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Improving uptake of non-communicable disease screening in Sri Lanka: Eliciting peoples' preferences using a discrete choice experiment

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Key words: Non-communicable disease, screening, discrete choice experiment, peoples' preference, health service delivery, Sri Lanka

Abbreviated running title: Peoples' choice for a NCD screening model

Key Messages:

1. The discrete choice experiment (DCE) showed that people's preferences for a NCD screening delivery model differed from what policy makers perceived to be important

in the Health Lifestyle Centre (HLC) model for screening. People highly valued the spending less than 2.5 hours at a screening programme, being ablet o access outside of the routine opening hours and having cost free screening.

2. Peoples' preferences for attributes of a screening programme for NCDs varied depending on the sector of their residence (urban, rural, estate). Thus, a one-size-fits-all model may not be the best option to increase uptake of screening.
3. Peoples' preferences for health service delivery models differed when they were apparently healthy seeking for screening services for NCDs and when they were ill and seeking health care.

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Improving uptake of non-communicable disease screening in Sri Lanka: Eliciting people's preferences using a discrete choice experiment

Abstract:

A national programme to universally screen the population between 35 – 65 years for non-communicable diseases was established at 'Healthy Lifestyle Centres (HLCs)' in 2011 in Sri Lanka. Despite several efforts by policy makers, the uptake of screening remained below 10% of the target population and with disparities in uptake across districts and among men and women. Considering service beneficiaries as a vital stakeholder, a discrete choice experiment was carried out to estimate people's preference for a NCD screening service delivery model in rural, urban and estate sectors in a district in Sri Lanka. The choice design and the general survey questionnaire was developed through focus group discussions, literature reviews and stakeholder consultations. Data was collected by stratified random sampling, with 187 participants from the urban sector, 253 from the rural sector and 152 from the estate/plantation sector. Peoples' preference was assessed as utility estimates derived using multinomial logistic regression. Reliability was assessed within test among all study participants and with test-retest among 40 participants showed 80% precision. Urban and rural sectors gave the highest priority to workplace screening over screening at HLCs. The estates attributed the highest priority for cost free screening. If cost free screening is offered with having to spend 1-2 hours at the most preferred opening times for each sector with warm and friendly staff, the uptake of screening can predicted to be increased by 65, 29 and 21 times respectively in urban, rural and estate sectors relative to having to attend HLCs from 8am – 4 pm, spending more than 2 hours and Rs. 1000 with unfriendly staff. Thus, peoples' preferences on service delivery aspects seemed to have differed from government priorities. Preferences when ill and apparently healthy differed, as they preferred to spend less time and money when healthy than when ill.

Introduction

Sri Lanka has the highest death rates due to cardiovascular diseases among the South Asian countries (IHME 2017). With an estimated prevalence of 10.7%, Sri Lanka has the second highest prevalence for diabetes in South Asia followed by India (prevalence of 10.4%) and Bangladesh and Maldives (prevalence of 9.2%) (IDF 2019). In 2017, the three highest causes of death and disability in Sri Lanka were ischaemic heart disease, diabetes, and stroke (IHME 2017). The WHO-STEPS survey, a nationally representative risk factor prevalence survey, estimated that 74% of adults between 18 – 69 years have at least one risk factor for non-communicable diseases (NCDs). High rates of at-risk people remaining undiagnosed is a common problem in Sri Lanka with nearly one fifth of hypertensive patients remaining

undiagnosed. In 2015, 51% of adults between 18 – 69 years had never had their blood sugar checked and 70% had never had their blood cholesterol checked at least once in their lifespan (Ministry of Health 2015).

Screening for NCDs and its' risk factors offers an opportunity for the people to understand their level of risk, and the healthcare providers an opportunity to offer interventions, including lifestyle modifications and treatment (World Health Organization 2013). Sri Lanka has shown its commitment to promote early detection of NCDs by including it in the national policies from early 1990s (Presidential Task Force for formulation of National Health Policy 1992). Following pilots of several implementation models, in 2011 a universal screening programme for all apparently healthy people between 40 – 65 years was initiated with "Healthy Lifestyle Centres" (HLCs). These were established in government sector primary care hospitals to provide screening and health education for NCDs free of charge (Mallawaarachchi et al, 2016). By 2019, 1005 HLCs were functioning at least one day per week throughout Sri Lanka (NCD unit, Ministry of Health 2020).

However, the service utilization of HLCs remains low. From 2011 to 2018, coverage of the target population by HLCs, had increased only from 2.6%, up to 10% (NCD unit, Ministry of Health, 2020). The STEPS survey indicates that nearly 9% of the population has a cardiovascular risk more than 30%, but HLCs have only detected 1% of the attendees with a cardiovascular risk of more than 20% (Ministry of Health, 2015, NCD unit, Ministry of Health, 2020). It should be noted that there is no mechanism to collect this data from the private sector. There is considerable variation in the level of utilization across districts. In 2019, the average utilization of screening by the total target population was 7%, but the variation between districts ranged from 1.5% to 17%. The variation by gender was significant. Men comprise 49% of the Sri Lankan population but only 30% of the screened population (NCD unit, Ministry of Health 2020). Understanding why this variation exists is key to designing attractive, people centred NCD screening services. An internal review by programme managers and experts (Mallawaarachchi et al, 2016) and a survey of HLC's (Weerasinghe et al, 2016) identified several factors contributing to the low uptake of services. Limited dedicated human resources at HLCs, opening hours conflicting with working hours of the target population, and the non-availability of a total screening package were some of the issues. Over the years, some policy measures have been adopted to address these, such as increasing availability of human resources at HLCs, streamlining procurement of testing

strips and increasing the number of clinics. Despite these, the coverage of the target population remained at 10% in 2019 (NCD unit, Ministry of Health, 2020).

Increasingly, service beneficiaries are being recognised as a dominant stakeholder in planning health services, as their perspectives on barriers they face, and the solutions they propose can improve acceptability and use of a service (WHO 2016). DCEs are a quantitative method based on economic and consumer theories to measure preferences for services or products. This approach is particularly informative for services that are not yet implemented or have aspects which do not exist (Mc Fadden 1973). In recent decades, DCEs have been used widely to elicit patients' preferences for health service configuration for primary care services and delivery (Clark et al. 2014). Quaife *et al.* (2018) found that DCEs can be effectively used to predict uptake behaviour with a sensitivity of 88% and predict behaviour that will be foregone with a specificity of 34%. With regards to preventative care and screening programmes, DCEs have been used to elicit preferences for breast cancer and colorectal cancer screening (Hol et al. 2010; Mandrik et al. 2019), for lifestyle modification programmes for diabetes patients (Veldwijk et al. 2013) and for consultation process preventive health checks (Larsen et al. 2020). We were unable to find previous literature using DCEs to explore people's preferences for aspects of a service delivery model for NCD screening, despite the important role that preferences play in the success of such a programme. We report on a study conducted to ascertain people's preferences for a service delivery model for NCD screening in Sri Lanka and examined heterogeneity in preferences among different societal contexts and strata, which would contribute to policy recommendations to strengthen NCD screening in Sri Lanka. In addition, we demonstrate the reliability of the DCE design and contribute to wider knowledge-base on the use of DCEs in a LMIC.

