

Increasing questionnaire response: evidence from a nested RCT within a longitudinal birth cohort study

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Abstract

Background: Adequate response rates are essential when using questionnaires in research, as these can affect the validity of studies and the ability to generalise the findings to a wider population.

Aims: The study measured the response rate to questionnaires in a large longitudinal epidemiological study and sought to determine if any of the changes made throughout data collection had a positive impact on the response to questionnaires and readdressed any imbalance seen in response by participants level of deprivation.

Methods: Data were taken from a prospective, comparative study, designed to examine the effects of the reintroduction of water fluoridation on children's oral health over a five-year period. Response rates were analysed for the first year of data collection from this sample. During this year changes were made to the questionnaire layout and cover letter to attempt to increase response rates. Additionally a nested randomised control trial compared the effect on response rates of three different participant reminders to complete questionnaires were trialled.

Results: Data were available for 1824 individuals. The assessment of different reminders indicated that while sending the whole questionnaire again to non responders, resulted in the highest level of response (25%), calling participants was the only method that appeared to address the imbalance in IMD between responders (29.5, 95%CI 16.9-42.0) and non-responders (26.8, 95%CI 23.5-30.2) $t(12.994) -0.446$, $p=0.663$.

Conclusions: Low response rates were recorded within this large, longitudinal study giving rise to concerns about response bias. In order to address these biases, data can be weighted in order to compensate for the skew in those taking part compared to the population. Resending the entire questionnaire again is the most effective way of reminding participants to complete the questionnaire. As this is a less labour intensive method than for example, calling participants more time can then be spent targeting groups who are underrepresented in the study such as those most deprived.

Introduction

There are a number of factors that should be considered when looking to maximise response rates to questionnaires. Firstly, the mode of administration can be altered, with questionnaires being returned via the post, completed online or through personal interviews. Second the design of the questionnaire could change i.e. length, content or appearance [1]. Third incentive based approaches could be used to increase response (money, gifts or prize draws) [2]. Finally the non-responding behaviour of the participant could be addressed using a theory based behaviour change intervention [3].

Study Design

Mode of administration

Postal distribution has been traditionally used for questionnaire studies, however these come with a number of issues including printing and postage costs and an inability to use branching or programming to support a participant as they proceed through a questionnaire i.e. questions provided only if they require a response based on previous answers.

Online surveys, which typically provide links within an email that lead respondents to a webpage to complete a survey online, have some advantages over the postal method described above. They are cheaper and can to some extent be automated using branching logic which allows them to be completed more quickly. However, they also come with a number of limitations including bias with regards to who will respond. Evidence suggests that there is uneven access to this type of technology across different populations [4]. Some studies have shown a lower response rate of 10-11% for online questionnaires [5] with email contact being seen as impersonal [6].

Personal interviews conducted either face to face or over the phone can be structured yet flexible with participants able to seek clarification to questions and why they are being asked. As they are based on personal interaction participants may be more likely to complete the questionnaire in its entirety if contacted (although actually contacting participants at a convenient time can be problematic) [7]. A limitation to these types of surveys is that they are subject to interviewer and responder bias, are expensive and time consuming for the researcher with a potentially lower response rate if participants cannot be contacted [8,9].

Questionnaire design

There are a variety of elements relevant in questionnaire design to increase response rates. From the way questions are phrased to the layout and look of a questionnaire [7]. Edwards [1,6] conducted a systematic review which indicated researchers increase the response rate by; using coloured ink, having a user friendly layout, a shorter questionnaire and making the questionnaire and letter more personalised.

Identifying incentives and barriers

Edwards [1] noted that incorporating an incentive and including stamped addressed envelopes increased response rate. All types of incentive (monetary or non-monetary) increased response but with an odds ratio of 2.02 (95% CI 1.79 to 2.27) the monetary incentive vs. no incentive provided the largest response effect and also included the highest number of trials (49 with 46,474 participants). Other strategies such as following up with an additional contact or sending a second copy of the questionnaire were also found to significantly influence response.

Theories in behaviour change in non-responders.

