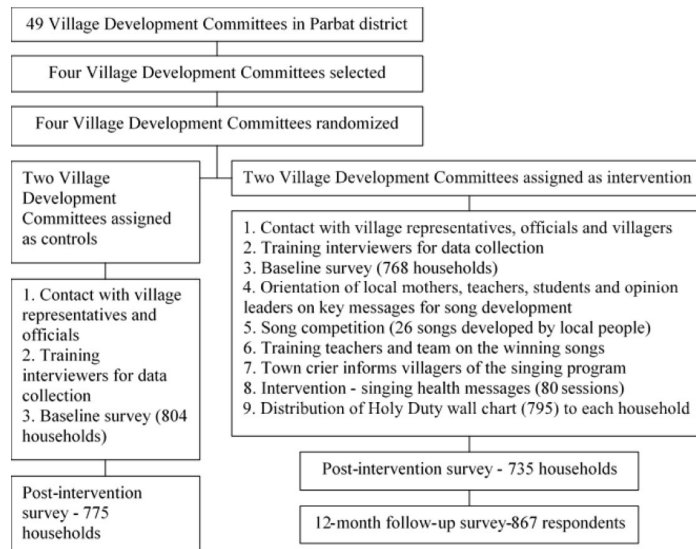
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662 **Video title and legend**

663 **Video**

664 Title: Pathways to Improving Maternal Mortality in Rural Nepal

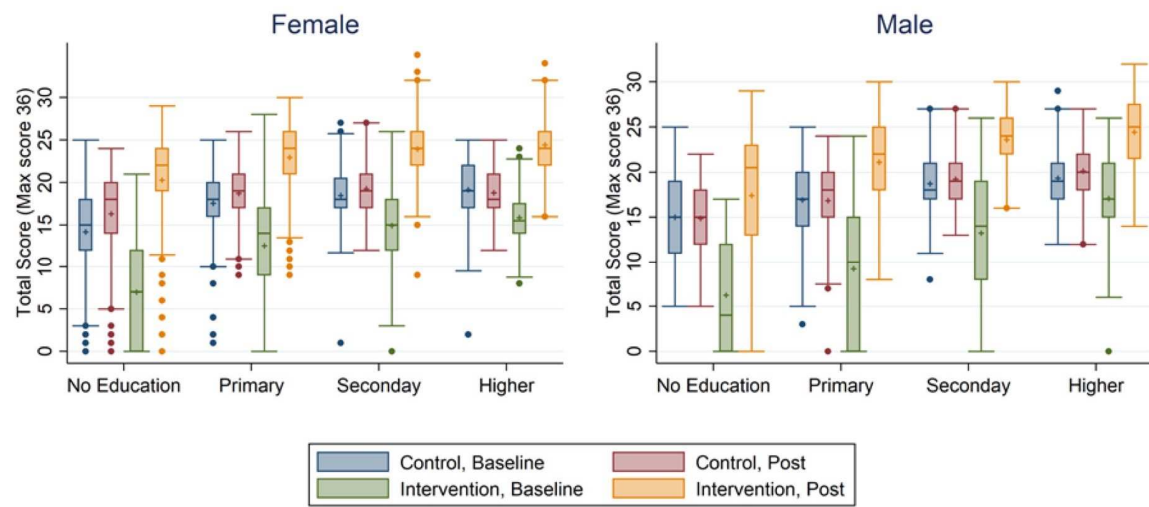


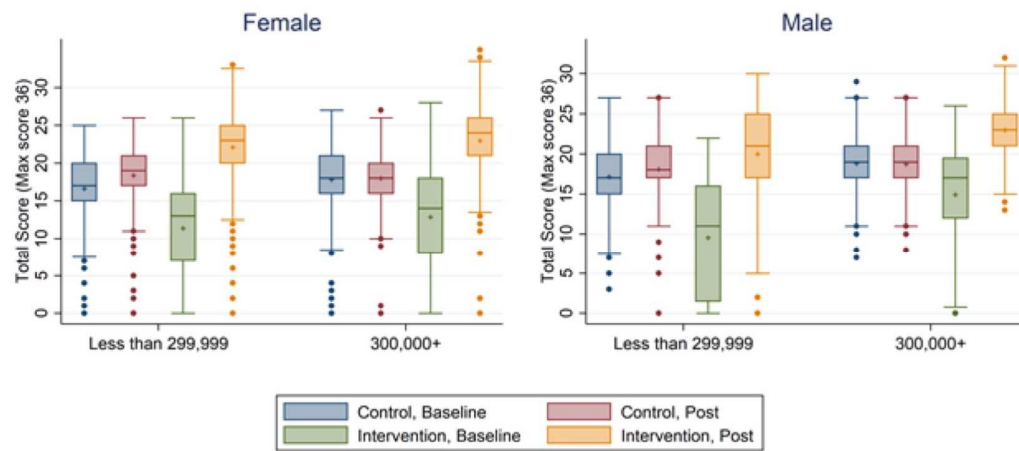






[illegible]





Income in Nepalese Rupees

Total score by gender and age: baseline, post-intervention  
and at 12-month follow-up