Methods

The study setting selected was one district out of the 24 districts in Sri Lanka (Kalutara) which has representation of urban, rural and estate sectors that are closer to the national distribution and screening utilization by the target population (5.8%) close to the national average. Urban sector is defined as belonging to a municipal or an urban council area. Estate sector is defined as areas with plots consisting of more than 20 acres (8 hectares) of land of tea, rubber, coconut or palm plantations and having more than 10 residential workers. Rural sector is the remaining areas of the country (Department of Census and Statistics 2012).

Attribute development using mixed methods research

Best practice in attribute generation and reporting recommended in Coast *et al*. (2011) was followed. We used a literature review and focus group discussions (FGDs) to develop an extensive list of attributes and attribute levels. Six FGDs were conducted in their local setting by the principal investigator with approximately 10 – 15 participants in each group. The subgroups selected and the reasons for selecting the subgroups are given in detail in Additional file 1. To identify the health service delivery aspects/attributes perceived as important by the non-attenders to NCD screening, nearly ¾ of the FGD participants were recruited using the case definition; people between 35-65 years of age, with no history of high blood pressure, diabetes mellitus, dyslipidaemia, ischaemic heart disease and stroke, and who have not undergone comprehensive screening for NCDs, including Body Mass Index (BMI) assessment, blood pressure assessment and at least blood sugar assessment in the past three years. One fourth of the FGD participants were targeted to be recruited from those who have been recently diagnosed with either high blood pressure, diabetes, heart disease or all, so that they are able to provide valuable inputs for the discussion on how they got screened and what attributes supported their access to services. A purposive sampling was done to recruit a mix of men, women, in different target age groups, who are generally utilizing either government sector or private sector healthcare, or both. The area Public Health Midwife (PHM) supported in recruiting a well conversant group of people who are likely to be comfortable with each other. As the socio economic context, disease burden and access to healthcare are different in the three sectors (urban, rural and estate), three FGDs were conducted in these three regions. One FGD was restricted to males, to identify probable attributes to address the issue of low uptake of screening by men. One other FGD was restricted to recently diagnosed patients under treatment to elicit their experience with diagnosis and follow up. The final FGD was held in a suburban area with a mix of participants by gender and economic status that was approximately similar to previously conducted FGDs to prioritize the attributes and identify attribute levels.

Characteristics of the participants in the FGD are given in Additional file 2. All FGDs were audio recorded with consent. They were transcribed verbatim, translated to English and transferred to NVIVO 12 to support analysis. Thematic analysis (Braun & Clarke 2006) was conducted to identify the main themes related to health service delivery aspects/attributes perceived as important to utilize NCD screening services.

A panel of stakeholders and domain experts consisting of an expert in DCE studies, two health system researchers, four public health specialists at the primary care reform unit and NCD unit of the Ministry of Health, a health economist, a district technical lead on NCDs at the regional health office, and two primary care level doctors assessed the attributes and attribute levels derived from FGDs for relevance from a policy perspective, feasibility of adoption, conceptual independence of attributes and attribute level inter-relationships. Wordings of the attributes were directly obtained from the FGDs in local language. They were later translated to English for the purpose of recording it here. The finalized attributes and levels agreed are shown in Table 1.

TABLE 1 HERE

DCE design

Two experimental designs were used, one to accommodate "workplace screening" as an attribute level for "setting of screening" and one design without this attribute level. A definition was developed with stakeholder consensus to give the choice set with workplace screening to "people in formal employment in institutions that have at least 30 employees" to allow an efficient screening programme to be conducted. The other choice set without workplace screening, but similar in all other attributes and levels were given to people in informal employment or unemployed. One choice set consisted of 10 tasks used for the analysis of the DCE, with each task having two alternatives of health service delivery models and an opt-out of no screening. A fractional factorial design in which level balance, utility balance, minimal overlap and orthogonality was achieved to the best possible level was developed for the pilot study. The pilot study data was analysed in a multinomial logit (MNL) model to construct a D-optimal efficient design (Street et al., 2008) for the main survey. The D-optimal design is estimated through NGENE software by selecting the design that has the lowest D-error, which in turn gives the lowest possible standard error for the utility estimates (Choicemetrics 2018).

Questionnaire development and pre-testing

The questionnaire had sections to collect socio-demographic and socio-economic data, the DCE choice set, and health seeking behaviour data. The questionnaire was developed in the local language, using standard questions in existing validated tools such as Household

Income and Expenditure Survey and the WHO STEPs survey conducted in Sri Lanka (Department of Census and Statistics 2016; Ministry of Health 2015). An interviewer administered questionnaire was built in Epicollect 5 software platform for data collection. The choice tasks were printed on paper with pictorial representations for easy interpretation (Figure 1). The scenario of each alternative option was explained to the study participant by the interviewer following a standard format (an example of two scenarios are given in Additional file 2).

FIGURE 1 HERE

The questionnaire was content validated and piloted in 40 participants drawn from urban, rural, estate sectors from a region neighbouring the study setting. In the pilot, we assessed comprehension of the choice tasks by the participants by using a think aloud method, manageability of the number of choice tasks, feasibility of implementing the sample selection by the data collectors and the time taken to complete the questionnaire. No changes were made to the attributes and levels, but the order of presentation of attributes was changed for better comprehension, pictorial designs were refined and reliability checks were added as described below.

Data collection

Data collection was conducted in Kalutara district. Inclusion criteria were people between 35-65 years of age, with no reported past history of high blood pressure, diabetes mellitus, dyslipidaemia, ischaemic heart disease or stroke, and who have not undergone at least two of the following assessments for NCDs; BMI assessment, blood pressure measurement, blood sugar and cholesterol testing during the past one year. Sample size calculations for DCE studies are still evolving with no single equation that is widely accepted (de Bekker-Grob et al., 2015). Therefore, we aimed to fulfil a few criteria based on previous literature. Johnson & Orme (2003) had suggested a minimum of 200 for each subgroup. de Bekker-Grob et al, (2015) had recommended calculating the sample size following a pilot study, and then by analyzing the stated preference (Sp) statistic using the NGENE software. The Sp statistic estimated a minimum sample of 124 to provide significant parameters at the 5% level. Considering the sampling method planned was stratified cluster sampling, a design effect of 1.5 was added (WHO, 2017). Allowing for 10% non-response, we aimed to collect a

minimum sample of 204 from each of urban, rural and estate sectors.

The household survey was conducted using stratified cluster sampling method. A *Grama Niladhari* division (GND), the lowest level administrative unit in Sri Lanka was taken as a cluster unit. The sampling frame was made by obtaining the total list of GNDs in each sector in Kalutara District. Sixty GNDs, with 20 from each sector (urban, rural, estate) was randomly selected. Each selected GND was further segmented into smaller areas of approximately 30 houses, using Google satellite mapping view. One of these segments were randomly selected. A trained data collector moved in a pre-determined direction checking every house for an eligible participant until the sample was fulfilled. Enumerators were given a target of 11 to be collected from each GND with at least four men and three in formal employment.

