

Incorporating technology in smoking cessation interventions: In-person vs. Video-call formats

Ana López-Durán^{a,b,*} , Carmela Martínez-Vispo^{a,b} , María Barroso-Hurtado^a ,
Daniel Suárez-Castro^a , Elisardo Becoña^{a,b} 

^a Smoking and Addictive Disorders Unit, Department of Clinical Psychology and Psychobiology, University of Santiago de Compostela, Spain

^b Institute of Research in Psychology (IPsiUS), University of Santiago de Compostela (USC), Santiago de Compostela, Spain

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ABSTRACT

Introduction: The use of video calls to provide health-related interventions has grown significantly, showing positive results in a broad range of psychological interventions. Scarce research has examined video-call use in smoking cessation treatments. The purpose of this study was to compare two randomised controlled trials conducting a cognitive-behavioral intervention to quit smoking in-person versus using video calls.

Material and methods: This study is a secondary analysis of two randomised controlled trial studies (RCTs) conducted using two delivery formats: in-person vs. video calls. The sample comprised 498 adults seeking smoking cessation treatment. We analysed smoking cessation, cigarette reduction, and treatment satisfaction outcomes according to delivery format.

Results: No significant differences were found in sex, age, and baseline smoking-related variables. A significantly higher proportion of participants in the video-call format had university studies, were actively working, and had a history of depression compared to the in-person format. No significant differences were found in cessation, smoking reduction, and satisfaction with treatment. Predictive variables of 12-month abstinence were: baseline number of cigarettes smoked per day (OR = 0.93) in the case of the in-person format; and being a woman (OR = 0.53), cigarette dependence (OR = 0.46), and last year quit attempt (OR = 0.52) in the video-call format.

Conclusions: Both delivery formats showed similar abstinence rates at 12 months and satisfaction with the intervention. Therefore, in-person and video calls could be used to deliver smoking cessation treatments. Given that predictors of long-term abstinence differed across these delivery formats, further research is needed.

Trials registration: [ClinicalTrials.gov](https://clinicaltrials.gov) IDs: NCT02844595; NCT04765813.

1. Introduction

The increasing use of technology has led to new ways of delivering mental health treatments [1]. Telehealth involves using technologies to provide long-distance healthcare services [2], and video calls are one of the most widely used modalities. It is a synchronous format intervention that runs in real time with providers and patients simultaneously in different places [2,3], and it is the most similar telehealth modality to in-person interventions [3].

Batastini et al. [4] pointed out that the video-call delivery format could help bridge the gap between the demand and availability of mental health treatments. Video-call interventions are effective for the treatment of anxiety, depression, or insomnia [5–7], obtaining similar

outcomes compared to in-person treatments [8]. Moreover, it has been shown to be satisfactory for patients [7,9], acceptable for therapists and patients [10], provides good therapeutic alliance establishment, and results in cost and time savings [11]. However, further research is needed because most studies have focused on comparing these interventions with other long-distance interventions, such as telephone interventions [12]. In addition, studies examining the effectiveness of video-call interventions, including smoking cessation interventions, are warranted [7].

In this vein, the use of video calls has several advantages for smoking cessation interventions, such as increasing access to effective treatments for smokers who are reluctant or who experience barriers to seeking in-person treatments [13,14]. However, there is limited literature on the

* Corresponding author at: Smoking and Addictive Disorders Unit, University of Santiago de Compostela, Faculty of Psychology. Department of Clinical Psychology and Psychobiology, Campus Vida. 15782 Santiago de Compostela, Spain.

E-mail address: ana.lopez@usc.es (A. López-Durán).

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efficacy of the use of video calls for smoking cessation, especially when compared with in-person interventions [15]. For instance, Byaruhanga et al. [16] found that short-term abstinence outcomes were similar when comparing the use of video calls to telephone counselling, and superior to minimal interventions (e.g., written materials). Carlson et al. [13] examined abstinence outcomes of a smoking cessation treatment through video calls for rural participants compared to the same in-person intervention for urban participants, finding no significant group differences at 3-, 6- and 12-month follow-ups.

However, using video calls as a delivery format for interventions has limitations. For instance, Vinci et al. [17], who adapted an in-person group-based smoking and alcohol treatment to a video-call intervention, pointed out some challenges like participants' lack of technical resources or computer skills, the availability of a suitable place to make the video call, and difficulties in transmitting nonverbal information.

