Cervical cancer prevention through financial interventions: An empirical study

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Abstract:

Background: The risk of cervical cancer is very high due to poor awareness levels among the common masses in Low and middle income countries (LMIC) of the world. Literatures shows low rates of acceptance of cervical cancer screening programs among women in these regions are one of the contributing factors to the high incidence rate in these countries. This study is an attempt to assess the efficacy of monetary incentives on women's participation in a cervical cancer screening program.
Methods: To evaluate the effectiveness of financial incentives as an intervention in improving women's participation in a cancer screening program, a randomized controlled trial (RCT) was conducted in the Kamrup district of Assam, India. A total of 196 women participated in the awareness campaign, and the participants were randomly categorized using STATA 15 software into three random groups namely a high-incentivized group, a low-incentivized group, and the controlled group.
Result: The likelihood of women's participation in a cancer screening program is 76.76 times more for the high incentivized group compared to the control group. The results also indicate the odds in favour of women's participation in a cervical cancer screening program is 4.33 times more for the high-incentivized group compared to the low-incentivized group. Thus, the results of the study reveal that higher financial incentives have higher rates of success in encouraging women to participate in a cancer screening program.
Conclusion: The results of the experiment reveal a positive impact of financial incentives as a way of encouraging women to participate in a cervical cancer screening program. The finding of the present study also confirms the finding of the earlier experimental study conducted by Choudhury and Borah (2022).
Policy summary statement: Intervention in the form of financial incentives can go a long way to mitigate the major problem of low participation of women in cervical cancer screening programs in developing countries like India.

Keywords: Intervention; Cervical cancer; Randomized Controlled Trial (RCT)

1. Introduction:

Cancer is a non-communicable disease (NCD) that refers to the growth of malignant cells in any part of the body (Rajpal et al., 2018). When cancer develops in the cervix of women, it is referred to as cervical cancer. It is the fourth most common cancer in women globally and the second most common in the low- and middle-income countries (LMICs). In 2018, there were 0.57 million new cases of cervical cancer, accounting for 7.5% of women's cancer deaths. According to the estimates of WHO, out of the total annual death of women from cervical cancer, 85% of women deaths belong to LMICs (WHO, 2020). India is no exception, and the country alone accounts for one-fourth of the global burden of cervical cancer. North East (NE) India is one of the leading regions with a high number of cervical cancer cases. The age-adjusted incidence rate of cervical cancer is the highest in Arunachal Pradesh (Papumpare District: 27.7 per 100000 women) and Mizoram (Aizawl District: 27.4 per 100000 women). Other NE states such as Mizoram, Tripura, and Assam also account for a significant

share of the total cervical cancer cases in India (NCDIR, 2021).

Unlike in developed regions around the world, cervical cancer remains a major public health hazard in the LMICs like India. The good part of cervical cancer is that, it is possible to prevent it by detecting early symptoms of cancer (Gustafsson et al., 1997; Murri et al., 2006; Kahesa, 2008). Literature shows that by introducing effective screening programs to detect the earliest signs of cancer, developed countries have achieved a significant decline in the incidence and mortality of cancer (Guidozzi, 1996; Kahesa, 2012). However, developing countries are far behind in this regard due to a lack of adequate financial as well as other bottlenecks (Vora & Saiyed, 2020). One of the major causes of such a high incidence of cases in India is the lack of preventive and early detection and treatment programs. Over the years, the incidence of cervical cancer and mortality has declined in countries primarily due to the implementation of preventive measures such as screening, early diagnosis and treatment for pre-cancer, and early cancer (Nugrahani et al., 2017;Mehraban et al., 2018; Assefa et al., 2019; Arbyn et al., 2021; Woo et al., 2021). A global call to action on eliminating cervical cancer through intensified vaccination against human papilloma virus (HPV), screening, and treatment was announced by the Director-General of the World Health Organization (WHO) in May 2018. India is one of the countries bearing the highest global burden of cervical cancer, is no exception to this trend. The Government of India launched the "National Programme for the Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS)" in 2010 with the focus to enable opportunistic screening for common non-communicable diseases inclusive of cervical cancer in the country.