The data collectors provided information in the information sheet about the study and obtained consent. The data was collected between September to November 2019. The data in Epicollect 5 was uploaded daily, and the principal investigator ensured data quality by reviewing a sample of records each day. The data was then transferred to STATA 15 for coding and analysis.

Data analysis

The DCEs are built upon two theories, the random utility theory and consumer theory. The random utility theory (Marschak 1960), explains that all individuals have a preference when choosing a product or a service. We assume here, that when an individual (i) is faced with two options/alternatives to select from (alternatives j and c), the individual chooses what gives them the maximum satisfaction/ utility (U*i*). The utility of an individual *i* by choosing the option *j* over *c* (U*ij)* is derived from an observable component (V*ij*) and an unobservable component (ε_{ij}).

$$U_{ij} = V_{ij} + \varepsilon_{ij} \quad (1)$$

Lancaster (1966), stated that goods or services are made up of a combination of characteristics/ attributes (X = 1,2,3,4, ..k) that gives the person a utility value.

$$V_{ij} = \beta_{oij} + \beta_{1ij}X_{1ij} + \beta_{2ij}X_{2ij} + \beta_{3ij}X_{3ij} + \cdots\cdots\cdots + \beta_{kij}X_{kij} + \varepsilon \quad (2)$$

β_{1ij} is the co-efficient associated with the characteristic/attribute X_1 of the alternative *j* for the individual *i*. The random component is assumed to have an independent and identical distribution (IID) allowing β to be estimated with logit models (McFadden 1973).

The three sectors (urban, rural, estate) were analysed separately using MNL models. Except for the Cost of screening and Time Spent variables, the attributes were dummy coded. The cost of screening and time spent variables were treated as continuous variables. However, when interpreting these two variables, the co-efficient values were multiplied by the values used in the choice designs (eg: Cost of screening Rs. 1500 is interpreted as β of cost of screening* 1500) to indicate the relative utility lost for commonly anticipated cost and time values spent at screening programmes relative to the reference value. The sign of the coefficient indicates a positive or negative effect on utilities relative to the reference category. The value provides an indication to the relative importance of the attribute level, relative to the reference category within each of the models (Hensher et al, 2005, Mangham et al, 2009, WHO 2012).

The policy impact is measured by the predicted probability change in uptake of screening because of a change in one of the attribute levels keeping the others constant. Thus, the predicted probability value (P_{ij}) indicates the difference in percentage probability of uptake of screening of individual *i* choosing *j* alternative over *c*. This was assessed by taking the exponent of the utility of alternative *j*, divided by the sum of the exponents of all available alternatives (*j* and *c*) in the choice set.

$$P_{ij} = \frac{\exp(X_{ij}\beta)}{\Sigma_J \exp(X_{ij}\beta)} \quad (3)$$

Willingness to pay (WTP) for marginal improvements in attributes assess the monetary value an individual is willing to pay to have one attribute over another. This was estimated along with the confidence interval for attributes that showed a significant preference by taking the ratio of the coefficient of an attribute to the cost attribute (Bridges et al. 2011; Ryan et al. 2012).

We explored to see if the differences in utilization observed in the current screening programme between gender and socio economic status would show a considerable effect in these choice designs. Based upon priori hypothesis derived using literature and findings from FGDs, socio-demographic, socio-economic and health seeking behaviour variables were selected and added as interaction terms to the regression model. As utilization of screening services are historically noticed to be low among men, sex was interacted with attributes behaviour, time of access and time spent at screening. The monthly household income was interacted with the cost of screening, behaviour and time spent. The method of receiving

payment was interacted with the time of access and time spent. Previous experience of healthcare usage was interacted with the place of screening. Level of education was interacted with attitude and behaviour. These interactions were added one at a time to the regression model to assess what characteristics may play a role in changing preferences to the main attributes. A model with all interaction terms were not considered due to limitations of sample size. Based on substantive needs of the program we selected some significant interaction variables for the MNL analysis.

Reliability assessment

Reliability of the DCE design was assessed with two methods, within the choice design and by test- retest. Following the 10 choice sets used for the MNL analysis, two extra choice sets were included for within test reliability assessment. The 11th task was a dominant task created by the researchers to assess rationality in responses (Johnson et al. 2013; Trevonen et al. 2018) The 12th task was a repeat of the 3rd task to assess reliability of responses (Mangham et al. 2009).

The test- re-test reliability was assessed in 40 participants with a gap of two weeks between the first assessment and the second. Percentage compatibility was assessed for each participant and an average obtained. A value of more than 80% was considered to provide a good reliability (Rigby et al. 2015). McNemars' Chi Square test was conducted (Ryan et al. 2001; Skjoldborg et al. 2009) to assess if there was a difference between individual responses in the two surveys.

Results

Results of the FGDs are presented first, followed by results of the household survey of the DCE.

FGD analysis

A total of 63 participated in the six FGDs. The mean age of the participants was 47.3 years (SD = 8.3) with 47% in the 35 – 45 age group. Fifty percent of the total sample were men. Fifty one percent of the participants were employed, either in daily paid, monthly paid or contract work. Eighty four percent were not diagnosed with a chronic disease or undergone any testing within the last year. Details of the characteristics of the participants are given in Additional file 3.

Eight main themes were derived from the FGDs that contributed to the development of attributes and attribute levels.

The time spent at a screening programme: Due to majority of the participants feeling apparently healthy, they preferred to spend as minimum time as possible at a screening programme. Participants from the estate sector were specially more concerned of the time they had to spend on multiple visits to a healthcare provider to complete screening as they usually live far away from main roads. People in urban and rural sectors expressed a willingness to pay extra to spend less time at a screening programme.

> *"Now it's (life) a race with time. If we have to spend 2 -3 hours at a screening centre it's not worth it. If I have some illness, then its justifiable." [Urban sector FGD, 30 – 40-year-old, male, daily paid worker]*
> *"I have to take my children to school, bring them back and do all the housework, I can spare about an hour or two for this. Even when I think of my husband, he will have to go to the job in the morning, they would only expect to spend an hour or so." [Rural sector FGD, 40 – 50-year-old, housewife]*

Time spent at consultation with the healthcare provider: Overcrowded clinics has led to the time spent with the healthcare provider to be very limited. Participants expressed that they tend to select healthcare providers who gave an adequate one to one time.

> *"When I go to the doctor, I like to at least have 20 minutes, explaining things to me. The doctors at hospital are not explaining things to us". [Rural FGD, 40 – 50-year-old, housewife]*

A convenient access time: Preferences varied across individuals based on their employment types and family responsibilities. Some preferred standard opening hours of the government sector clinics (8am – 4pm), while some preferred weekends, early mornings, or evenings.

> *"If this clinic stays open till about 8 pm, at least on a few days a week, for people to come after work it would help." [Urban FGD, 30 – 40-year-old, Male, self-employed]*
> *"If it's open on Saturdays and Sundays it will solve many of these problems. The problems are there for us in weekdays and the government hospitals are also open on*

weekdays." [Suburban Sector FGD, 40 – 50-year-old, man, self-employed]

Cost of screening: Participants expressed that screening had costed them somewhere between Rs. 400 – Rs. 3000 in the private sector (1 USD = 180 Sri Lankan Rupees). Some expressed their preference for free government services, while some employed participants identified voucher schemes available at the workplaces as helpful.