As mentioned before, in the last few years, the use of digital formats to provide health interventions focused on quitting smoking has grown exponentially [18]. As a result, some studies have analysed the characteristics of individuals who seek Internet-based smoking cessation interventions. In this line, Brown et al. [19] found that those who are younger, more familiar with the use of technology, more nicotine dependent, more motivated to quit smoking and who have recently tried to quit are more interested in Internet-based smoking cessation interventions.

Given the scarcity of studies that investigate the use of video calls for smoking cessation interventions, the main objective of the present study was to compare two randomised controlled trials conducting a cognitive-behavioral intervention to quit smoking in person versus using video-call formats. Concretely, our research questions are: (1) are there differences in sociodemographic, baseline smoking behavior, and mental health characteristics between participants enrolled in an in-person vs. video-call smoking cessation treatments?; (2) are there differences in satisfaction with treatment at the end of the interventions; abstinence outcomes and smoking reduction at 12-months follow-up between participants enrolled in an in-person vs. video call smoking cessation treatments?; and (3) which are the variables that predicted smoking cessation success at 12-months follow-up according to the treatment delivery format (in-person vs. video calls)?

2. Materials and methods

2.1. Study design

The present study is a secondary analysis of two randomised controlled trials (clinicaltrials.gov/#NCT02844595 and [#NCT04765813](https://clinicaltrials.gov/#NCT04765813)). A full description of the two studies' recruitment, randomisation, interventions, and participant characteristics has been reported previously [20,21]. Both studies were approved by the Bioethics Committee of the University of Santiago de Compostela and followed the CONSORT reporting guideline [22].

2.2. Participants

The pooled sample of both RCTs comprised a total of 498 adults seeking smoking cessation treatment in the Smoking Cessation and Addictive Disorders Unit of the University of Santiago de Compostela (Spain) between January 2016 and October 2023.

2.3. Inclusion and exclusion criteria

The following inclusion criteria were used in both studies: ≥ 18 years, providing written informed consent, wishing to participate, filling out the pre-treatment assessment, and smoking a minimum of 6 cigarettes per day. Furthermore, in López-Durán et al. [21], smokers should have a smartphone and an e-mail address.

The exclusion criteria used in both studies were: a) diagnosis of

severe mental disorder (e.g., psychotic disorder), b) other substance use disorder (e.g., cannabis, alcoholism), c) have received an effective treatment to smoking cessation over the past year, d) consumption of tobacco products other than cigarettes, e) a high life-risk pathology requiring immediate treatment (e.g., myocardial infarction), and f) failing to attend the first intervention session. In López-Durán et al. [24], participants with a visual impairment that prevented them from using a mobile App were excluded.

2.4. Procedure

Smokers were recruited through different resources (e.g., the media, referrals from healthcare services). Potential participants contacted the Smoking Cessation and Addictive Disorders Unit, underwent a pre-treatment assessment, and provided written informed consent before the smoking cessation intervention.

Participants received a psychological smoking cessation intervention comprising eight weekly group sessions. Follow-ups were conducted over the one-year period after the last intervention session. Participants were generally contacted by telephone to collect information about their smoking status. Those in the in-person format also attended the Unit to verify abstinence biochemically through carbon monoxide (CO) measure. Those participating in the video-call format provided this information through self-report. A complete description of the intervention characteristics of both studies can be consulted in Becoña et al. [20] and Lopez-Durán et al. [21]. Each study was conducted using two different delivery formats: a) in-person format in the Smoking Cessation and Addictive Disorders Unit facilities [20]; and b) video-call format, using Microsoft Teams [21]. The data from each study arm was combined, as there were no significant differences in abstinence rates between study conditions. Specifically, in the study conducted by Martínez-Vispo et al. [23] prolonged abstinence was 26.4% (28/106) for the experimental group and 18.3% (19/104) for the control group ($\chi^2 = 2.005, p = 0.157$). In contrast, in the study conducted by López-Durán et al. [24], it was 24.3% (34/140) for the experimental group and 31.1% (46/148) for the control group ($\chi^2 = 1.656; p = 0.198$).