Although with the new age breakthrough of medical science and technology, the treatment of cancer has progressed remarkably, the expenses for cancer care are still extremely high. The cost of cancer treatment comes with expenditures on prevention of cancer, cancer screening and treatment, time and effort spent by patients and their families, loss of productivity due to cancer-induced disability, and premature death due to cancer (Dinesh et al., 2020). The economic and psychological burden of cancer and its impact on both the patient and caregiver has led to the study of preventive measures to avoid cancer altogether. Preventing cancer also means reducing future loss of productivity. Various cancers like breast, cervical, colorectal, and lung can be prevented before further spreading of the disease if they are screened at the right time and at regular intervals. By implementing knowledge already known about prevention strategies, a significant amount of lives can be saved, and the cost of cancer care can be reduced (Colditz and Emmons, 2018).

Literature reveals that despite having alarming indications and evidence about cervical cancer incidence, there is the absence of a more comprehensive initiative from public health authorities for prevention and control of cancer in India due to lack of resources and other bottlenecks (Bobdey et al., 2016;Colditz and Emmons, 2018; Chauhan et al., 2020; Dinesh et al., 2020). Literature also shows that despite having some infrastructural facilities for screening, very few women are screened in developing countries due to woman's low participation and acceptance of screening programs (Chirenje et al., 2001; Kahesa et al., 2012). As a result, in spite of the availability of affordable and effective methods for early detection and treatment, cervical cancer still continues to be a public health problem (Bobdey et al., 2016). Thus, women's acceptance and participation in a cancer screening program is of utmost importance for the effectiveness of any cancer detection program (Chirenje et al., 2001; Vora & Saiyed, 2020). Therefore, there is a need to design suitable policies/strategies to encourage women to accept cervical cancer screening. With this background, an attempt is made in this study to evaluate the effectiveness of financial incentives as an intervention to increase women's participation in a cervical cancer screening program

2. Research Methods

2.1. Conceptual framework

Acceptance and participation in a health screening program can be represented by a discrete decision to participate or not to participate (a variable defined as either one or zero). Following Goswami and Choudhury (2015) and Wendland and Sills (2008), women's decision to participate in a cervical cancer screening program is defined as a binary decision. Literature suggests that women's decision to accept and participate in a cervical cancer screening programme is influenced by a host of factors. In the study, it is hypothesized that a combination of socio-economic, exposure to health risk, and health intervention factors influence women's preferences for the screening program, which in turn, influences the decision of women, whether to participate or not in a cancer screening program. The flow chart in **Figure 1** represents the conceptual framework of women's decision to participate in a cervical cancer screening program.

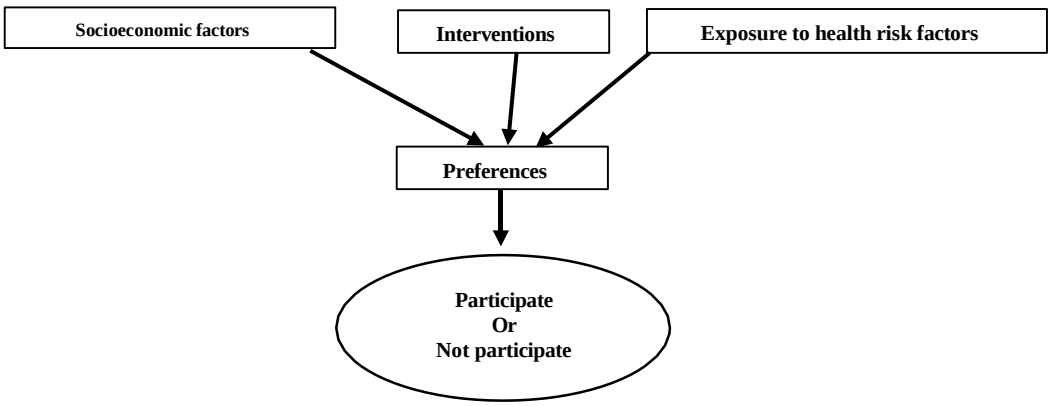


Figure 1: Conceptual framework of women's decision to participate in a cervical cancer screening program