While the concepts described above detail the simple elements that can facilitate or incentivise participants, an attempt to address non-response can also be made through targeting the behaviour of participants using theoretically informed interventions. Cane *et al.* [10] developed a theoretical domains framework (TDF) that encompasses component constructs used to guide behaviour change interventions. These include the domains of knowledge, skills, social role/identity, beliefs about capabilities and consequences, social influences and motivation [10]. Elements from these can be used to influence the behaviour researchers wished to change (in this case responding to a questionnaire). This can be achieved by incorporating aspects of these domains into information provided to participants, for example as part of a cover letter or leaflet. Table 1 gives an example of this; including the breakdown of the Theoretical Domains Framework described by Cane *et al.*, [10], and each of the behaviour change constructs and definitions in relation to questionnaire response. This breakdown is also based on previous work carried out by Duncan (2015) who used these theoretical domains to increase response rate in a trial in primary care dentistry.

Table 1: Behaviour change constructs and descriptions relevant to questionnaire response.

(Based on Cane et al (2012) TDF and Duncan's behaviour change letter

Theoretical domain that could be targeted	Theoretical domain constructs
Intentions and goals	Establish the <i>intention</i> to return the questionnaire Detail original consent and encourage return of questionnaire as soon as possible
	State the <i>goals</i> in relation to returning the questionnaire Target both immediate goals (completing questionnaire) and longer term goals
Social influences	Relate the research to <i>social norms or conformity</i> Provide information on the number of people taking part and completing the questionnaire if appropriate
Beliefs about consequences	Information of <i>consequences and attitude</i> Specific information about the benefits of taking part and what the consequences will be if people do not complete the information. Detail what the expectations of the outcomes will be
Behavioural regulation	Implementation <i>intention</i> and how will they put a plan into <i>action (action planning)</i> Detail an example of where, when, and how behaviour will be performed.
Environmental context and behaviour	Identify <i>barriers</i> and how these can be overcome Introduce or define environmental or social stimulus with the purpose of prompting or cueing the behaviour.
Knowledge	<i>Information about the study, disease and why this is important</i>

It is vital to understand response and any potential bias as these can affect the validity of studies and the ability to generalise the findings to a wider population. Particularly if the response is skewed in a way that could directly affect the main outcome. In the case of the CATFISH longitudinal study the outcome of interest has previously been associated with levels of deprivation. Given that previous studies have also shown deprivation is associated with the response rate of individuals it is important to understand whether response is associated with IMD [11] and if so whether any of the changes made are able to address any imbalance.

Aims

This paper assesses the changes made throughout baseline data collection on response rates in a longitudinal cohort study. The changes included introducing behavioural change components into a cover letter, altering the layout of the questionnaire and testing the effectiveness of three different participant reminders to complete questionnaires.

A secondary aim was to assess the impact of deprivation on response rates and determine if any changes to the questionnaire or reminders readdressed any imbalances (based on IMD - Index of Multiple Deprivation)

These changes and introduction of new methods occurred in a pragmatic fashion within the overall longitudinal study given the lower than expected response rate after the study had started.

2.3 Study hypothesis

The study's main null hypotheses to be tested are:

There is no association with deprivation (IMD) and the response rate

Altering the cover letter or methods of sending reminders will produce no difference in response rates

Altering the cover letter or methods of sending reminders will have no impact on any IMD bias in response rates

Study design

The data has been taken from a prospective, comparative study, designed to examine the effects of the reintroduction of water fluoridation, on young children's oral and general health. The details of this study can be found in the CATFISH protocol [12].

For this part of the study baseline questionnaires were sent out to consented parents following the birth of their child. This took place over a 12-month period according to the date of birth of the child. For the first 4 months participants received a questionnaire with a standard cover letter through email or by post (this period is referred to as Wave 1). For approximately the following 4 months participants received a questionnaire with an easier to read layout. In addition an updated cover letter was used which utilised simple behaviour change techniques to encourage response such as motivation and goal setting, beliefs about the consequences of completing the questionnaire, action planning and further information on the study. The updated cover letter and questionnaire was sent along with a free pen (this period is referred to as Wave 2) . For approximately the last 4 months a nested RCT was used to determine which three methods to remind non-responders to return their questionnaire was most effective. The