Attitude of the healthcare staff: Disrespectful attitude and behaviour of health staff was identified as a major influencer in making choices. Participants were willing to forego free services in nearby government hospitals and spend on transport to access tertiary care services provided by the government, or private sector to be treated with dignity and respect.

> "*If we do it (screening) here (in the community hall), people will come. They don't want to go to the hospital. You should see the attendants and their attitudes. He's just a labourer." [All mens' FGD, 40-50-year-old, in formal employment]*
> "*It is much better to pay Rs. 1000 to a tuk tuk and go to the xx (tertiary level) hospital. They treat us nice." [Rural FGD, 40-50-year-old, housewife]*

Setting for screening: Many formally employed participants preferred screening offered for a low cost or no cost at workplaces. Only three participants out of the total had accessed HLCs at government hospitals. Community level screenings and private providers closely known to them too were preferred by many.

Felt need to undergo screening: Unwillingness to undergo screening was attributed to lack of an unwell feeling and lack of awareness on NCDs. Men expressed an inclination towards risk-taking behaviour with not seeking health care early enough to prevent a serious illness or dying. Further, the sense of losing freedom, feeling of being inferior among the family members had impacted their health seeking behaviour.

> "*We don't take these illnesses seriously. We are not afraid of these illnesses." [Urban FGD, 40-50-year-old, male, daily paid worker]*

Quality of screening: Few participants expressed their experience with poor quality

screening as a result of incorrect reports from glucometers and strips. This had caused inconvenience by having to repeat testing and caused dissatisfaction to utilize screening.

Two thematic areas, "the felt need for screening" and "quality of screening" were removed following stakeholder consultations. The felt need for screening needs to be addressed with health promotion activities which are outside the purview of this DCE. Stakeholders expressed that ensuring good quality screening should be an essential component and not an option, thus quality of screening was removed from the attribute list.

Community Survey for the DCE

Characteristics of respondents

A total of 634 households; 205 in urban sector, 264 in rural sector and 165 in estate sector with an eligible participant were visited. In the estate sector, the sample was only collected from 15 GNDs, thus fulfilling only 81% of the required sample size as some of the GNDs had mostly areas with plantations and not adequate residential areas to derive the sample from. In the rural sector, to achieve the desired representation of men and women and people in formal employment, a higher number of households were visited than the minimum estimated sample size. A total of 592 respondents, with 187 from urban (response rate, 89%), 253 from rural (response rate, 94%) and 152 from estates (response rate, 92%) were in the study sample (See Table 2). Approximately half of the sample population were male, and the average age was 48 years. Three quarters of the urban population (n=140) and 66% (n=167) of the rural population has had an education higher than GCE Ordinary Level (Grade 11) examination. However, in the estate sector 80% (n=121) of the sample had not completed school up to Ordinary Level examinations and 40% (n=61) had not completed education beyond primary school. Fifty seven percent (n=107) of the urban sector and 39% (n=60) of the estate sector sample reported that they have last accessed a private provider for their ambulatory care needs. More than 40% (n=276) of the study participants across all three sectors perceived a private provider as their usual healthcare provider for ambulatory care needs. Other than the educational attainment which showed to be higher in the study sample, other characteristics were aligned with the general characteristics of the three sectors in Sri Lanka (Central Bank of Sri Lanka 2019).

TABLE 2 HERE

Choice analysis

Choice data analysis was conducted on the selections made on 10 out of the 12 choice tasks. The reliability assessment using the last two choice sets are reported separately. The choice design with the extra option of 'workplace screening' with all other attribute levels being similar to the other design, was received by 63 participants (33.7%) in the urban sector, 63 participants (24.9%) in rural sector and 54 participants (35.5%) in estate sector.

Results from the MNL model is given in Table 3. Most of the attribute estimates were statistically significant at 95% level indicating that these selected attribute levels were important for the utility of people relative to the reference level. The 'opt-out' alternative was selected only in 6% of the tasks.

In the urban and rural sectors, workplace screening was valued the most (β=2.10, $p<0.01$ and β=1.34, $p<0.01$ respectively). In the urban sector, second highest priority was given to the attitude of health staff, with disrespectful and rude attitude and behaviour had cause to loose utility significantly (β = -1.75, $p<0.01$). The third highest priority was given to spending half an hour or less at a screening programme relative to spending two hours or more (β = -1.41, $p<0.01$). The rural sector, gave similar priorities for attitude of health staff and time spent half an hour or less relative to two hours or more (β= 1.33, $p<0.01$) at a screening programme. Coefficients for cost of screening indicates the utility lost for each increment of cost by a Rupee (1 USD = 180 Sri Lankan Rupees). Cost of screening was shown to be the highest priority in the estate sector, where having to spend Rs. 1500 compared to cost free screening had caused to lose utility the most (β= -1.35, $p<0.01$). Even having to spend Rs. 1000 for screening had ranked as the fourth most important attribute in their choices (β= -0.9, $p<0.01$). Different access times were preferred by each sector. The urban sector had significantly preferred only Saturday morning, while the estate sector had preferred weekday mornings compared to routine opening hours of government hospitals from 8am – 4pm on weekdays. The rural sector preferred all access time options presented rather than routine day time opening hours.

TABLE 3 HERE

Predicted probability of uptake of screening

Predicted probability ratios for uptake of single attributes, that showed significant co-efficient values for utility, holding other attributes constant are given in Figure 2. In the urban and rural sectors, the highest difference in the probability of uptake was shown for workplace screening relative to at HLC. The second highest gain for the urban sector can be achieved by improving the attitude and behavior of health staff. Reducing time at screening and cost by Rs 1500 provided similar gains to urban and rural sectors. The probability gains predicted by improvement in staff behaviour, and time spent were lower in the estate sector. The reductions in cost of screening is likely to produce highest gains in the estate sector. As the government mandate to sustain the HLCs will not change in the near future, the study aimed to seek additional strategies that would improve the uptake of screening at HLCs. Thus, two scenarios were assessed to estimate the probability of uptake if multiple attributes were improved keeping the site fixed as HLCs (details in Additional file 4). If cost free screening was offered with having to spend 1-2 hours at the most preferred opening times for each sector with staff treating the participants warm and friendly, the uptake of screening can predicted to be increased by 65 times in the urban sector, 29 times in the rural sector and 21 times in the estate sector relative to having the HLCs opened from 8am – 4 pm, spending more than 2 hours and more than Rs. 1000 with unfriendly staff.

FIGURE 2 HERE

Willingness to pay (WTP) for different attributes

A positive WTP indicates the monetary value that respondents are willing to pay to get the desired attribute level and a negative WTP indicates the monetary value to be compensated to have a certain attribute level, compared to the reference category (Details in Table 4). The urban sector is willing to pay Rs. 1918 to avoid disrespectful attitude and behavior, while the estate sector is willing to pay Rs. 982 for the same. All sectors were willing to pay more than Rs.1300 to spend less than half an hour at screening than to spend more than 2 hours.

