



# Smarter Knocks, Fewer Calls

## *Adaptive Use of CATI in Knock-to-Web Survey*

Lise Snellingen Bye, Statistics Norway, [Ind@ssb.no](mailto:Ind@ssb.no) & Bengt Oscar Lagerstrøm,  
Statistics Norway, [bol@ssb.no](mailto:bol@ssb.no)

### **1. Abstract**

Knock-to-web and push-to-web strategies are increasingly used in official surveys to reduce data collection costs while maintaining data quality. Existing research has primarily examined universal mode-sequence experiments, with limited attention to how such strategies are implemented under operational constraints where interviewer follow-up must be selective.

This paper evaluate a large-scale adaptive knock-to-web design implemented in the Norwegian Survey on Living Condition – Working Environment. The study examines whether interviewer resources can be used selectively as a bias-reduction mechanism rather than as the primary mode of data collection.

The survey is based on a sample of approximately 40,000 individuals aged 18-74. Initial data collection followed a web-first strategy, using an internet portal for digital communication (Altinn) or postal invitations, followed by repeated reminders via digital mail and SMS. After two weeks of web data collection, selected nonrespondents were assigned to CATI follow-up based on adaptive targeting criteria emphasizing younger age groups considered at higher risk of nonresponse bias. During fieldwork, the age criterion for CATI follow-up was adaptively expanded in response to observed response rates and available interviewer capacity.

CATI contact was designed primarily as a knock-to-web intervention, with interviewers encouraging web completion and offering telephone interviews only as a secondary option. Outcomes are evaluated in terms of response rates, age-related sample composition, mode transitions following interviewer contact, and operational efficiency.

Results show that targeted knock-to-web follow-up substantially improved representation among younger respondents without extending interviewer resources to the full sample. Among respondents successfully contacted by interviewers, a large majority chose to complete the questionnaire online rather than by telephone interview. The intervention increased response rates among respondents aged 18–45 years by 6.1 percentage points while preserving a predominantly self-administered measurement design.

The study demonstrates how bias-oriented, adaptive use of CATI within a web-first design can support data quality in large-scale official surveys under realistic resource constraints.

Keywords: Knock-to-web, adaptive data collection, survey bias



## **2. Introduction**

Mixed—mode designs combining CAWI and CATI are increasingly used to balance survey cost, response rate and data quality. Recently there has been more interest in using CATI smarter by having interviewers motivating responding surveys online, also called a knock-to-web approach, by combining push-to-web and knock-to-nudge.

Push-to-web is already a widely used approach. It involves the use of offline contact, for example postal letters, to 'push' people to go online and complete a web questionnaire. It is often combined with other data collection modes in a mixed mode approach (Dillmann, 2017). Recent knock-to-nudge studies suggest that interviewer contact can increase participation without necessarily conducting full interviews (Domarchi, et al., 2025; Maslovskaya, et al., 2025).

This paper contributes to the literature by evaluating a large-scale adaptive knock-to-web strategy implemented within the operational production system of Statistics Norway. Rather than using CATI as a universal follow-up mode, interviewer resources were allocated selectively to respondent groups considered at elevated risk of nonresponse bias. The paper addresses four main research questions: (1) Can targeted CATI follow-up improve representation in a web-first survey?, (2) To what extent do contacted respondents complete the survey online rather than by CATI?, (3) Can interviewer resources be allocated adaptively to improve operational efficiency?, and (4) Does knock-to-web represent a viable compromise between response rates, measurement comparability, and long-term production sustainability?

## **3. Background and Theoretical Framework**

Traditional survey practice has often prioritized maximizing response rates under the assumption that higher response rates necessarily reduce bias. However, recent survey methodology literature increasingly emphasizes total survey error frameworks in which response rates constitute only one component of overall data quality (Groves & Heeringa, 2006).

In mixed-mode surveys, increases in response rates may come at the expense of increased measurement error if different modes produce systematically different responses (Tourangeau et al., 2013). This challenge is particularly important for subjective survey domains such as psychosocial work environment, mental health,



life satisfaction, stress, workplace conflicts, and attitudes. In 2022, Statistics Norway conducted a mode experiment that demonstrated that CAWI and CATI modes produced substantively different estimates for several working environment indicators (With et. al., 2024). These findings motivated a stronger emphasis on preserving self-administered measurement while still addressing selective nonresponse.