2.2. Research Design:

In the study, an experiment is conducted within a Randomized Controlled Trial framework (RCT). Arandomized controlled trial (RCT) is a trial in which test subjects are randomly divided into two groups: one receiving the intervention (the experimental group) that is being evaluated and the other receiving conventional treatment (the control group) or placebo. The two groups are subsequently followed up to see if there are any differences between them in the results. The outcome of the trial is used to evaluate the effectiveness of the intervention (Kendall, 2003).

In this study, an RCT was conducted to provide a realistic evaluation of the effects of the financial or monetary intervention on women's decision to participate in a cervical cancer screening program. The entire procedure of the experiment was divided into two stages. In the first stage, an intensive awareness campaign on cervical cancer was conducted within a radius of about 2 km from Sontola Health Centre, located at Chayani Development block of Kamrup (Rural) district of Assam. This awareness campaign was arranged for households with at least one woman above the age of 30. Households were visited for the first time, and during the visit, information regarding the purpose of the study and the possible interventions to be applied during the study were explained to them. After that, consent regarding participation in the experimental study was sought out, and only the interested women were invited to participate in the study. During the awareness campaign, a baseline survey of the participating households was done through a well-structured interview schedule.

In the second stage, the background of the experimental design of the study was formulated. A total of 196 women participated in the awareness campaign on cervical cancer. STATA 15 software was used to randomize the participants into three random groups. The first group and the second groups were offered Rs. 500 (treatment group 1) and Rs. 250 (treatment group 2) respectively as monetary incentives on participation in a cervical cancer screening program. The third group was the control group of the study, and no monetary incentives were provided to the members of this group. However, an awareness campaign on cervical cancer was done for all the participants of each group, and everyone was advised to visit the Sontola Health Center, which was within a radius of 2 km from the participant's households. At Sontola Health Center, a 4-day cervical cancer screening camp was organized by the Non-Communicable Disease (NCD) Cell of Kamrup (R) district. It is to be noted here that under the National Health Mission, the Government of India has been implementing *National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke* **(NPCDCS**) since 2010 up to the District level. Under NPCDCS, NCD Cells have been established at National, State, and District levels for programme management, and NCD Clinics have been set up at District and Community Health Center (CHC) levels to provide services for early diagnosis, treatment, and follow-up for common NCDs. According to the data of the Ministry of Health & Family Welfare, Government of India, there are 665 District NCD Cells, 637 District NCD Clinics, and 4472 CHC NCD Clinics are functioning till March 2020.

Thus, the participants were categorized as treatment group 1, treatment group 2, and control group through a software-based randomization process to avoid any selection bias problem and to form completely random groups. Visual inspection with the acetic acid (VIA) method, which is currently the cheapest method of screening cervical cancer, was used by the doctors of the NCD cell during the cancer screening camp. Within the prescribed timeline, the women who visited the Sontola Health

Centre for screening were categorized as the participants of the screening programme, and the rest were categorized as non-participants. Thus, the financial incentive has been injected into the study as an intervention to encourage women to accept and participate in a cancer screening programme.

2.3. Empirical model of estimation

In order to validate the results of the experiment, logistic regression was also estimated as an econometric model to statistically verify the impact of financial interventions injected into the study in two levels. In the proposed logistic model, the dependent variable is the women's decision to participate in the screening program or not, i.e. those women who participated in the screening program were assigned value 1 and those who did not participate in the program were assigned value 0. Thus the dependent variable becomes a binary variable.