three methods were reminders; by phone, by postcard or sending the whole questionnaire again for those who did not reply to the first questionnaire. In order to determine which were more effective, the methods of addressing non-response were randomly allocated to families who didn't respond to the first questionnaire (this period is referred to as Wave 3). It should be noted if randomisation were not possible (i.e. no phone number was held for that participant and they had been allocated a telephone call they were assigned one of the other reminders). A de identified list of participants (those who did not respond to the initial questionnaire) were created each month, a computer generated randomisation sequence was created and allocated to each unique ID number for postcard, telephone or repeat questionnaire reminder on a 1:1 without stratification. Participants would be aware of their status (whether or not they received a telephone call) but were unaware of any other groups status and that this was monitored as part of a RCT. It was impractical for the researcher administering the intervention (contacting people by telephone to complete the questionnaire, etc) and the outcome - completing the questionnaire to be blinded to the group status.

Variables of interest

Data were gained from information recorded during the consent process or from questionnaires, apart from Index of Multiple Deprivation (IMD), which is computed from individuals' postcode. IMD quintiles were arrived at using the National Perinatal Epidemiological Unit (NPEU) IMD using the breakdown given in Appendix A1 [13]. The primary outcome was the percentage of participants who had returned a questionnaire.

Study participants

Participants eligible for this study were those who had a child born in one of two designated hospitals in Cumbria from 1st September 2014 to 31st August 2015. This formed the study population. Groups were subsequently formed from waves of those who received both the standard questionnaire and cover letter (wave 1), an altered questionnaire and cover letter (wave 2) and finally the third group were randomised to receive one of three different reminders following no response to the questionnaire (wave 3), please see Figure 1.

Insert Figure 1 here

Statistical analysis

Statistical significance level was set at 5% for all analysis. Statistical analysis was performed using SPSS (IBM Corp. Released 2017. IBM SPSS Statistics for Mac, Version 25.0. Armonk, NY: IBM Corp).

Continuous variables were tested using independent two-tailed t-test if they met the necessary assumptions.

Logistic regression analysis was carried out to determine the strength of association between response rate and type of reminder and IMD.

Ethical considerations

The CATFISH water fluoridation study has been reviewed and approved by an NHS ethics committee (14/EE/0108) and NIHR. All participants provide written informed consent prior to enrolling in the study for themselves (parent) and their child.

Results

Out of the 1824 participants who consented to be part of the study 47% completed the baseline questionnaire for their child. Overall those who responded to the questionnaire had a mean IMD of 22.3 (95% CI 21.4-23.2) with non-responders having a mean of 28.4 (95% CI 27.4-29.4), which indicated non responders were significantly more deprived than responders in respect to IMD ($t(1701)=9.011$, $p=0.001$).

Throughout the year that baseline data was collected, two changes were implemented to attempt to increase response rate. This resulted in what could be described as three waves of data collection,

In Wave 1 non-response was an issue overall (from both email and postal questionnaires) with only 25% of questionnaires returned from the first attempt. However a second postal attempt elicited an additional 21% of questionnaires returned; providing an overall response rate of 46% after 2 attempts (see Figure 2).

Following the change to the cover letter and additional free pen (Wave 2), response rose to 36% when looking at response from the initial mail out of questionnaires to this group. However when non responders were sent the questionnaire a second time this elicited fewer returns, resulting in a similar overall response of 49% after 2 attempts (see Figure 2). This indicates the overall response rate had not improved considerably between Wave 1 and Wave 2. This is despite a higher response rate observed for Wave 2 after the first send out compared to the first send out for Wave 1. This is illustrated further in Figure 2, which shows the proportion of those responding out of those receiving the questionnaire on each attempt.

Insert Figure 2 here

As response rates only improved marginally between Wave 1 and 2 the research team decided to look at different reminders in order to understand if one method would elicit a better response to those who had not initially completed the questionnaire. Results from the random allocation of the three different methods to remind participants to complete the questionnaire showed resending the entire questionnaire was the most effective method in gaining responses. Twenty-five percent of those resent the questionnaire in the second attempt completed and returned this. This was compared to a postcard reminder, which resulted in 18% of questionnaires returned, and phone calls where 15% of questionnaires were completed (see Figure 2).