Responsive survey design aims to dynamically allocate fieldwork resources toward respondent groups contributing most to nonresponse bias rather than applying identical follow-up procedures to all respondents (Groves & Heeringa, 2006). The knock-to-web strategy implemented in this study reflects this logic. Interviewer resources were not used universally but selectively targeted towards demographic groups underrepresented in the early web response phase. In conventional mixed-mode surveys, interviewers conduct complete interviews with nonrespondents. In knock-to-web designs, interviewers instead function primarily as recruitment agents encouraging self-completion online. This distinction is important because the intervention may improve representation while preserving mode consistency, reduced interviewer effects and lower costs relative to full CATI interviewing. The approach represents an intermediate strategy between fully interviewer-administered surveys, traditional mixed-mode surveys and purely web-based designs.

#### **4. Survey design**

##### **4.1 Survey context and data collection design**

The Survey on Living Conditions – Working Environment (LKA) is a large social survey measuring physical, organizational, and psychosocial working conditions among employed individuals aged 18-74 years (N= 40 000). For more details see Bye & With (2026).

Because young adults, especially combined with low educational level, are considered at higher risk of nonresponse bias and report less motivation to answer self-administered we decided to use interviewers to call the respondents to encourage them to respond on the web questionnaire inspired by a user journey mapping conducted at Statistics Norway a few years ago (Keute et. al., 2023) and the subsequent data collection with use of CATI adaptively to target young adults in similar surveys (Grimstad, 2023).



The initial contact was web-first, using an official internet portal for digital communication (Altinn) or postal invitations for those who were not digital users of Altinn. The invitation was combined with an SMS, urging the respondents to read the letter and participate online. In the following two weeks, three reminders were sent. After two weeks of online data collection, we changed strategy and started to call the younger adults in line with our preferred strategy.

### **4.3 Adaptive targeting strategy**

The initially CATI targeting criterion included respondents aged 18-35 years. The targeting criterion was adaptively expanded to include respondents up to age 45 during data collection. So, in addition to follow our adaptive strategy, this adaptive approach reflected a responsive survey design logic in which interviewer resources were allocated dynamically based on observed representational deficits during ongoing fieldwork (Groves & Heeringa, 2006).

## **5. Results**

### **5.1 Overall response patterns**

Response rates were highest among women, older respondent (45+) and those with tertiary education (Appendix Table 1). These patterns are consistent with border findings from web-first surveys at Statistics Norway (Grimstad & Støren, 2024).

Figure 1 and figure 2 in the appendix show results for the knock-to-web recruitment process. 27.8 per cent finished the web questionnaire after the knock-to-web call. This led to an increase in the response rate in the target group by 6.1 percentage points and the overall response rate by 3.2 percentage points. Figure 3 shows the distribution of interviews, breakoffs, and non-response across different demographic groups, among respondents who agreed to complete the web questionnaire.

### *5.4 Effects on representativeness*

Table 2 in the appendix shows sample bias after two weeks of data collection - before the knock-to-web follow-up had started, and the sample bias after ended data collection. The largest improvements were observed for age composition.

Prior to knock-to-web follow-up:

- respondents aged 18–35 years were substantially underrepresented,



- respondents aged 46 years and older were overrepresented.

After knock-to-web follow-up:

- age-related representational bias decreased substantially,
- improvements were also observed for educational composition.

To test whether the CATI recruitment contributed to a reduction in sample bias, a logistic regression analysis was also conducted on the net sample. The dependent variable indicates whether response to the web questionnaire was completed before or after the CATI recruitment. The independent variables are gender, age group, and educational attainment. Table 3 in the appendix gives odds ratios for answering after the CATI recruitment, compared with responding during the initial phase of data collection. There are statistically significant differences observed for age and educational attainment, indicating that people with lower educational attainment and younger individuals have higher odds of being interviewed after knock-to-web compared to people with higher educational attainment and older individuals. No statistically significant differences are observed for gender.

The results demonstrate that selective interviewer follow-up can reduce important sources of nonresponse bias without extending CATI resources to the entire sample.