2.5. Measures

At baseline, we administered the following questionnaires:

- Semi-structured clinical interview: to explore data related to participants' tobacco use and current or past depression treatment.
- Smoking Habit Questionnaire [25]: It collects information about participants' sociodemographics and smoking-related variables (e.g., amount of cigarettes smoked/day).
- Fagerström Test for Cigarette Dependence [26,27] (FTCD): It is self-report questionnaire to measure cigarette dependence. The total score ranges from 0 to 10 points, with a score ≥ 6 indicating cigarette dependence [28]. We used the Spanish adaptation of the test, which presents a Cronbach's alpha of 0.66[29]

At the end of treatment, the Client Satisfaction Questionnaire (CSQ-8 [30]) was used. This self-report questionnaire measures participants' general satisfaction with the intervention. Total score ranges from 8 to 32 points. Higher scores indicate higher satisfaction with the intervention. We used the Spanish version of the CSQ-8, which has a Cronbach's alpha of 0.80 [31].

The main study abstinence outcome was prolonged abstinence at a 12-month follow-up. Participants were considered abstinent when they self-reported not having smoked more than 5 cigarettes following the grace period of 15 days from quit day (end of treatment) to the 12-month follow-up assessment [32,33].

2.6. Statistical analysis

The mean and standard deviation for continuous variables and frequencies for categorical variables were calculated to characterise the total sample. Pearson’s chi-square (χ^2) statistic for the categorical variables and Student’s *t*-test for the continuous variables were used to compare participants who received the intervention in-person versus through video call. Effect sizes were also reported (Cramer’s *V* and Cohen’s *d*, respectively) when significant group differences were found.

The influencing variables related to treatment outcomes (prolonged abstinence at the 12-month follow-up with lapses), stratified by the treatment delivery format, were examined using multivariate logistic regression analyses with forward stepwise analysis, including the following variables: sex (0 = male, 1 = female), age, education (0 = less than university, 1 = university), working status (0 = non-working, 1 = actively working), living with a smoker (0 = no, 1 = yes), cigarettes smoked per day, cigarette dependence (FTCD < 6 = 0, FTCD \geq 6 = 1), desire to quit; intention to quit, last year quit attempt (0 = no, 1 = yes); current depression treatment (0 = no, 1 = yes); past depression treatment (0 = no, 1 = yes); last year psycho-pharmacotherapy use (0 = no, 1 = yes). Potential multicollinearity between study variables was examined using Spearman’s correlation coefficient and variance inflation factor (VIF). We report the correlations and VIFs for the independent variables in Supplemental Table 1. As indicated in this table, correlations were all < 0.65 and VIF < 2.5 for all variables, indicating no collinearity [34], except for age and years of smoking. Therefore, the variable years of smoking was not included in the logistic models. Pseudo R^2 (Nagelkerke) and the Hosmer-Lemeshow test were used to determine model fitness. We followed an intention-to-treat approach, assuming that participants who did not provide information about their smoking status at the end of the intervention continued smoking. A *p*-value of less than 0.05 was considered statistically significant. Statistical analyses were conducted using IBM SPSS version 27 (Statistical Package for the Social Sciences) and version 27.0 (IBM Corp., Armonk, New York, USA).

3. Results

Of the total sample (*n* = 498), 62.4% were females (*n* = 311), and the mean age was 45.56 years (*SD* = 10.79). In addition, 47.2% of the participants had university studies (*n* = 235), and most were working (63.7%; *n* = 317). Regarding smoking-related variables, the mean of cigarettes smoked per day (CPD) was 19.3 (*SD* = 8.39), and the mean

score on the FTCD was 4.8 (*SD* = 2.12).

3.1. Participants’ characteristics according to treatment delivery format

A significantly higher proportion of participants who received the smoking cessation treatment through video calls had university studies and were actively working than participants receiving the in-person treatment (Table 1). When examining smoking-related variables, non-significant differences were found between formats. Regarding mental health variables, participants receiving treatment through video calls reported a higher frequency of past and current history of depression treatment and current use of psycho-pharmacotherapy than participants receiving the in-person treatment (see Table 1).

3.2. Smoking cessation outcomes and satisfaction with treatment according to treatment delivery format

When examining treatment outcomes, non-significant differences were found at the end of the intervention (in-person 59.0% (124/210); video calls 65.6% (189/288); $\chi^2 = 2.25$; *p* = 0.134) and in prolonged abstinence at the 12-month follow-up between formats (in-person 22.4% (47/210); video calls 27.8% (80/288); $\chi^2 = 1.86$; *p* = 0.172) (see Fig. 1). A similar pattern was found regarding satisfaction with treatment (see Table 2).