TABLE 4 HERE

Preference heterogeneity for identified respondent characteristics

Possible heterogeneity in preferences was assessed between selected attributes and sex, level of income, method of payment in employed, level of education, and perceived provider for usual ambulatory care needs (Details in Table 5). Significant heterogeneity in preferences

were found in urban and estate sectors. Males significantly lost utility by spending more time at a screening programme than women. People who had a daily paid job in the urban sector significantly did not prefer to spend more time at a screening programme. People with a higher income and a higher education (GCE O/L or higher) lost more utility by experiencing disrespectful and rude behavior than people who had a lower income and education. Women, experienced a significant negative utility by disrespectful attitude and behaviour compared to men. In estate sector, people who have considered a private provider as their usual health provider did not significantly prefer a private setting for screening. The results of a model following purposive selection of a few significant interactions (at $p < 0.05$) is given in Additional File 6.

TABLE 5 HERE

Reliability Assessment

Within experiment reliability revealed, 85% participants selected the dominant task as expected and 87% chose the same option they chose earlier on the repeated task; these are in line with other published studies (Quaife et al. 2017; Tervonen et al. 2018).

Test – retest assessment was conducted on 37 participants (response rate 92%), who made choices for the 3 alternatives (Option A, B and the opt-out) across the 12 choice tasks. The total selections made was 440 out of 444 (37*12) choice selections. Percentage agreement was 86% for the choice sets given to the formally employed which had workplace screening as an option and 80% for the other choice set. The extended McNemar test revealed a probability of 0.17, thus, no significant difference in the choices made between the two DCE surveys (see Table 6).

TABLE 6 HERE

Discussion

For nearly a decade since the establishment of the government funded programme dedicated for NCD screening in Sri Lanka, the highest coverage reached was 10% of the target population. In the last few years many supply side strategies and measures were adopted with the aim of increasing coverage, but the attention given to demand side preferences had been insufficient. This is the first study to provide evidence from the peoples' perspective. To the

best of our knowledge, it is the first study to consider stated preferences for service delivery aspects of NCD screening in a LMIC.

The option of obtaining workplace screening, compared to screening at HLCs showed the highest preference among the formally employed in an institutional setting in urban and rural sectors. Given that, 41% of the 'economically active' are in formal employment (Department of Census & Statistics 2019), providing workplace screening facilities provides the best option to increase NCD screening coverage. Community level screening was the second-best option for the setting of screening by the urban sector. In urban and sub urban settings in Sri Lanka, most employed people commute to work. Therefore, options that provide screening closer to their home or workplace can be expected to provide a higher utilization. However, in policy and program implementation, workplace or community screenings is a difficult strategy to implement due to the inability to ensure delivery of quality services with the full package of screening. Implementing an outreach clinic requires additional resources to coordinate public health field staff who are attached to the preventative care units and the HLC staff in the curative care hospitals. Such coordination is lacking in most regions resulting in inability to either reach out to the community effectively by the curative care staff or delivering a quality programme by the preventative care staff due to lack of laboratory facilities and training (Karunaratna, 2021). Studies done in India and Kenya, piloting outreach clinics in workplaces and at community centres had reported an increased uptake in the initial step of screening, but low follow up rates for confirmatory tests to the clinics (Dyavarishetty & Kowli, 2016; Pastakia et al, 2013). This supports the need to continue providing easily accessible settings for the working population throughout the process of screening, diagnosis and follow up. It was unexpected to find no significant preference for workplace screening among the estate sector population, considering that a higher proportion of men and women were employed in the estate itself. It may be that previous experience with health service provision by different estate managements or the non-preference to have the management find out the chronic diseases the employees may have contributed to the choice selections.

A household survey done in Western province (World Bank Group, 2017), showed that nearly 31% had accessed an out-patient provider for healthcare within the previous 30 days and two thirds of it had been to a private provider. In this study sample, more than 30% of all sectors had accessed healthcare within the previous 30 days and 58% of participants in the urban sector had chosen a private provider for their ambulatory health needs for their last

visit. Though, the urban sector showed a positive preference for private providers for NCD screening it was not found to be significant. Respondents in rural and estate sectors did not prefer a private setting for screening relative to HLCs. Utilization of free government sector services for ambulatory care was seen highest among the estate sector study sample. This finding is similar to data from the national consumer finance surveys that the estate sector was unlikely to utilize private sector compared to urban and rural sectors even when adjusted for income levels (Pallegedara & Grimm, 2017). This was further confirmed in the analyses to assess heterogeneity in preferences, which showed the estate sector people who perceived a private provider as their usual provider for ambulatory care, did not prefer a private provider for screening.

Cost of screening had also contributed considerably to increase the predicted probability of uptake in all three sectors, though the priority level in each sector varied. The estate sector which is the poorest of the three sectors attributed price the highest priority, while the urban sector, the richest, prioritized it as the fourth important attribute. However, the interactions showed that the level of income did not have a significant effect on the preference to spend on screening. Healthcare is usually considered price inelastic, especially when people are ill. However, preventative care which includes screening for diseases which are asymptomatic and are in early stages are known to be price sensitive as these are likely to be perceived a non-essential need (Ringel et al. 2002). Though, the Household Income and Expenditure survey of 2016 (Department of Census and Statistics, 2016) had shown that a household on average had spent Rs. 2500 (7% of their monthly household expenditure) on personal and healthcare in a month, this study revealed that people in all sectors did not prefer to pay for screening.

The attitude of health staff was found to be an important attribute in choice decisions to attend NCD screening in all three sectors. This was expressed as an important concern affecting their choices in the FGDs and some even expressed a willingness to pay out of pocket to attend service providers who they thought have a kind attitude and behaviour. However, urban and rural sectors have given this attribute a higher priority than the estate sector. Both urban and rural sectors had a population with a higher educational level and income relative to the estate sector. People with higher disposable income and education have, higher expectations of responsiveness from health systems (Atun et al. 2013; Malhotra & Do 2013; Mannava et al. 2015; Rice et al. 2011). The preference heterogeneity results showed, females in the estate sector were more sensitive to a poor attitude by health staff

compared to men. Weerasinghe & Bandara (2015) had stated that, though more women in estate sector are economically active compared to other sectors, some of these women have no access to their income or have decision making power. Thus, being socio-economically deprived and being women may have placed them in a vulnerable position subjecting them to disrespectful behaviour by health staff. From a policy perspective, the need for improved attitude and dignified treatment of patients in government sector institutions has been addressed in policy documents in the health sector from 2000 (Ministry of Health 2003; Ministry of Health, Nutrition and Indigenous Medicine 2016). The findings of this study provide evidence that it has not yet being resolved and would add significant gains if its improved and perceived as improved by the service beneficiaries.

A consistent overall gain in probability of uptake could be predicted with reducing time spent at screening to half an hour or less. Soule (1957) explains when people are in a higher socio-economic status, their 'opportunity cost' of losing leisure time is relatively higher compared to a person with a poor socio-economic status. For some others, more time spent at screening may mean 'opportunity lost' of time available for earning. The level of income, sex, or method of payment as assessed for interactions showed no significant heterogeneity in preference for the time spent attribute.