## **6. Discussion**

### *6.1 Can targeted CATI follow-up improve representation in a web-first survey?*

The results indicate that selective CATI follow-up substantially improved representativeness among demographic groups that were underrepresented after the initial web-first phase. Prior to the knock-to-web intervention, respondents aged 18–35 years were underrepresented by 7.2 percentage points compared with the gross sample. After CATI follow-up, this difference was reduced to 2.3 percentage points. Similar improvements were observed for respondents aged 36–45 years and for respondents with lower educational attainment.

These findings support the logic of responsive survey design described by Groves and Heeringa (2006), where fieldwork resources are allocated dynamically toward respondent groups contributing most to nonresponse bias rather than toward maximizing overall response rates alone. In our study, interviewer resources were concentrated on younger adults because early response monitoring indicated that



this group was substantially underrepresented during the web-first phase. The adaptive expansion from ages 18–35 to 18–45 further illustrates how responsive designs can be operationalized in ongoing production systems.

The findings are also consistent with previous research showing that younger adults and respondents with lower educational attainment are less likely to participate in self-administered web surveys (Peytchev, 2013). Importantly, our results demonstrate that even relatively limited interviewer intervention may substantially reduce this imbalance.

At the same time, the findings also illustrate an important distinction between response rate improvement and bias reduction. The overall response rate increased by only 3.2 percentage points, while representational improvements within key demographic groups were considerably larger. This supports the argument in total survey error theory that response rates alone are insufficient indicators of survey quality (Groves & Heeringa, 2006).

#### *6.2 To what extent do contacted respondents complete the survey online rather than by CATI?*

One of the most important findings in the study is that most respondents contacted by interviewers still chose web completion rather than interviewer-administered interviewing. Among respondents successfully contacted by CATI, nearly eight out of ten agreed to answer online, while only a very small proportion insisted on completing the main interview immediately by telephone.

This finding suggests that interviewer contact primarily functioned as a motivational intervention rather than as an alternative measurement mode. The interviewers acted mainly as recruiters or “nudgers” encouraging participation in the self-administered questionnaire. This aligns closely with the knock-to-nudge literature from the UK, where interviewer contact has been shown to increase participation propensity without necessarily conducting full interviews (Domarchi et al., 2025; Maslovskaya et al., 2025).

However, our study extends this literature in several important ways. Existing knock-to-nudge studies have primarily focused on face-to-face interviewer contact (CAPI) and often within pandemic-related operational contexts. By contrast, our study demonstrates that similar mechanisms may also operate using CATI interviewers in large-scale production surveys under ordinary operational



conditions. This is an important contribution because CATI interviewer resources are generally less costly and easier to scale than face-to-face interviewer operations.

The finding is also methodologically important considering previous evidence from Statistics Norway showing that CATI and CAWI may produce systematically different estimates for subjective working environment indicators (With et al., 2024). By motivating respondents to complete the survey online rather than by telephone interview, the knock-to-web strategy may help reduce mode effects while still improving representation.

This suggests that interviewer contact and interviewer-administered measurement should be viewed as analytically distinct components of survey participation. The interviewer effect in this design appears to operate primarily through increased participation propensity rather than through the interview mode itself.

### *6.3 Can interviewer resources be allocated adaptively to improve operational efficiency?*

The study also demonstrates how interviewer resources may be used more selectively and strategically under increasing operational constraints. Traditional mixed-mode surveys often allocate interviewer follow-up broadly across all remaining nonrespondents. In contrast, the present design restricted CATI follow-up primarily to demographic groups considered at elevated risk of nonresponse bias. This distinction is important because interviewer-administered data collection is increasingly expensive and difficult to sustain at large scale. The findings therefore suggest that interviewer resources may increasingly function as targeted bias-reduction resources rather than as universal production modes.

The adaptive expansion of the CATI target group during fieldwork further illustrates how responsive allocation may improve operational efficiency. Rather than predefining a fixed data collection design for the entire field period, interviewer resources were adjusted dynamically based on observed response patterns and remaining interviewer capacity. This reflects the operational principles described in responsive survey design theory (Groves & Heeringa, 2006).