The specification of the proposed model is as follows:

$$P^* = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_{10} X_{10} + \varepsilon_i \qquad (1)$$

Where,

X_1 = Type of family (1 for nuclear and 0 for joint family)

X_2 = Employment status of the respondent (1 for employed and 0 for unemployed)
X_3 = Respondent's role in household's decision making (1 for Yes and 0 for No)
X_4 = Respondent's role in decision-making on own health issues (1 for Yes and 0 for No)
X_5 = Health risk (1 for vulnerable group and 0 for otherwise)
X_6 = Respondent's educational attainment level (in schooling years)

X_7 = Total family members (in numbers) X_8 =
Wealth index (index)

X_9 = Age of the participants (in years)

X_{10} = Financial interventions (1 for high incentivized group, 2 for low incentivized group, and 0 for controlled group)

ε_i = error term; α and β are the parameters to be estimated

However, P* is a latent variable and it is not directly observable. The researcher can observe the participant's decision to participate in the screening program such that P = 1 if a woman participates in the screening program and 0 if she does not, which is observable, i.e.

P = 1 if $P^* > 0$ Or
P = 0 if $P^* \leq 0$

SPSS 13 and STATA 15 software were used for data analysis.

3. Results/outcomes of the experiment:

The literature says the RCT is a gold-standard methodology in program evaluation research. According to Henry (2010), randomized experiments are considered by most to be the closest approximation to the ideal evidence because it assigns individuals to the treated groups or untreated control groups in such a way that all the other factors that influence the outcomes are unrelated to whether the individual is treated or untreated i.e., random assignment to one or the other group can be expected to balance all of the influences on the observed outcomes other than the programme. The researcher further states that if individuals are randomly assigned to treatment, differences between the treatment group and control group on outcomes can be reasonably attributed to the effects of the program. Therefore, it is necessary to verify whether the basic characteristics of different groups are balanced or not. However, literature also suggests that significant testing of baseline differences in an RCT should not be performed (Boer et al., 2015). Following Tarozzi et al. (2014), it is decided to incorporate the baseline summary statistics and randomization test in the study. Table 1 shows the baseline summary statistics and randomization test. It is seen from the table that there is statistically no significant difference in the means (or proportion) across the three experimental arms of all the factors.

Table 2 shows women's decision to participate in a cervical cancer screen program across the 3 experimental arms. It is observed from the table that out of the total 196 women who had participated in the experiment and who were advised to participate in the free cancer screening camp, 43.40% of women attended the cancer screening camp. The experimental arm-wise result shows that about 79% of women of treatment group 1 participated in the cervical cancer screening programme. The proportion of participants in the screening program is observed at 46.20% for treatment group 2, whereas in the control group, only about 5% of women participated in the screening program. The estimated Chi-square (73.665) is found statistically significant at a 1% level of significance, indicating strong evidence of association of attributes.

Table 1: Baseline summary statistics and randomization test

Sl. No.	Variables/factors	Unit of measurement	Treatment 1 group	Treatment 2 group	Controlled group	p-value
	1	**2**	**3**	**4**	**5**	**6**
1	Type of family	1=Nuclear; 0 = Joint	0.68	0.66	0.60	0.595
2	Employment status	1= Employed; 0= Unemployed	0.24	0.20	0.22	0.838
3	Role in household's decision making	1= Yes; 0= No	0.56	0.62	0.55	0.738
4	Role in decision making on own health issues	1= Yes; 0= No	0.64	0.66	0.61	0.880
5	Health risk	1= Yes; 0= No	0.39	0.40	0.39	0.986
6	Educational attainment level	In years	7.12	6.48	5.95	0.282
7	Family size	In numbers	4.38	4.57	4.46	0.832
8	Wealth index	In numbers	0.064	-0.213	0.148	0.097
9	Age of the participants	In numbers	41.24	40.29	43.11	0.156

Note: Figures of columns 3-5 represent arm-specific means (or proportion)

Table 2: Women's decision to participate in a cervical cancer screen programme across the three experimental arms

Sl. No.	Experimental arms	Respondents				Total respondents	
		Participated	%	Not-participated	%	Number	%
1	Treatment group 1	52	78.80	14	21.20	66	100
2	Treatment group 2	30	46.20	35	53.80	65	100
3	Controlled group	03	04.60	62	95.40	65	100
Total		**85**	**43.40**	**111**	**56.60**	**196**	**100**