An important finding of this study was that there was no specific preference for the person who conducts screening. It was an unexpected finding, since in FGDs, specially in the urban sector and rural sector FGDs, preference for a familiar doctor was expressed. One possible explanation may be that, if people perceives themselves to be more at high risk with being smokers and who consumed alcohol in excess, due to the attached cultural stigma, they may not have preferred to divulge the information to a familiar doctor. However, this non preference will support a strategy of utilizing staff other than doctors such as community nurses to conduct the NCD screening programme in primary care hospitals.

The DCE findings in this study can be considered internally valid due to the comprehensive methodology followed in constructing the attributes. (Bridges et al. 2011; Janssen et al. 2017). External validity is fulfilled if the choices made are more in line with the choices made in the real world. As the study utilized hypothetical service delivery models to assess preferences, the exact revealed preferences for this study cannot be assessed. In addition, we conducted reliability tests that showed more than 80% precision. The key findings can be used for future policy and program implementation decisions in Sri Lanka. The study also

contributes to the wider literature on DCE and specifically on its application to NCD screening in LMICs.

Limitations

The sample size was estimated following probability estimates derived from the pilot study and also considering other 'rule of thumb' measures (de Bekker-Grob et al. 2015). Though we considered clustering effects in the sample size estimates, we did not include analysis techniques to account for clustering. Further, we did not include interaction effects when estimating sample size. Although the sample size achieved was greater than that required to detect significant main effects in the DCE, the lack of significant interaction effects may be due to small sample size. The 'opt-out' option was selected only in 6% of the choice tasks. The way the choice tasks were presented or the socio-cultural reluctance to reject an offered option, may have made the participants feel more obliged to make a choice than to select "opt out". The inclusion of the cost attribute gave us considerable advantages in the analysis, including allowing us to estimate willingness to pay for attributes. As the government healthcare in Sri Lanka does not generally charge a fee, it may have contributed to people associating high cost of screening to private healthcare providers, thus not preferring private healthcare for screening. The data are analysed using MNL regression which requires the assumption of independence of irrelevant alternatives, however the use of interaction terms to explore preference heterogeneity may mitigate this.

We did not consider pooling the results across the three sectors or testing for significant differences across the three sectors (urban, rural and estate), as the sampling method was more focused on deriving preferences that are unique to these three sectors.

Conclusions

The DCE study explored peoples' preferences from a set of hypothetical scenarios based on selected attributes of a NCD screening program in Sri Lanka and estimated priorities in preferences in three sectors, urban, rural and estate. At a time when the government is embarking on a primary care reform and implementing its NCD strategy for screening this evidence is timely to inform implementation policies to make them more aligned with peoples' preferences to maximise uptake.

Peoples' priorities in selecting attributes of a NCD screening health service delivery model differed according to the sector they are living in. Urban and rural sectors gave more priority

for workplace screenings, and attitude and behaviour of staff, while the estate sector gave more priority for cost free screening and time spent on screening. This study showed that people's priorities are not always aligned with the governments focus areas in expanding service coverage and that their preferences of health seeking when people feel ill and when they are healthy are likely to be different. The study findings provide new evidence for policy and implementation to improve the low uptake of NCD screening in HLCs in Sri Lanka.