At the same time, the study also highlights the limitations of relatively simple targeting rules based mainly on age. Although age proved highly predictive of late participation, the regression analysis suggests that educational attainment was



also strongly associated with participation after CATI follow-up. Future implementations may therefore benefit from more advanced response propensity models incorporating additional predictors such as educational attainment, occupational characteristics, prior participation history, paradata, and contact history.

Such developments would move knock-to-web strategies closer to fully adaptive survey systems in which interviewer resources are continuously optimized toward respondents contributing most to potential bias reduction.

#### *6.4 Does knock-to-web represent a viable compromise between response rates, measurement comparability, and long-term production sustainability?*

Overall, the findings suggest that knock-to-web may represent a promising intermediate strategy between traditional interviewer-administered surveys and purely self-administered web surveys.

Pure web surveys are operationally efficient and preserve measurement consistency but often suffer from selective nonresponse. Traditional mixed-mode surveys may improve response rates and representativeness but risk introducing measurement differences across modes (Tourangeau et al., 2013). This trade-off is particularly important for surveys measuring subjective phenomena such as psychosocial work environment, stress, workplace conflicts, and attitudes, where interviewer presence may influence responses.

The knock-to-web strategy partly reconciles these competing objectives by using interviewer contact selectively while preserving predominantly self-administered measurement. In this sense, the approach may represent a practical operational compromise between data quality and production sustainability.

The strategy also aligns with broader structural developments affecting official statistics agencies, including declining response rates, increasing interviewer costs, growing pressure toward digitalization, and increasing emphasis on efficient allocation of data collection resources. Rather than maximizing response rates at any cost, future survey systems may increasingly prioritize minimizing total survey error under constrained operational budgets. At the same time, the study should not be interpreted as evidence that interviewer-administered surveys are becoming unnecessary. The results instead suggest that interviewer roles may evolve. In future survey systems, interviewers may increasingly function as



targeted engagement specialists focused on motivating participation among underrepresented groups rather than conducting full interviews for the majority of respondents.

#### *6.5 Limitations and future research*

Several limitations should be acknowledged. First, the study was not based on randomized experimental assignment to knock-to-web treatment, limiting strong causal inference. The observed improvements in representativeness therefore cannot be interpreted as purely experimental effects.

Second, the analysis focused primarily on response outcomes and representational indicators rather than substantive survey estimates. Although the design was motivated partly by concerns regarding mode effects identified in previous Statistics Norway research (With et al., 2024), the present study did not directly evaluate whether the strategy improved the accuracy or comparability of substantive working environment indicators.

Third, the study included only limited cost analysis. Future research should compare the cost-efficiency of pure web, traditional mixed-mode, and adaptive knock-to-web designs using indicators such as cost per completed interview, cost per percentage-point reduction in bias, and interviewer hours per additional respondent.

Future studies should also investigate effects on substantive survey estimates, long-term respondent behavior across repeated survey participation, optimal adaptive targeting algorithms, and whether knock-to-web effects vary across different survey topics and populations. The findings nevertheless demonstrate that adaptive knock-to-web strategies are operationally feasible at large scale and may provide national statistical offices with an important methodological alternative under increasing financial and operational constraints.

## **7. Conclusion**

This study demonstrates that adaptive knock-to-web strategies can improve representativeness in large-scale web-first surveys while limiting interviewer workload and preserving predominantly self-administered measurement. Rather than treating CATI as a universal interviewing mode, the approach repositions interviewer contact as a selective intervention aimed at reducing nonresponse bias



under realistic operational constraints. The findings suggest that knock-to-web may provide national statistical offices with a viable long-term strategy for balancing declining response rates, increasing operational costs, pressure toward digitalization, and concerns regarding measurement comparability across modes. Future survey systems may increasingly depend on adaptive allocation of interviewer resources toward respondents contributing most to nonresponse bias rather than toward maximizing overall response rates alone.