Strong evidence of a difference in IMD between those who completed the questionnaire compared to those who didn't complete in wave 1 was observed ($t(613) = 4.986$, $p = 0.0001$, mean difference scores are presented in Figure 3). This difference was still observed after changes were implemented in wave 2. Therefore, despite a slight increase in response during the initial send out between wave 1 and 2 this increase has not addressed the imbalance of IMD between responders. When exploring the different reminder methods to increase response rate for non-responders, contacting participants over the phone was the only method that appeared to readdress the IMD differences observed ($t(12.994) = -0.446$, $p = 0.663$).

Insert Figure 3 here

To assess the effect of IMD and different reminders, a logistic regression was estimated with the variables entered separately (see Table 2- model 1) and as an interaction. Model 1 indicated the odds of a participant completing a questionnaire was 1.99 times higher for those receiving the whole questionnaire again compared to those who received a telephone call ($p=0.074$). IMD showed a marginal effect with an odds ratio of 0.98 (95%CI 0.96–0.99). When interactions with IMD were included (See Table 3 - model 2) only the postcard vs the telephone reminder showed a significant interaction effect, indicating in comparison to the telephone reminder, whether a participant responded or not to the postcard reminder was influenced by the IMD of participants.

Table 2: Logistic regression for response by reminder and IMD (Model 1)

Variable	Odds Ratio	SE	P-value	95% CI
Resent telephone (ref)	1.00	-	-	-
Resent questionnaire	1.99	0.387	0.074	0.93-4.26
Resent postcard	1.17	0.422	0.705	0.51-2.68
IMD	0.98	0.012	0.042	0.96-0.99

Model χ^2 (3) = 8.463 p = 0.037 Nagelkerke R²= 0.048 = 4.8% variance explained.

Table 3: Logistic regression for response by reminder and IMD (Model 2- interaction)

Variable	Odds Ratio	SE	P-value	95% CI
Resent telephone (ref)	1.00	-	-	-
Resent questionnaire	5.77	0.833	0.035	1.13-29.55
Resent postcard	5.49	0.891	0.056	0.96-31.52
IMD	1.01	0.021	0.562	0.97-1.05
Resent telephone * IMD				
Resent questionnaire * IMD	0.96	0.027	0.137	0.91-1.01
Resent postcard * IMD	0.94	0.033	0.051	0.88-1.00

Model χ^2 (5) = 13.701 p = 0.026 Nagelkerke R²= 0.072 = 7.2% variance explained

When looking at the difference in the distribution of the population by IMD quintiles (see table 4) to those who both consented and responded to the questionnaire. It can be seen that while a significant proportion of the population is located in more deprived areas (IMD quintile 4 and 5) there were a higher proportion of those responding from the least deprived quintiles compared to distribution of the population (IMD quintile 1 and 2).

Table 4: Population and sample difference in IMD quintiles

	IMD 1	IMD 2	IMD 3	IMD 4	IMD 5
Population	7%	16%	21%	30%	26%
Sample of those consented	8%	17%	22%	29%	24%
Sample of those responding	10%	21%	26%	26%	17%
Difference between responded and population	3%	5%	5%	-4%	-9%

Discussion

Throughout the first four months of baseline data collection it was noted response was lower than expected. Therefore an ethical amendment was sought in order to change the cover letter using behaviour change techniques identified by Cane and previously implemented in other dental studies [3,10]. In wave 1 (which utilised a standard letter) 25% of participants responded for the first attempt which rose to an overall response rate of 46% following a second attempt. When the cover letter was updated an increase in response rate was observed for the first attempt with 37% of people responding. A smaller number of people responded to the second attempt and therefore an overall response rate following the updated cover letter was 49%. A marginal improvement of 3% increase in response rate was therefore achieved. When exploring the difference in IMD of responders before and after the changes were

implemented it was apparent that while a small increase in response was observed between wave 1 and 2, this increase did not address the difference in IMD observed between responders and non-responders.