Relative risk ratio and odds ratio are calculated to quantify the impact of financial interventions on women's decision to participate in a cervical cancer screen programme. Table 3 shows the estimates of relative risk ratio and odds ratio between two arms. It is observed from the table that the risk of outcome in treatment group 1 is about 17 times more than the controlled group, whereas the same is 10 times more for treatment group 2 than the controlled group. If the comparison is done between treatment group 1 and treatment group 2, it can be inferred that the risk of outcome in the treatment group is 71% more compared to treatment group 2. The odds ratio presented in the table shows that the likelihood of women's participation in the cervical cancer screening programme is 76.76 times more for treatment group 1 compared to the controlled group. Likewise, the probability of women's participation in a cervical cancer screening programme is 17.71 times more for treatment group 2 compared to the controlled group. The results also indicate the odds in favour of women's participation in a cervical cancer screening programme is 4.33 times more for treatment group 1 compared to treatment group 2. Thus, the experiment shows the evidence of the positive impact of financial incentives on women's decision to

participate in a cervical cancer screening programme.

Table 3: Estimates of relative risk ratio and odds ratio

Sl. No.	Experimental arms	Relative risk ratio	Odds ratio
1	Between treatment group 1 and controlled group	17.07	76.76
2	Between treatment group 1 and controlled group	10.00	17.71
3	Between treatment group 1 and treatment group 2	01.71	04.33

In order to estimate the impact of financial interventions controlling the impacts of other independent variables on women's decision to participate in the cervical cancer screening program, a logistic regression model is estimated as an empirical model of estimation. The estimated logistic regression model is found to be significant overall at the 1% level with the calculated value of Wald Chi2 at 59.42 (Table 4). The area under the ROC curve presented in Figure 2 shows that the accuracy of the model is 88.35% (0.8835 area value). Variance inflation factor (VIF) is estimated to diagnose the multicollinearity problem and to avoid the heteroskedasticity problem, the robust standard error is estimated.

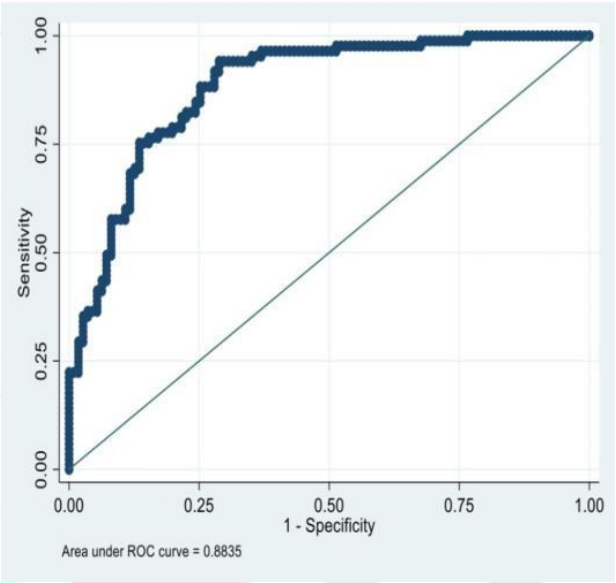
Table 4 Results of the estimated regression model

Sl. No.	Explanatory variables	Coeff.	Robust Std. Err.	z	P>z	Odds ratio	Marginal effect	VIF
1	Type of family	0.165	0.510	0.320	0.746	1.179	0.037	1.550
2	Employment status	1.297	0.509	2.550	0.011	3.657	0.308	1.130
3	Role in household's decision making	-1.122	0.443	-2.530	0.011	0.326	-0.254	1.540
4	Role in decision-making on own health issues	0.770	0.481	1.600	0.110	2.159	0.167	1.560
5	Health risk	-0.017	0.454	-0.040	0.970	0.983	-0.004	1.160
6	Educational attainment level	0.064	0.067	0.950	0.341	1.066	0.014	1.670
7	Family size	-0.056	0.152	-0.360	0.715	0.946	-0.013	1.500
8	Wealth index	0.113	0.228	0.500	0.619	1.120	0.026	1.180
9	Age of the participants	-0.023	0.027	-0.840	0.404	0.978	-0.005	1.400
10	**Financial interventions**							
	i. High incentive group	4.698	0.741	6.340	0.000	109.681	0.825	1.370
	ii. Low incentive group	3.146	0.734	4.280	0.000	23.240	0.655	1.410
11	Constant	-2.714	1.733	-1.570	0.117	-	-	-