## 7. References

Bye, L. S. & With, M. L. (2026) Levekårsundersøkelsen arbeidsmiljø 2025. Dokumentasjonsnotat. Notater 2026. Statistisk sentralbyrå (only in Norwegian)

Dillmann, D.A.(2017). The promise and challenge of pushing respondents to the Web in mixed-mode surveys. Survey Methodology, Statistics Canada, Catalogue No. 12-001-X, Vol. 43. No.1. Paper available as PDF (English): <https://www150.statcan.gc.ca/n1/pub/12-001-x/2017001/article/14836-eng.pdf>

Domarchi, C., Maslovskaya O & Smith P W F (2025) 'Knock-to-nudge methods for recruitment in self-administered surveys: Evidence review', Survey Futures Report no. 8. Colchester, UK: University of Essex. Available at: <https://surveyfutures.net/wp-content/uploads/2025/11/report-8-knock-to-nudge-evidence-review.pdf>

Grimstad, S. (2023). Undersøkelsen om læring blant voksne 2022. Notater 2023/39. Statistisk sentralbyrå (only in Norwegian)

Grimstad, S., & Støren, K. S. (2024). Livskvalitetsundersøkelsen 2024. Notater 2024/40. Statistisk sentralbyrå (only in Norwegian)

Groves, R. M., & Heeringa, S. G. (2006). Responsive design for household surveys: Tools for actively controlling survey errors and costs. Journal of the Royal Statistical Society: Series A (Statistics in Society), 169(3), 439–457. <https://doi.org/10.1111/j.1467-985X.2006.00423.x>

Keute, A., Rossbach, K., Lillegård, M., Gravem, D. F. & Grimstad, S. (2023). Final methodological and implementation report – Improvement for the Norwegian AES 2022. Documents 2023/38. Statistics Norway.

Maslovskaya O, Domarchi C & Smith PWF (2025) 'Effectiveness of the knock-to-nudge approach for establishing contact with the respondents: Evidence from the National Readership Survey in the UK', Survey Futures Working Paper no. 10. Colchester, UK: University of Essex. Available at <https://surveyfutures.net/working-papers/>.

Peytchev, A. (2013). Consequences of survey nonresponse. The ANNALS of the American Academy of Political and Social Science, 645(1), 88–111. <https://doi.org/10.1177/0002716212456838>

Tourangeau, R., Conrad, F. G., & Couper, M. P. (2013). The science of web surveys. Oxford University Press.

With, M. L., Lund, K. og Gravem, D. (2024). Ulike innsamlingsmetoder i Levekårsundersøkelsen om arbeidsmiljø 2022. En analyse av seleksjons- og moduseffekter ved kombinasjon av telefonintervju og webskjema. Notater 2024/35. Statistisk sentralbyrå (only in norwegian)



## 8. Appendix

*Table 1. Response rate and non-response rate by gender, age group, and highest completed educational level. per cent.*

|                                             |           | Not       |         |           | Non-     | Total     |
|---------------------------------------------|-----------|-----------|---------|-----------|----------|-----------|
|                                             | Interview | completed | Refusal | Prevented | response | number of |
|                                             |           |           |         |           |          | persons   |
| Total                                       | 48,2      | 3,9       | 11,3    | 0,4       | 36,1     | 39 915    |
| Gender                                      |           |           |         |           |          |           |
| Male                                        | 46,1      | 3,4       | 12,9    | 0,4       | 36,1     | 22 629    |
| Female                                      | 51,5      | 4,6       | 9,2     | 0,3       | 51,5     | 17 286    |
| Age group                                   |           |           |         |           |          |           |
| 18-35 years                                 | 44,9      | 5,1       | 21,4    | 0,5       | 28,1     | 12 774    |
| 36-45 years                                 | 45,3      | 4,2       | 19,0    | 0,8       | 30,7     | 8 149     |
| 46-67 years                                 | 51,6      | 3,0       | 0,8     | 0,1       | 44,5     | 16 678    |
| 68 years or older                           | 56,0      | 2,6       | 3,2     | 0,2       | 38,0     | 2 314     |
| Educational level                           |           |           |         |           |          |           |
| Primary and<br>lower secondary<br>education | 37,6      | 4,9       | 14,7    | 0,8       | 42,1     | 7 525     |
| Upper secondary<br>education                | 47,8      | 3,7       | 11,1    | 0,1       | 37,3     | 19 767    |
| Tertiary<br>education                       | 60,4      | 3,8       | 8,7     | 0,2       | 27,0     | 10 429    |
| Unknown                                     | 34,3      | 3,1       | 13,5    | 2,0       | 47,1     | 2 194     |