As response rates to the initial distribution of questionnaires had improved, the research team decided to explore effective interventions to increase response to a second administration of the questionnaire (for those who initially hadn't responded to the questionnaire). The options were to resend the entire questionnaire again, send a reminder postcard or use of telephone call to the participants. Resending the entire questionnaire was the most effective method in increasing response compared to the other approaches used in this study. Previous RCTs looking at consent in dental studies have also shown that repeat mailings have produced the highest response rate in comparison to sending a single letter or providing additional information [14]. Telephone calls to participants appears to be the only method that readdressed the imbalance of IMD in responders to non-responders. These results should be treated with caution; however it does indicate resending questionnaires would be the most appropriate method to improve to response overall and reflects similar RCTs which have demonstrated repeat mailings are one of the most effective ways to increase response [14]. Specific groups within the study could then be targeted with phone calls to attempt to address the imbalance in IMD of those who do not respond. This strategy would be an effective use of time and resource as calling participants is a more cumbersome method, with access to phone numbers not always possible and this method did result in fewer responses overall.

The reasons given for non-response when contacting participants over the phone were; time constraints, busy or chaotic lifestyles (particularly with a new born), or moving home since their address had been recorded. This is another reason why phone calls were important in certain cases as the mobility of the population meant certain participants had not received the questionnaire on the first post out. Phone calls also appeared to be an appropriate way of administering the questionnaire to some parents as they stated it would be unlikely they would remember to return the written questionnaire through the post.

Sources of bias

The data were taken from a larger longitudinal survey being conducted over 5 years. The survey employed a census approach, therefore every individual who gave birth in the Cumbria area of England over the period of one year were approached to take part. A sampling strategy was consequently not required to gain a representative sample of the population as this was a whole population study. Despite this study utilising a census approach there are still possible sources of bias in its representativeness to the target population.

Social desirability and approval bias [15] is a limitation throughout most surveys but is difficult to quantify the effect it will have. Parents who wish to be perceived as good, knowledgeable and diligent in relation to raising their child may alter some of their answers if they believed they are more in keeping with social norms and if their behaviours are thought to go against recommended guidance [16,17]. However there is no reason this social desirability bias should differ across groups if they are balanced at baseline (or significantly impact if an imbalance at baseline is addressed within the analysis). The main impact from social desirability bias is that certain confounders may represent a weaker effect on the outcome.

Recall bias should be less of an issue, as this is a longitudinal study questions are being asked about what a parent and child are doing at the time the questionnaire is administered rather than recalling past behaviour. However there was certain information parents struggled to provide, such as height/length of child. Parents noted while some information was collected as part of their child's regular development (such as weight) by other health professional height was not and therefore was only answered by 30% of those responding.

It was noted responders were significantly different from non-responders when looking at IMD; this was also the same for consenters and non-consenters. As IMD is associated with the outcome of interest in this longitudinal study (tooth decay) [18] this means that the results should be adjusted for not only non-consent but non-response [19].

Study limitations

A limitation in relation to the methods used to increase response rate is that only the reminder section of this research (whether respondents received a reminder by telephone, questionnaire or posted) utilised an RCT to test these methods. In relation to study design, RCTs are conventionally placed near the top of the hierarchy of evidence. As randomly allocating individuals to different interventions reduces bias (such as selection bias) by balancing unknown prognostic factors at baseline [20]. However the change to the cover letter was evaluated in a different way by comparing it to the data collected for the population in the last four months there are a number of issues with this method. There could have been something different about the population who responded to the questionnaire in wave 1 to wave 2. For example data collected could have been influenced by additional external factors (i.e. disruption to the postal system) or seasonal effects (e.g. close to Christmas, summer holidays) could have also affected the response rate. Comparing groups over different periods of time weakens the conclusions that can be drawn from the data collected. It is acknowledged this

was done as a pragmatic step and is being reported as such. Therefore caution should be taken in the conclusions drawn from this data in relation to increasing response rates.