Number of observation =196
Wald Chi-Square (11) =59.42
Prob>Chi-Square =0.000
Pseudo R^2 =0.3957
Log pseudo likelihood =−81.0556
Area under ROC curve = 0.8835

Note: Marginal effects for discrete variables are calculated at mean value.
Marginal effect is for discrete change of dummy variable from 0 to 1.

Figure: 2 Area under ROC curve



The results of the estimated logistic regression show that controlling other factors, both high and low financial incentives have a statistically significant positive impact on the probability of participation in the screening program. However, the likelihood of participation in the cancer screening program is more for the high-incentivized group compared to the low-incentivized group. The odds ratio shows that controlling other factors, the likelihood of participation of women in cervical cancer screening is 109 times more for the high-incentivized group compared to the controlled group, whereas the probability of women's participation in cervical cancer screening is about 23 times more for the low incentivized group. This study reveals the fact that higher incentives bring a higher response from participants. Thus, by introducing financial incentives as an intervention, the problem of low acceptance and participation in a cervical cancer screening program can be overcome.

The overall finding of the experiment is that financial incentives can go a long way to encourage women to participate in a cervical cancer screening program. Thus, by introducing financial incentives as an intervention, the problem of low acceptance and participation in a cervical cancer screening program can be overcome.

4. Conclusion:

Cancer is one of the leading causes of death before the age of 70 years in most countries. Although there is remarkable progress in the screening and treatment of cancer, the expenses for cancer care are still extremely high. The cost of cancer treatment comes with expenditures on prevention of cancer, cancer screening and treatment, time and effort spent by patients and their families, loss of productivity due to cancer-induced disability, and premature death due to cancer.

Out of all cancers, **cervical cancer** is found to be one of the most prevalent and deadly female cancers worldwide. Cervical cancer can, however, be prevented by detecting early symptoms of cancer. With appropriate screening procedures and awareness, the incidence and mortality due to cervical cancer can be curbed to a significant level. However, despite having some infrastructural facilities for screening, very few women are screened in developing countries due to woman's low participation and acceptance of screening programs. Thus, in spite of considerable medical progress in the field of cancer care and treatment, cervical cancer still remains a public health hazard. Therefore, an attempt is made in the study to evaluate the effectiveness of financial incentives as an intervention in increasing women's participation in a cervical cancer screening program.

A randomized controlled trial was carried out where the entire procedure of the experiment was divided into two stages. In the first stage, an intensive awareness campaign on cervical cancer was conducted, and in the second stage, the background of the experimental design of the study was formulated. A total of 196 women participated in the awareness campaign on cervical cancer. The participants were categorized as treatment group 1, treatment group 2, and control group. The first group and the second groups were offered Rs. 500 and Rs. 250 respectively as monetary incentives on participation in a cervical cancer screening program. No monetary incentives were provided to the members of the control group.

The results of the experiment reveal that financial incentives can go a long way to encourage women to participate in a cervical cancer screening program. The results from the experiment showed that the likelihood of women's participation in the cervical cancer screening programme is 76.76 times more for treatment group 1 compared to the controlled group. Likewise, the probability of women's participation in a cervical cancer screening programme is 17.71 times more for treatment group 2 compared to the controlled group. The results also indicate the odds in favour of women's participation in a cervical cancer screening programme is 4.33 times more for treatment group 1 compared to treatment group 2.Thus, by introducing financial incentives as an intervention, the problem of low acceptance and participation in a cervical cancer screening programme can be mitigated to a great extent. The policy implication here is that along with appropriate measures of providing awareness through campaigns, financial incentives will further push the acceptance rate of cancer screening among the targeted population.

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