Source: The Survey on Living Conditions – Working Environment, Statistics Norway, 2025



Table 2: sample, net sample and sample bias by gender, age group, and highest completed educational level. per cent.

|                                       | Gross sample | Net sample prior CATI | Net sample after CATI | Difference net – gross prior CATI | Difference net – gross after CATI | Difference Change |
|---------------------------------------|--------------|-----------------------|-----------------------|-----------------------------------|-----------------------------------|-------------------|
| <b>Gender</b>                         |              |                       |                       |                                   |                                   |                   |
| Male                                  | 56,7         | 53,8                  | 53,9                  | -2,9                              | -2,7                              | 0,2               |
| Female                                | 43,3         | 46,2                  | 46,1                  | 2,9                               | 2,7                               | -0,2              |
| <b>Age group</b>                      |              |                       |                       |                                   |                                   |                   |
| 18-35 years                           | 32,0         | 24,8                  | 29,7                  | -7,2                              | -2,3                              | 4,8               |
| 36-45 years                           | 20,4         | 17,0                  | 19,1                  | -3,4                              | -1,3                              | 2,1               |
| 46-67 years                           | 41,8         | 50,1                  | 44,5                  | 8,3                               | 2,7                               | -5,5              |
| 68 years or older                     | 5,8          | 8,1                   | 6,7                   | 2,3                               | 0,9                               | -1,4              |
| <b>Educational level</b>              |              |                       |                       |                                   |                                   |                   |
| Primary and lower secondary education |              |                       |                       |                                   |                                   |                   |
|                                       | 18,9         | 13,8                  | 14,6                  | -5,1                              | -4,2                              | 0,8               |
| Upper secondary education             |              |                       |                       |                                   |                                   |                   |
|                                       | 49,5         | 49,2                  | 48,9                  | -0,3                              | -0,6                              | -0,3              |
| Tertiary education                    |              |                       |                       |                                   |                                   |                   |
|                                       | 26,1         | 33,8                  | 32,6                  | 7,6                               | 6,4                               | -1,2              |
| Unknown                               |              |                       |                       |                                   |                                   |                   |
|                                       | 5,5          | 3,3                   | 3,9                   | -2,2                              | -1,6                              | 0,6               |
| <b>Total amount of persons</b>        |              |                       |                       |                                   |                                   |                   |
|                                       | 39 915       | 14 058                | 19 325                |                                   |                                   |                   |

Source: The Survey on Living Conditions – Working Environment, Statistics Norway, 2025