Implications

It can be observed that both a consent and response bias is present in this data set. The implication for the CATFISH study (and possible future studies) is to take this into account and adjust for these differences in the analysis and interpretation of the data. There are a variety of ways of weighting data in order to address representativeness in surveys. These include *inverse probability weights* [21] i.e. 1/probability that unit is selected, or to account for non-response, a model of the probability of selection such as logistic regression could be performed (sometimes called propensity weighting). Weighting can also be achieved adjusting for an auxiliary variable [19]. In this case the auxiliary variable we have information for both consent and response is IMD/IMD quintiles. As the percentages of people who responded are different from the population, i.e. the population consists of just 7% of people who are labelled as least deprived, yet more people within this range responded to the questionnaire (10%). Therefore this group is over represented in the response. In order to attempt to rectify this a weight can be assigned to each person based on this skew calculated below.

Table 5: IMD weight calculations

$$\text{IMD 1} = 7\%/10\% = 0.700$$

$$\text{IMD 2} = 16\%/21\% = 0.762$$

$$\text{IMD 3} = 21\%/26\% = 0.808$$

$$\text{IMD 4} = 30\%/26\% = 1.154$$

$$\text{IMD 5} = 26\%/17\% = 1.529$$

Conclusions

Addressing response bias

Response bias is apparent in this study and therefore techniques to minimise this will need to be incorporated in the analysis, weighting the data is an appropriate method in order to reduce the likely effect of this bias and provide results, which more closely represent the population being studied. This is applicable when information is available about non-responders/consenters or about the population as a whole.

Increasing response rate

There is limited evidence of the methods to improve response rates to postal questionnaire in health research [22]. While some caution should be taken in utilising the results of this data, given the primary outcome and the smaller sample sizes when groups were looked at

individually it does indicate repeat mailings offer the most promising method of maximising response. On the other hand, telephone contact may offer the best method to readdress potential differences in deprivation of responders/non-responders. Changing the format/layout of the questionnaire, adding behavioural change techniques to a cover letter and potentially the addition of a free pen may have a small positive effect on response.

Declarations

Ethics approval and consent to participate

The CATFISH water fluoridation study has been reviewed and approved by NRES Committee East of England - Cambridge South (14/EE/0108) an amendment to carry out the RCT was approved by the research committee. All participants provide written informed consent prior to enrolling in the study for themselves (parent) and their child.

Consent for publication

Not applicable

Availability of data and materials

The datasets generated and/or analysed during the current study are not publicly available as the overall study (on water fluoridation) will not be completed until 2021.

Competing interests

MG is an Associate Editor at BMC Oral Health

All other authors declare no competing interests

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Authors' contributions

MG IAP contributed to the study design and manuscript

TW, RE, MS, MK, MT, WW contributed to the study design

MG performed data analysis

All authors read and approved the final manuscript

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Figures

Figure 1: Flow chart of methods used to increase questionnaire response for each wave