Regarding smoking reduction (\geq 50% from baseline to end of treatment point assessment), non-significant differences were found in

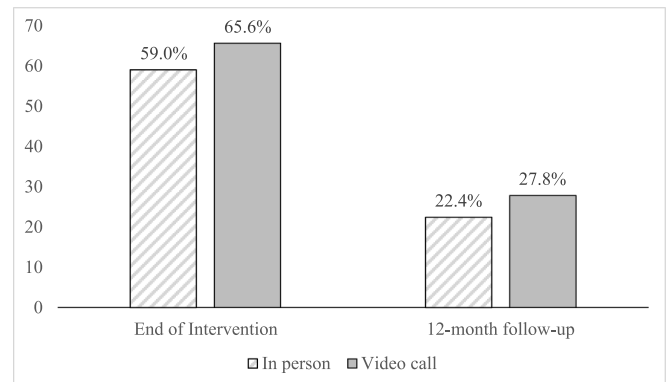


Fig. 1. Abstinence rates according to in-person vs. video-call formats.

Table 1

Sociodemographic, smoking, and mental-health characteristics according to treatment delivery format (in-person vs. through video calls).

| | In-person treatment (<i>N</i> = 210) | Video-call treatment (<i>N</i> = 288) | χ^2/t | <i>p</i> | Cramer’s <i>V</i> /Cohen’s <i>d</i> |
|--|--|--|------------|----------|-------------------------------------|
| | <i>M</i> (<i>SD</i>)/% (<i>n</i>) | <i>M</i> (<i>SD</i>)/% (<i>n</i>) | | | |
| Sociodemographic characteristics | | | | | |
| Sex (female) | 62.4 (131) | 62.5 (180) | 0.001 | 0.978 | |
| Age | 45.2 (11.03) | 45.8 (10.6) | -0.577 | 0.564 | |
| Education level (university) | 40.5 (85) | 52.1 (150) | 6.566 | 0.010 | 0.12 |
| Working status (yes) | 57.6 (121) | 68.1 (196) | 5.718 | 0.017 | 0.11 |
| Smoking-related characteristics | | | | | |
| N° of cigarettes/day | 19.0 (7.3) | 19.5 (9.1) | -0.645 | 0.519 | |
| Years smoking | 26.3 (11.5) | 26.7 (10.9) | -0.394 | 0.694 | |
| Living with a smoker (yes) | 39.0 (82) | 35.2 (101) | 1.357 | 0.507 | |
| Last year quit attempt (yes) | 37.1 (78) | 33.7 (97) | 0.639 | 0.424 | |
| Desire to quit (0–10) | 9.0 (1.4) | 8.9 (1.4) | 0.805 | 0.421 | |
| Intention to quit (0–10) | 8.7 (1.8) | 9.0 (1.2) | -1.929 | 0.054 | |
| FTCD | 4.8 (2.2) | 4.8 (2.1) | -0.157 | 0.875 | |
| Cigarette dependence (FTCD \geq 6) | 41.9 (88) | 38.2 (110) | 0.698 | 0.403 | |
| Mental-Health-related characteristics | | | | | |
| Past depression treatment (yes) | 42.9 (90) | 55.6 (160) | 7.833 | 0.005 | 0.125 |
| Current depression treatment (yes) | 18.1 (38) | 28.8 (83) | 7.594 | 0.006 | 0.123 |
| Current use of psycho-pharmacotherapy (yes) | 23.3 (49) | 32.6 (94) | 5.138 | 0.023 | 0.102 |

FTCD = Fagerström Test for Cigarette Dependence.

Table 2
Treatment satisfaction according to treatment delivery format (in-person vs. through video calls).

| | In-person treatment (N = 210) | Video-call treatment (N = 288) | χ^2 | p |
|---|-------------------------------|--------------------------------|----------|-------|
| | % (n) | % (n) | | |
| CSQ-8-1: How would you rate the quality of service you received? (Excellent) | 89.7 (157) | 88.3 (218) | 0.34 | 0.845 |
| CSQ-8-2: Did you get the kind of service you wanted? (Yes, definitely) | 82.9 (145) | 83.0 (205) | 0.09 | 0.956 |
| CSQ-8-3: To what extent has our service met your needs? (All or almost all) | 72.6 (127) | 74.5 (184) | 3.11 | 0.211 |
| CSQ-8-4: If a friend were in need of similar help, would you recommend our service to them? (Yes, definitely) | 89.7 (157) | 91.1 (225) | 1.58 | 0.664 |
| CSQ-8-5: How satisfied are you with the amount of help you received? (Very satisfied) | 81.7 (143) | 85.4 (211) | 1.06 | 0.589 |
| CSQ-8-6: Have the services you received helped you to deal more effectively with your problems? (Yes, definitely) | 77.1 (135) | 72.5 (179) | 1.68 | 0.432 |
| CSQ-8-7: In an overall, general sense, how satisfied are you with the service you received? (Very satisfied) | 81.7 (143) | 85.4 (211) | 2.41 | 0.300 |
| CSQ-8-8: If you were to seek help again, would you come back to our service? (Yes, definitely) | 90.3 (158) | 87.0 (215) | 2.12 | 0.549 |