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figure 1

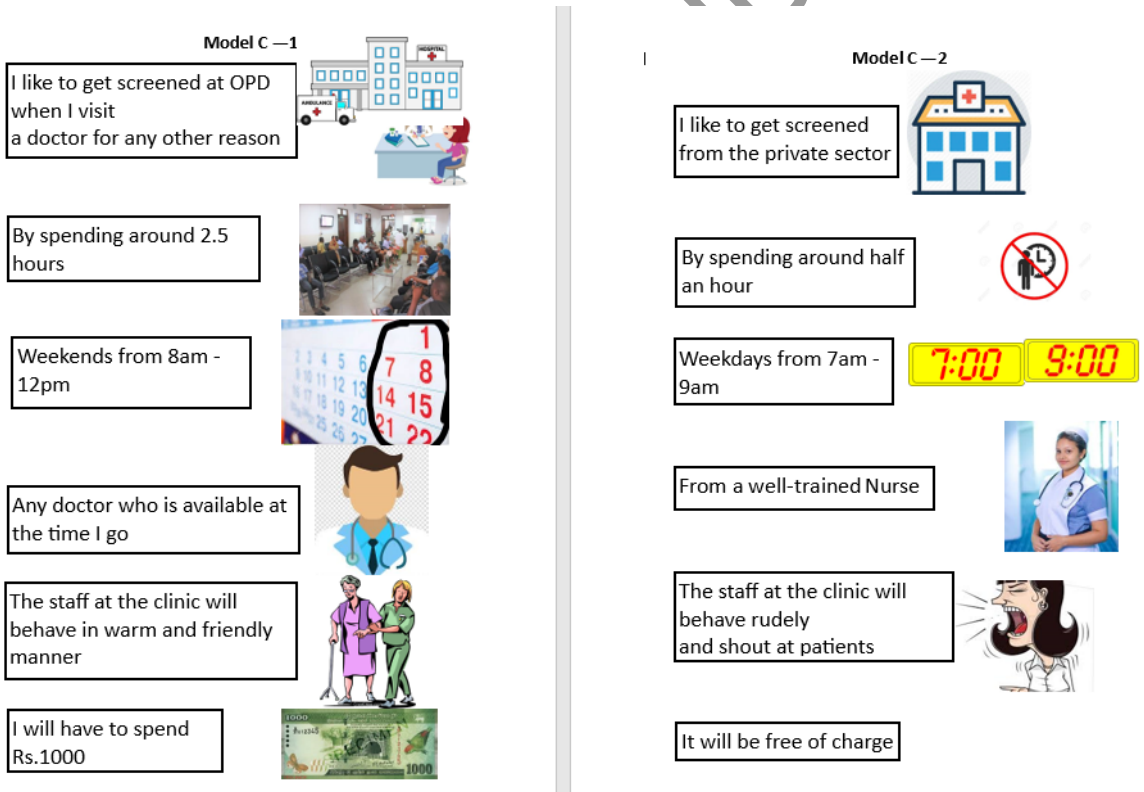

figure 2

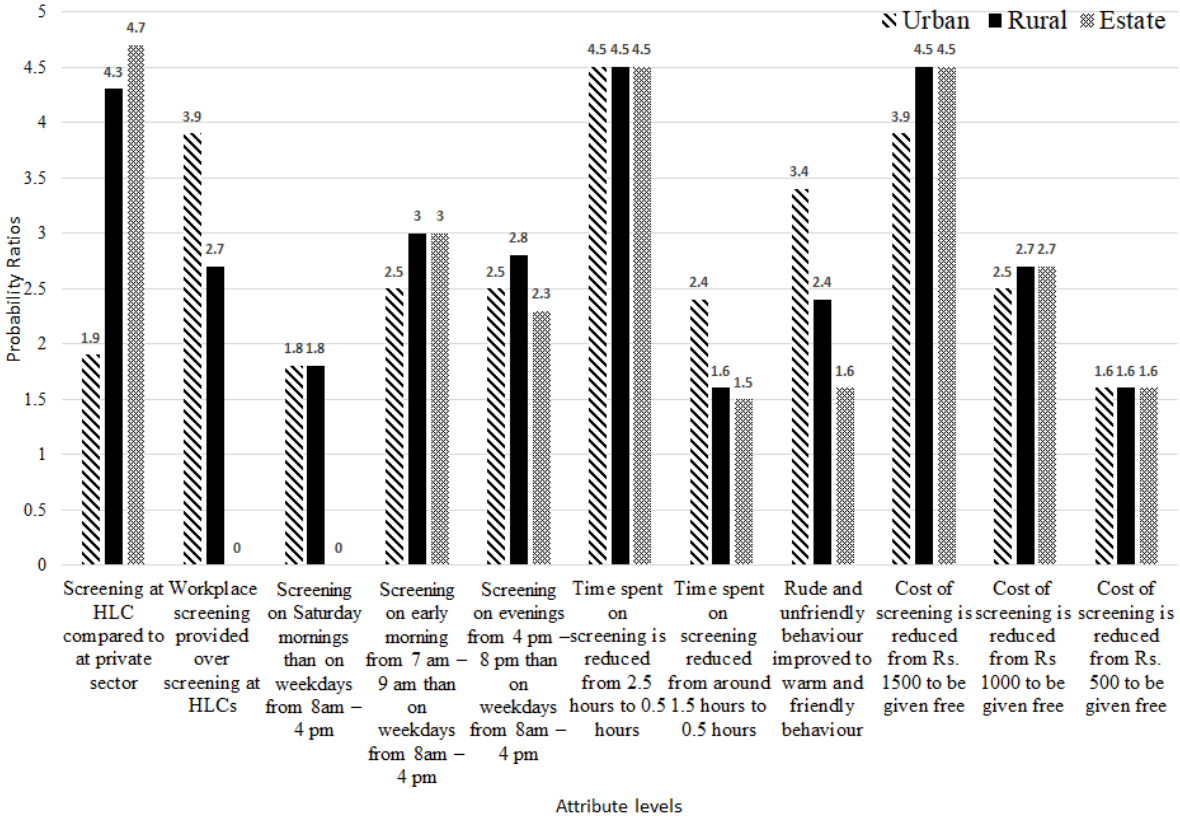

Table 1. Final attributes list for the DCE survey

Attribute	Levels
Place or setting for screening	1- I like to get screened at a Healthy Lifestyle Clinic in a hospital. 2- I like to get screened at OPD when I visit a doctor for any other reason. 3- I like to get screened in my village as a day clinic in a community centre/ religious place/school. 4- I like to get screened at my workplace. 5- I like to get screened from the private sector.
Person conducting screening	1- The doctor I'm familiar with, the one I usually go to for other illnesses. 2- Any doctor who is available at the time I go.

	3- A Well-trained Nurse.
When to access screening	1- Weekdays from 8 am - 4 pm. 2- Weekdays from 7 am - 9 am. 3- Weekdays from 4 pm - 8 pm 4- Weekends from 8 am - 12 pm.
Time spent at the screening programme	1- By spending 1 hour or less 2- By spending between 1 - 2 hours 3- By spending more than 2 hours
Behaviour of the health staff	1- The staff at the clinic will behave warmly and friendly. 2- The staff at the clinic will behave rudely and shout at patients.
Cost of screening*	1- It will be free of charge 2- I will have to spend Rs. 500. (Cost will be shared by both the government and private sector) 3- I will have to spend Rs. 1000. 4- I will have to spend Rs. 1500.

*(1 USD = 180 Sri Lankan Rupees (Central Bank of Sri Lanka, 2019)

Table 2. Respondents' characteristics

Socio demographic variables	Urban sector (N=187) n (%)	Rural sector (N=253) n (%)	Estate sector (N=152) n (%)
Sex			
Males	98 (52%)	121 (48%)	67 (44%)
Females	89 (48%)	132 (52%)	85 (56%)
Mean Age (SD)	47.8 (0.8)	48.4 (0.9)	48.4 (0.9)
Ethnicity			
Sinhalese	147 (79%)	233 (92%)	23 (15%)
Tamil	2 (1%)	19 (8%)	127 (84%)
Moor	38 (20%)	0 (0%)	2 (1%)
Level of education			
Up to Grade 5	10 (5%)	15 (6%)	61 (40%)
Grade 6 – 10	37 (20%)	71 (28%)	60 (40%)
Passed O/L examination	63 (34%)	94 (37%)	16 (10%)
Passed A/L examination	62 (33%)	57 (22%)	9 (6%)
Higher education	15 (8%)	16 (6%)	6 (4%)

Current employment status			
Employed	132 (71%)	131 (52%)	92 (60%)
Housewife	42 (23%)	106 (42%)	53 (35%)
Unable to work	4 (2%)	2 (1%)	7 (5%)
Retired	7 (4%)	14 (5%)	0 (0%)
Employed population by sex	**N =132**	**N = 131**	**N = 92**
Males	80 (61%)	95 (72%)	50 (54%)
Females	52 (39%)	36 (28%)	42 (46%)
Method of payment for employed population	**N=132**	**N= 131**	**N=92**
Daily	65 (49%)	66 (50%)	52 (58%)
Monthly	67 (51%)	65 (50%)	40 (42%)
Household income (1 USD = 180 Sri Lankan Rupees (Central Bank of Sri Lanka, 2019)			
Mean (SD)	Rs. 51,535 (3,092)	Rs. 43,980 (2,797)	Rs. 30,657 (1,646)
Median	Rs. 40,000	Rs. 35,000	Rs. 30,000
(IQ Range)	(30,000 - 60,000)	(24,625 – 55,000)	(15,000 – 41,500)
Most recent visit to a healthcare provider			
Within the last 30 days	68 (37%)	81 (33%)	63 (42%)
Within 2 – 12 months	66 (35%)	111 (46%)	49 (32%)
More than 12 months ago	30 (16%)	33 (14%)	28 (19%)
Can't remember	23 (12%)	16 (7%)	11 (7%)
Can't remember	7 (4%)	10 (5%)	1(1%)
Perceived usual ambulatory healthcare provider accessed for most needs			
Private sector clinic/hospital	106 (57%)	105 (41%)	65 (43%)
Government sector			
Primary care level clinic/ hospital	12 (6%)	48(19%)	43 (28%)
Base hospital and above	26 (14%)	18 (7%)	4 (2%)

Traditional practitioners	3 (2%)	4 (2%)	2 (1%)
Do not identify with any specific usual provider	40 (21%)	78 (31%)	38 (25%)

Table 3. Parameter estimates and significance levels of the multinomial logistic regression output of main effects