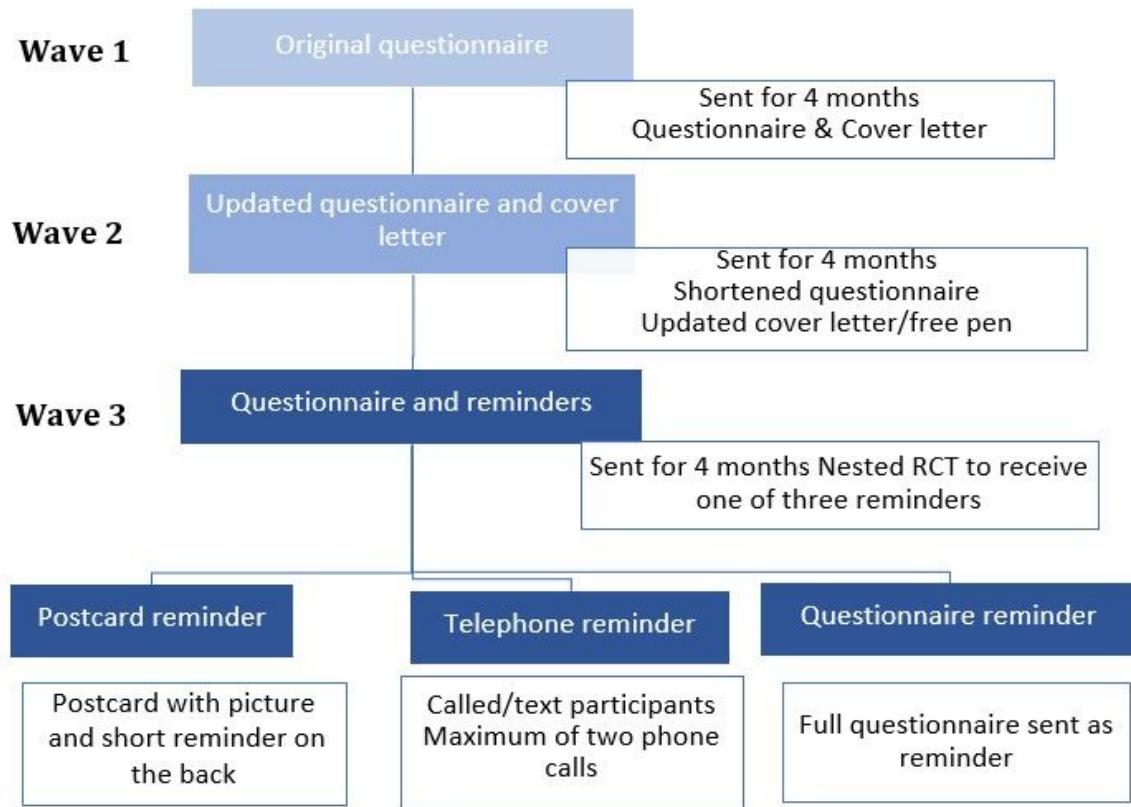


Figure 1

Flow chart of methods used to increase questionnaire response for each wave

Figure 2: Flow diagram of response for each wave

(Each attempt is given as a separate percentage out of those who received the questionnaire on that occasion)

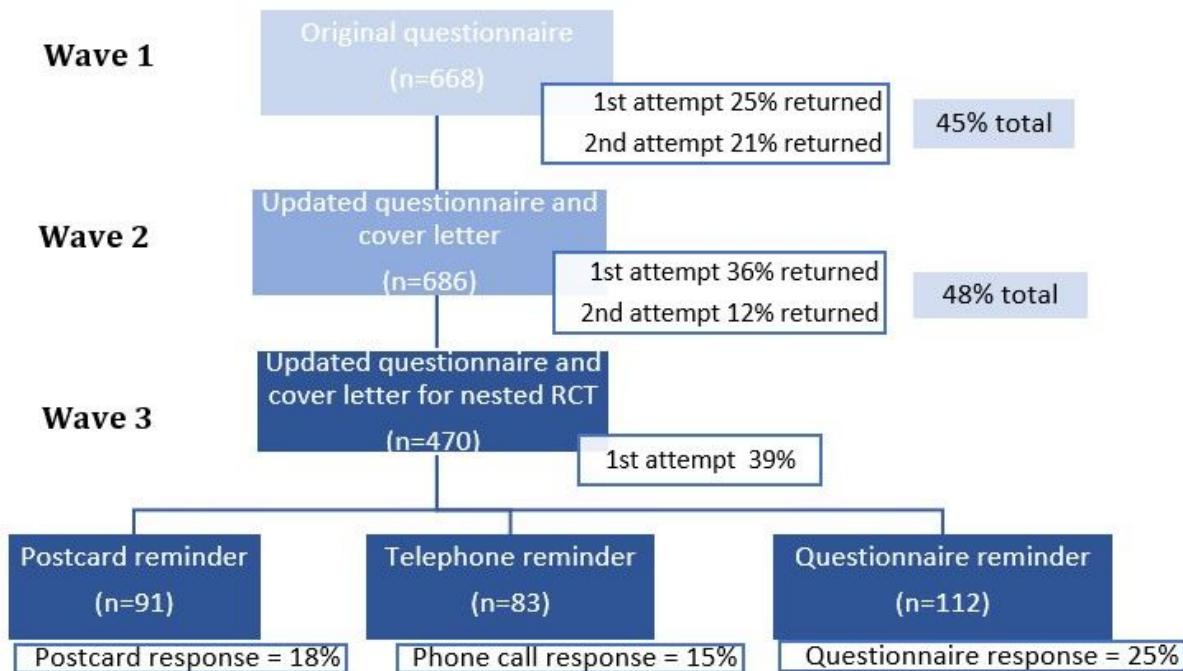


Figure 2

Flow diagram of response for each wave (Each attempt is given as a separate percentage out of those who received the questionnaire on that occasion)