CSQ-8 = Client Satisfaction Questionnaire.

the subsample of those participants who continued to smoke in the last session (In-person treatment 59.3% (n = 51/86); Video-call treatment: 55.6% (n = 55/99); $\chi^2 = 0.264$; p = 0.607).

3.3. Variables predicting prolonged abstinence outcomes at the 12-month follow-up

Two multivariate logistic regression models were conducted separately for each treatment delivery format (see Table 3). Data showed that for participants receiving the in-person treatment, CPD was the only variable significantly associated with a lower likelihood of prolonged abstinence at the 12-month follow-up (Adjusted Odd Ratio [AOR] = 0.93). For those who received the treatment through video calls, cigarette dependence (AOR = 0.46), being female (AOR = 0.56) and having

Table 3
Predictors of smoking prolonged abstinence at the 12-month follow-up for each treatment delivery format.

| In-person treatment | Exp(B) | p | 95 % CI | |
|--|--------|-------|---------|-------|
| | | | Lower | Upper |
| CPD | 0.93 | 0.017 | 0.88 | 0.98 |
| Constant | 0.95 | 0.926 | | |
| Hosmer – Lemeshow Test = 4.548; p = 0.473; Nagelkerke R ² = 0.047 | | | | |
| Video-call treatment | Exp(B) | p | 95 % CI | |
| | | | Lower | Upper |
| Sex (female) | 0.56 | 0.034 | 0.32 | 0.96 |
| Desire to quit | 1.22 | 0.058 | 0.99 | 1.51 |
| Cigarette dependence (FTCD ≥ 6) | 0.46 | 0.009 | 0.26 | 0.83 |
| Past quit attempt (yes) | 0.52 | 0.029 | 0.29 | 0.93 |
| Constant | 0.15 | 0.053 | | |
| Hosmer-Lemeshow Test = 2.186; p = 0.975; Nagelkerke R ² = 0.085. | | | | |

CPD = cigarettes per day; FTCD = Fagerström Test for Cigarette Dependence. CI = Confidence Interval.

tried to quit last year (AOR = 0.52) were associated with lower odds of long-term cessation success. A greater desire to quit was positively associated with quitting (AOR = 1.22), although this estimate did not reach statistical significance (p = 0.058, 95% CI [0.99, 1.51]).

4. Discussion

This secondary analysis from two RCTs intended to examine characteristics of treatment-seeking smokers according to treatment delivery format: in-person versus through video calls. We also analysed differences in prolonged abstinence outcomes at the 12-month follow-up, treatment satisfaction, and the variables that predicted long-term cessation success according to the treatment delivery format.

Our results revealed no significant differences in smoking-related variables, including cigarette dependence, according to the treatment delivery format. Regarding sociodemographic variables, a significantly higher proportion of participants in the video-call format had university studies and were actively working compared to the in-person format. This finding is consistent with Mañanes et al. [35], who found low participation of individuals with lower education levels in an online intervention. Previous studies have shown that individuals with higher education levels tend to be more digitally literate and more interested in e-Health interventions [36,37]. Further research is needed to analyse the existence of specific barriers to seeking treatment through digital formats for smokers with non-university education. We also found that a significantly higher proportion of participants in the video-call format were actively working. This could be related to the previously mentioned level of education because individuals with higher education are more likely to be working [38]. In addition, actively working people may face specific barriers to attending in-person interventions associated with work and family schedules, which can be overcome through video calls or online interventions [14,39].

Data also showed that a higher proportion of participants reported a history of treatment for depression in the video-call format compared to the in-person format. This finding could be related to the fact that the treatment through video calls was conducted after Covid-19, which could have impacted on participants' mental health [40]. Another possible explanation is that after Covid-19, most health services were adapted to digital formats, increasing the familiarity of using technology in a wide range of situations. This could ultimately be associated with a higher interest in this type of intervention by participants with a history of treatment for depression [41].