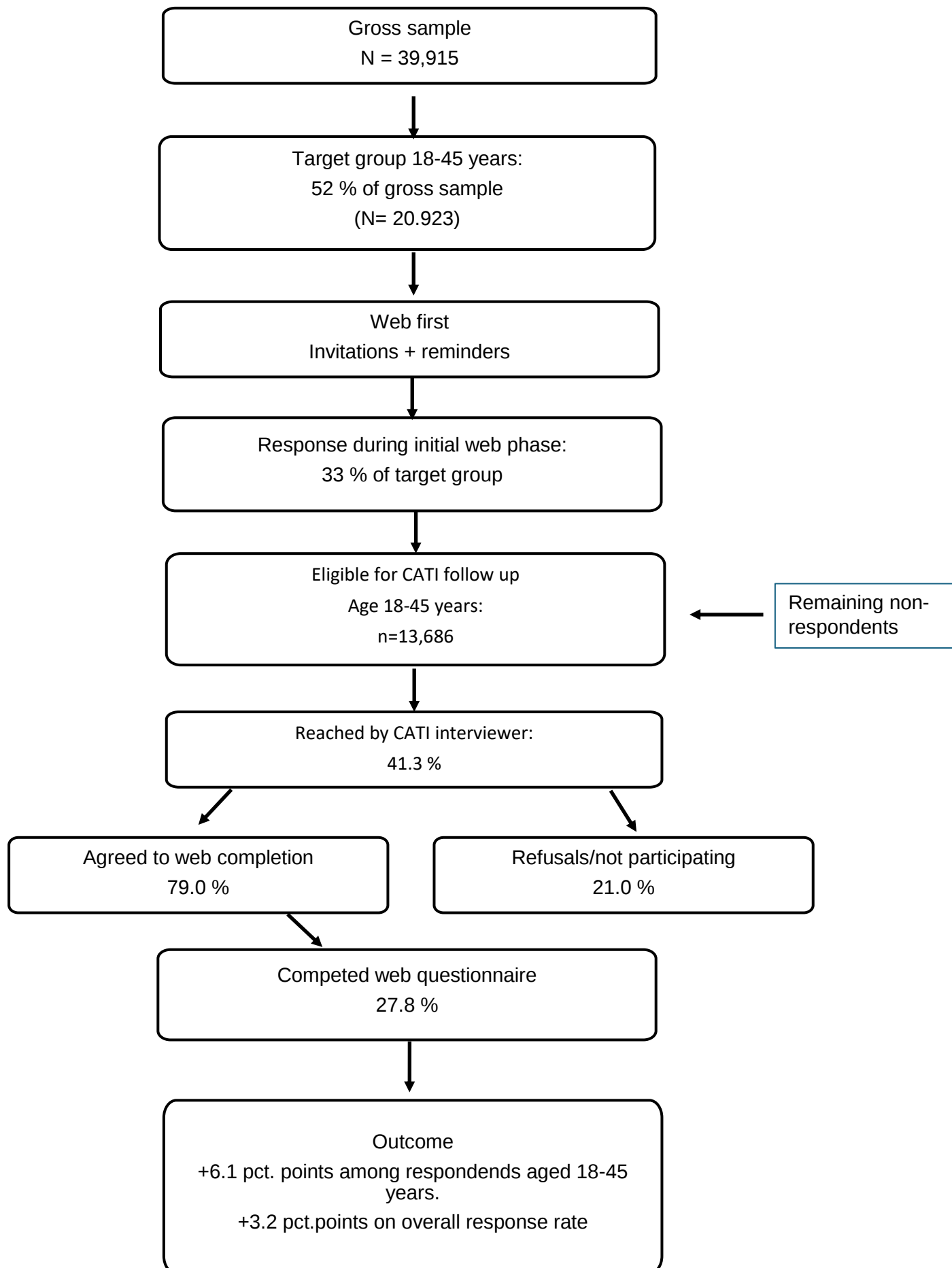
Table 3: Results from logistic regression analysis.

| Variable  | Category                   | Odds ratio | 95% CI      |
|-----------|----------------------------|------------|-------------|
| Gender    | Male (ref.)                | 1.00       | -           |
|           | Female                     | 0.96       | (0.90–1.03) |
| Age group | 68+ (ref.)                 | 1.00       | -           |
|           | 18-35                      | 4.27       | (3.59–5.08) |
|           | 36-45                      | 3.65       | (3.06–4.37) |
|           | 46-67                      | 1.50       | (1.26–1.79) |
| Education | Higher education<br>(ref.) | 1.00       | -           |
|           | Primary or lower           | 1.31       | (1.18–1.45) |
|           | Upper secondary            | 1.16       | (1.07–1.25) |
|           | Unknown                    | 1.57       | (1.33–1.84) |

Source: The Survey on Living Conditions – Working Environment, Statistics Norway, 2025