Figure 3: Flow chart showing IMD by response for each wave

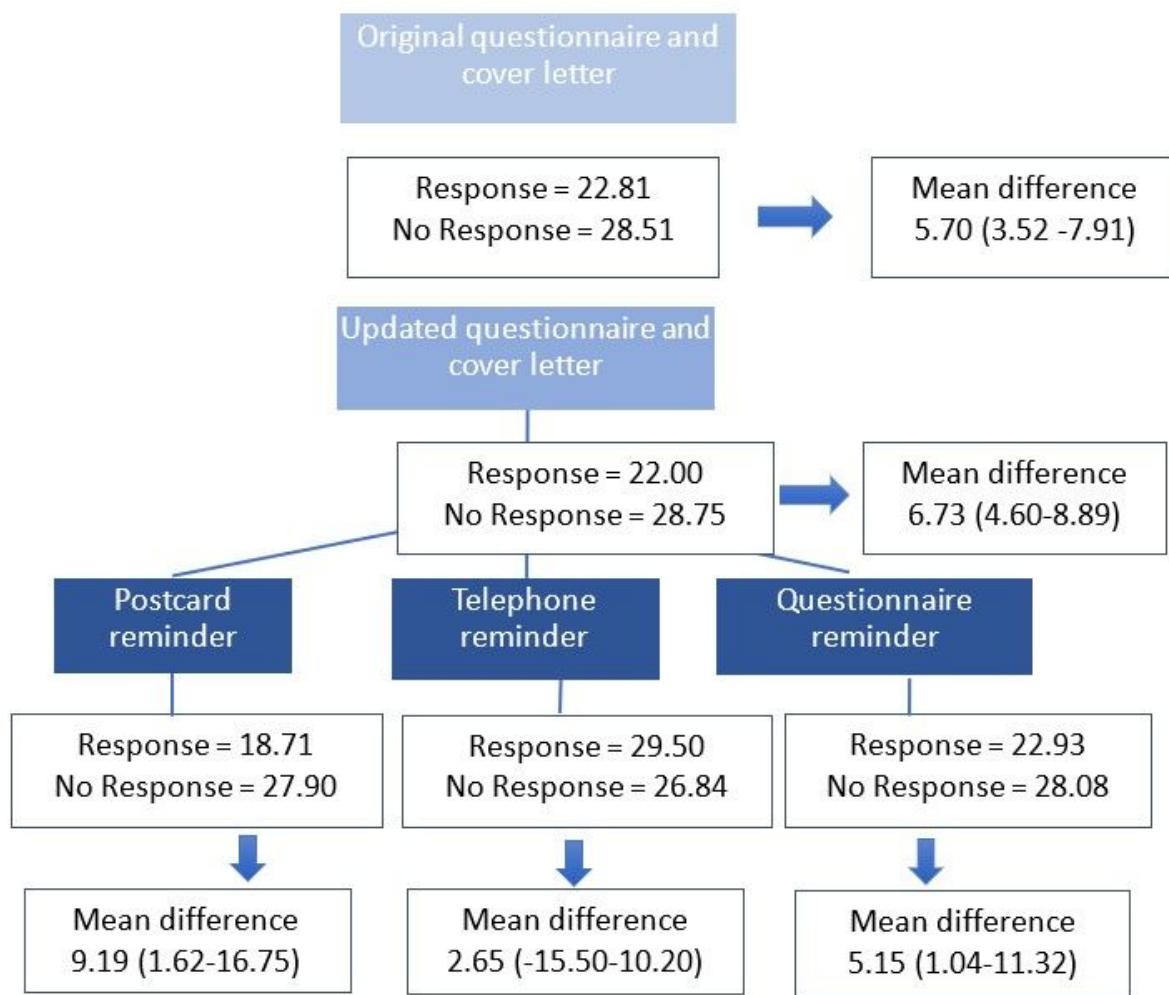


Figure 3

Flow chart showing IMD by response for each wave

Supplementary Files

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