Regarding 1-year abstinence, no significant differences were found between formats, which aligns with previous studies focused on smoking cessation [13] and other psychological problems [42,43]. Therefore, using video calls to deliver smoking cessation interventions could be a promising option for smokers experiencing barriers to participating in in-person interventions, such as the time and cost required to reach the treatment location, and work schedules and family responsibilities [17,44]. However, further research is needed, as there are still challenges associated with video calls [17], including technology-related problems, participants' low technology literacy, privacy-related problems, or engagement issues.

Our results also show no differences in satisfaction with the intervention between formats, with participants reporting high satisfaction scores. This is in line with previous research, showing similar therapeutic alliance in online and in-person formats [1].

Finally, the results of the present study showed that the variables predicting long-term cessation success differed depending on the format used. Participants who smoked more cigarettes per day before the intervention were less likely to be abstinent at 12 months in the in-person format, whereas in the video-call format, being a woman, being cigarette dependent, and having made a quit attempt in last year were associated with a lower likelihood of prolonged abstinence. Our findings are consistent with previous literature, as both cigarette dependence and the number of cigarettes smoked per day are variables

generally associated with a lower likelihood of short and long-term abstinence [45,46]. We also found that having made a quit attempt in the last year was related to a lower likelihood of cessation success for those receiving the video call intervention, which aligns with previous studies [47,48]. Finally, the fact that being a woman was related to lower abstinence odds in the case of the video-call format is an aspect that should be analysed in greater depth, as previous literature has shown that women experience more difficulties in maintaining long-term abstinence than men, especially in clinical settings [49].

Several study limitations should be acknowledged. First, the current study investigated differences between two trials using a slightly different intervention protocol. In addition, the study using the video-call format was conducted after the Covid-19 pandemic, which could have affected smokers, as tobacco users may be particularly sensitised for being an especially at-risk group. Second, abstinence outcomes for the video-call format were not biochemically validated due to the social distance measures of Covid-19 and the remote nature of the intervention. This could have led to inflated cessation success rates in this group, although previous research has indicated that self-reported abstinence is a reliable measure [50]. Third, we used self-reported questionnaires, which implied a risk of bias related to social desirability. Finally, this study is a secondary analysis of two RCTs, and therefore, the methodology does not allow for the entire establishment of the effects of these delivery formats. Therefore, future non-inferiority randomised controlled trials are needed to confirm the present findings.

In conclusion, this study showed non-significant differences in smoking-related characteristics of participants receiving a smoking cessation intervention in person versus through video calls. However, there were differences in education, employment status, and history of depression treatment among the participants. These variables should be addressed when delivering the intervention using remote procedures. Non-significant differences were found in long-term abstinence rates and satisfaction with the intervention, meaning that both delivery formats could be used without impacting cessation success. Finally, predictors of long-term abstinence differed across the two delivery formats. Particular attention should be paid to women, cigarette-dependent participants, and those with recent quit attempts when receiving the intervention through video calls.

5. Summary Table

What was already known on the topic

- Interventions for anxiety, depression, or insomnia delivered through video-calls show similar outcomes compared to in-person treatments.
- Acceptability and satisfaction with Telehealth, including video calls, are adequate for therapists and patients.
- Limited research specifically examined the use of video calls for smoking cessation interventions.

What this study added to our knowledge

- The study's findings showed no significant differences in sex, age, and baseline smoking-related variables, but a significantly higher proportion of participants had university studies, were actively working, and had a history of depression in the video-call format compared to the in-person format.
- Video-call and in-person formats obtained similar abstinence rates and smoking reduction at 12 months follow-up. Participants reported high satisfaction levels in both formats.
- Predictive variables of 12-month abstinence were different according to delivery formats: higher baseline number of cigarettes smoked per day in the in-person format; and being a woman, higher cigarette dependence, and last year quit attempt in the video-call format, were associated with lower odds of abstinence.

CRedit authorship contribution statement

Ana López-Durán: Writing – original draft, Visualization, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization. **Carmela Martínez-Vispo:** Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **María Barroso-Hurtado:** Writing – review & editing, Investigation, Conceptualization. **Daniel Suárez-Castro:** Writing – review & editing, Investigation, Conceptualization. **Elisardo Becona:** Writing – review & editing, Supervision, Resources, Project administration, Methodology, Funding acquisition, Conceptualization.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijmedinf.2024.105774>.

Data availability

Data will be made available on request.

Data will be made available upon reasonable request to the corresponding author.

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