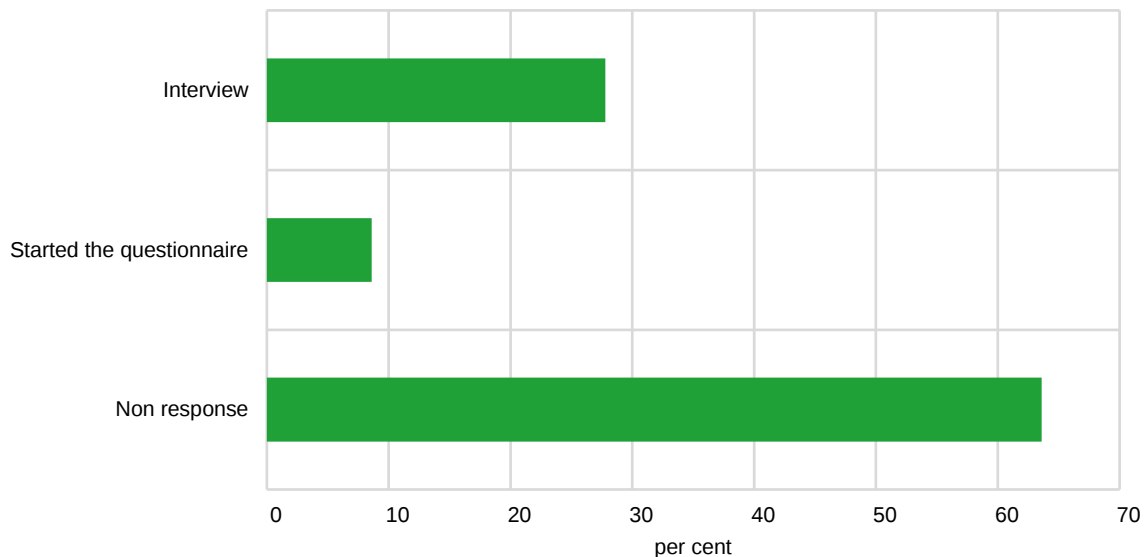
Figure 1: Outcome of knock-to-web requirement





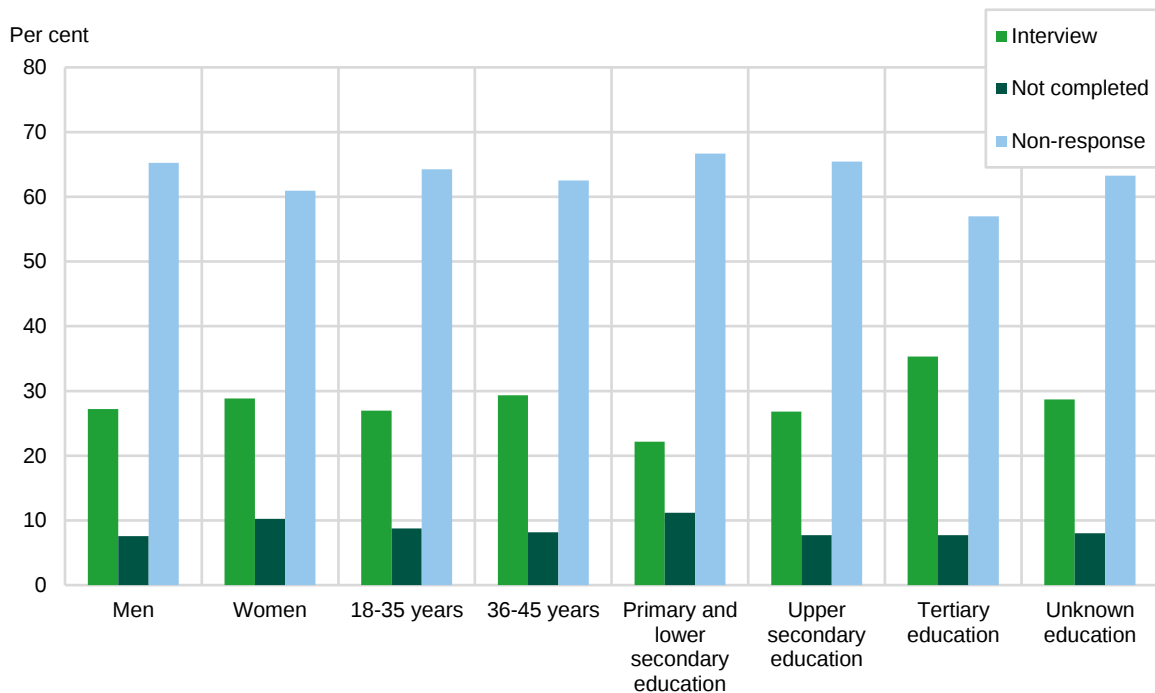
Source: The Survey on Living Conditions – Working Environment, Statistics Norway, 2025

Figure 2: Final outcome for respondents agreeing to answer the web questionnaire.



Source: The Survey on Living Conditions – Working Environment, Statistics Norway, 2025

Figure 3: Final outcome for respondents who agreed to answer the web questionnaire, across demographic groups. Per cent.



Source: The Survey on Living Conditions – Working Environment, Statistics Norway, 2025