Attribute levels	**Urban Sector**		**Rural Sector**		**Estate Sector**	
	Co-eff (SE)	**P value**	**Co-eff (SE)**	**P value**	**Co-eff (SE)**	**P value**
Place of screening						
HLC (Reference cat.)			0		0	
Hospital OPD	0.19 (0.14)	0.19	0.11 (0.14)	0.46	0.01 (0.16)	0.42
At the community	0.01 (0.16)	0.98	-0.05 (0.16)	0.58	0.05 (0.18)	0.54
At workplace	1.37 (0.25)	<0.001	0.99 (0.27)	<0.01	0.56 (0.28)	0.10
Private sector	-0.65 (0.21)	0.002	- 1.45 (0.22)	0.03	-1.54 (0.25)	0.01
Who should screen						
A familiar doctor (Reference cat.)	0		0		0	
Any doctor	0.51 (0.34)	0.001	0.35 (0.16)	0.18	0.42 (0.19)	0.15
A Nurse	-0.02 (0.40)	0.90	0.16 (0.17)	0.98	0.19 (0.19)	0.68
Access time for screening						
From 8 am – 4 pm (Reference cat.)	0		0		0	
Early morning (7am – 9am)	0.93 (0.19)	<0.001	1.10 (0.20)	<0.001	1.09(0.23)	0.01
Evening (4pm – 8pm)	0.93 (0.18)	<0.001	1.04 (0.19)	<0.001	0.83 (0.21)	0.03
Saturday (8am – 12pm)	0.58 (0.18)	0.001	0.56 (0.19)	0.02	0.34 (0.21)	0.13
Time spent at screening						
Around 30 mins	0		0		0	

(Reference cat.)						
Time linear (increments by mins)	- 0.01 (0.001)	<0.001	- 0.01 (0.00)	0.01	- 0.01 (0.001)	0.01
Attitude of staff						
Warm and friendly (Reference cat.)	0		0		0	
Rude and unfriendly	- 1.22 (0.13)	<0.001	- 0.89 (0.14)	<0.01	- 0.44 (0.16)	<0.01
Cost of screening						
Cost free (Reference cat.)	0		0		0	
Cost linear (Increments by a Rs.)	- 0.0009 (0.000)	<0.001	- 0.001 (0.000)	<0.001	- 0.001 (0.000)	<0.001
Opt-out	- 3.55 (0.21)	<0.001	-4.45 (0.22)	<0.001	-3.81 0.25)	<0.001
No. of observations	5445		7437		4467	
Log likelihood	-1258.8		-1507.9		-983.8	

Table 4. Marginal willingness to pay for attributes with a significant preference at 5% level

(1 USD = 180 Sri Lankan Rupees (Central Bank of Sri Lanka, 2019)

Attribute levels	**Urban Sector**		**Rural Sector**		**Estate Sector**	
	WTP (Rs.)	**95% CI**	**WTP (Rs.)**	**95% CI**	**WTP (Rs.)**	**95% CI**
Place of screening						
HLC (Reference)						
At workplace	1480	958, 2002	969	465, 1472	-	-
Private sector	-704	-223, -1185	-1423	-1928, -919	-1270	-1713, –828
Who should screen						
A familiar doctor						

(Reference cat.)						
Any doctor	544	204, 884	-	-	-	-
Access time for screening						
From 8 am – 4 pm (Reference cat.)						
Weekday 7am – 9am	1002	547, 1456	1083	649, 1517	903	506, 1301
Weekday 4pm – 8pm	998	548, 1448	1021	601, 1442	688	312, 1064
Saturday 8 – 12pm	630	226, 1033	551	183, 918	-	-
Time spent at screening						
30 mins (Reference)						
Time linear (Increments by minutes)	-12	-16, -7	-9	-12, -5	-5	-8, –3
Attitude of staff						
Warm and friendly (Reference)						
Rude and unfriendly	-1315	-1678, –951	-873	-1184, –562	-367	-635, – 99

Table 5. Interaction term effects derived from the interaction term multinomial logistic regression models

Interaction terms	All sectors		Urban		Rural		Estate	
	Interaction term		Interaction term		Interaction term		Interaction term	
	B (SE)	P value	B (SE)	P value	B (SE)	P value	B (SE)	P value
Male sex* Time spent at screening	-0.004 (0.00)	<0.001	- 0.007 (0.001)	<0.001	-0.001 (0.001)	0.20	-0.002 (0.001)	0.08
Male sex* Access between 7 am–9 am	0.11 (0.07)	0.15	0.02 (0.14)	0.98	0.12 (0.12)	0.32	0.32 (0.15)	0.04
Male sex* Access on between 4pm – 8pm	0.05 (0.10)	0.60	0.04 (0.19)	0.82	0.05 (0.16)	0.76	0.07 (0.22)	0.74
Male sex* Disrespectful	0.15 (0.08)	0.058	-0.03 (0.14)	0.8	0.14 (0.13)	0.26	0.47 (0.16)	0.004

behaviour								
Male sex* Cost of screening*	$6.41*10^{-5}$ ($8.12*10^{-5}$)	0.43	$8.86*10^{-6}$ ($1.46*10^{-4}$)	0.95	$1.28*10^{-4}$ ($1.31*10^{-4}$)	0.33	$1.41*10^{-4}$ ($1.56*10^{-4}$)	0.37
Income* Time spent	$1.08*10^{-8}$ ($1.10*10^{-8}$)	0.33	$1.39*10^{-8}$ ($1.54*10^{-8}$)	0.37	$3.45*10^{-8}$ ($1.88*10^{-8}$)	0.07	$4.72*10^{-8}$ ($4.11*10^{-8}$)	0.25
Income* Cost of screening	$1.08*10^{-9}$) ($9.9*10^{-9}$)	0.07	$9.05*10^{-9}$ ($1.8*10^{-9}$)	0.63	$2.39*10^{-9}$ ($1.3*10^{-9)}$	0.06	$1.14*10^{-9}$ ($3.9*10^{-9}$)	0.77
Income* Disrespectful behaviour	$-4.90*10^{-6}$ ($1.20*10^{-6}$)	<0.001	$-3.95*10^{-6}$ ($1.92*10^{-6}$)	0.04	$-2.57*10^{-6}$ ($1.64*10^{-6}$)	0.11	$-9.12*10^{-6}$ ($4.12*10^{-6}$)	0.03
Daily wage earner*Time spent	-0.002 (0.001)	0.005	- 0.003 (0.001)	0.02	-0.001 (0.001)	0.49	-0.002 (0.001)	0.27
Education <GCE O/L*Time spent	0.001 (0.001)	0.25	0.002 (0.001)	0.12	-0.001 (0.001)	0.32	0.005 (0.002)	0.01
Education <GCE O/L*Disrespectful behaviour	0.30 (0.09)	<0.001	0.28 (0.14)	0.05	-0.02 (0.13)	0.89	0.65 (0.21)	0.002
Age*Time spent at screening	$-1.51*10^{-5}$ ($3.26*10^{-5}$)	0.64	$2.28*10^{-5}$ ($5.45*10^{-5}$)	0.67	$-4.44*10^{-5}$ ($5.03*10^{-5}$)	0.38	$-4.14*10^{-5}$ ($7.09*10^{-5}$)	0.56

*A separate regression model is run for each interaction term.

Table 6. Tabulation of repeated choices in survey one and survey two

Second Survey	**First Survey**			**Total**
	Option A	**Option B**	**Opt-out**	
Option A	193	34	3	230
Option B	29	164	6	199
Opt-out	1	1	9	11
Total	223	199	18	440