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Association between self-reported motivation to quit smoking with effectiveness of smoking cessation intervention among patients hospitalized for acute coronary syndromes in Switzerland

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ABSTRACT

Guidelines recommend brief smoking cessation interventions for hospitalized smokers reporting low motivation-to-quit. However, an intensive smoking cessation intervention may improve smoking cessation for these smokers. We conducted a secondary analysis of a pre-post interventional study that tested the efficacy of a *proactive* approach systematically offering intensive smoking cessation intervention to all hospitalized smokers with acute coronary syndrome (ACS) compared to a *reactive* approach offering it only to smokers willing to quit.

We analyzed data from one study site in Switzerland, which recorded motivation-to-quit smoking at study inclusion between 08.2009 and 02.2012. The primary outcome was smoking cessation at 1- and 5-year. We tested for interaction by participant's motivation-to-quit score (low vs. high motivation), and calculated multivariable adjusted risk ratios (RR), stratified by motivation score.

We obtained motivation scores for 230 smokers. Follow-up was 94% (217/230) at 1-year and 68% (156/230) at 5-year. Among participants with low motivation to quit, 19% of smokers in the reactive phase had quit at 1 year compared to 50% of smokers in the proactive phase (multivariable adjusted RR = 2.85, 95%CI:0.91–8.91). Among highly motivated smokers, rates did not differ between phases: 48% vs. 49% (multivariable adjusted RR = 1.02, 95%CI:0.75–1.39, p-value for interaction between motivation-to-quit categories = 0.10). At 5-year follow-up, the point estimates were similar.

While our study has limitations inherent to the study design and sample size, we found that a proactive approach to offer systematic smoking cessation counseling for smokers with ACS reporting low motivation to quit was associated with higher smoking cessation rates at 1 year.

1. Introduction

Effective smoking cessation counseling is an essential component of secondary preventive care after acute coronary syndromes (ACS). Guidelines recommend that healthcare providers *ask* patients if they smoke, *assess* their readiness to quit, *assist* smokers willing to quit with counseling, and *arrange* a follow-up contact (the "5A's") (Fiore et al., 2012), but recommend only minimal intervention if smokers are not

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ready to quit. Recommended smoking cessation interventions are usually reactive, offered as an 'opt-in' approach (Richter and Ellerbeck, 2015), but the effectiveness of the opt-in approach has been recently challenged (Aveyard et al., 2012; Richter and Ellerbeck, 2015). Some have questioned the opt-in approach because it does not align with the proactive approach of interventions to treat other cardiovascular risk factors such as diabetes, dyslipidaemia and hypertension (Richter and Ellerbeck, 2015). In these interventions, treatment is offered systematically and patients can refuse (opt-out) (Faseru et al., 2017). An opt-out approach to smoking cessation would offer counseling to all smokers, whether or not they are ready to quit.

There is evidence suggesting that opt-out interventions for smoking cessation counseling are more effective than opt-in interventions for smokers in the outpatient setting (Aveyard et al., 2012; Fu et al., 2016; Fu et al., 2014; Japuntich et al., 2020; Pisinger et al., 2005b; Richter and Ellerbeck, 2015), but there is less evidence for its efficacy among hospitalized smokers (Faseru et al., 2017). We already conducted a pre-post interventional study that tested the acceptance and efficacy of a proactive, opt-out intervention based on motivational interviewing (MI), a non-judgmental, patient-centered counseling approach, with promising results (Auer et al., 2016). MI guides smokers through the process of behaviour change rather than solely offering smokers advice and recommendations based on their stated motivation (Codern-Bové et al., 2014; Lindson-Hawley et al., 2015, 2011; Miller and Rollnick, 2012).

In our study, we systematically offered MI-based intensive smoking cessation intervention to all smokers hospitalized for ACS in the proactive, opt-out, phase and compared it to a reactive, opt-in, phase where we only offered smokers a smoking cessation intervention when their healthcare provider requested one (Auer et al., 2016). The proactive approach yielded promising smoking cessation outcomes, but the differences between phases were not statistically significant. One of our four study sites recorded motivation to quit at study inclusion during the proactive and the reactive phases of the study. Thus, we tested the hypothesis whether a proactive approach of systematically offering smoking cessation intervention to all smokers, regardless of self-reported motivation-to-quit, benefited smokers who state they are not motivated-to-quit more than a reactive approach.

We set out to determine whether a higher proportion of smokers with low motivation-to-quit received an intensive MI-based smoking cessation intervention and quit smoking at 1- and 5-years follow-up when they were included during the proactive phase than those included during the reactive phase.

2. Materials and methods

We report data from participants enrolled in the study site of Lausanne, Switzerland; one of the four study sites of the Special Program University Medicine-Acute Coronary Syndrome (SPUM-ACS) prospective cohort study (NTC 01000701, clinicaltrials.gov).

We defined current smoking as smoking one cigarette or more per day during the month before hospitalization. Participants were included consecutively in the reactive phase (08/2009 to 10/2010) or in the proactive phase (11/2010 to 02/2012). In the proactive phase, a resident physician trained in MI systematically approached all included smokers and asked permission to discuss their smoking habits (Auer et al., 2016). In the reactive phase, clinicians in charge could request dedicated smoking cessation counseling based on their assessment of a patient's needs.

At study entry, before any dedicated smoking cessation intervention, study nurses asked all participants: "*On a scale from 1 (not motivated at all) to 10 (maximal motivation), what is your motivation to stop smoking?*" Our primary outcome was self-reported 7-day smoking abstinence at the in-person 1-year follow-up and 5-years phone follow-up, assessed by a single question. Smoking abstinence was validated by expired CO level at 1-year follow-up. Carbon monoxide levels of 10 ppm or were identifying participants as current smokers. Secondary outcomes were delivery of smoking cessation intervention, time spent in counseling, and prescription of nicotine replacement therapy (NRT) at discharge.

We computed risk ratios (RR) with 95% confidence intervals (CI) for smoking cessation outcomes at 1- and 5-year follow-up. To determine whether the initial motivation to quit smoking modified the effect of the intervention, we tested for interaction by dichotomous motivation score on smoking cessation rates at 1 year. Due to limited sample size, we used the alpha level of 0.10 to determine significant interaction. We stratified analyses on smoking cessation outcomes by participants' self-reported motivation-to-quit score at baseline (low motivation [1–5] and high motivation [6–10]. The cut-off for low vs high motivation was decided based on clinical judgment and arbitrarily set at the mean of the visual analog scale (1–5 and 6–10). Since we did not plan these analyses when we set up the trial, and therefore did not register our hypothesis or the cut-offs in a repository beforehand, cut-off should be considered a post-hoc decision and results considered exploratory.

We fitted multivariable adjusted generalized linear models following a negative binomial distribution, adjusted for demographic (age, sex, education), baseline smoking intensity (cigarettes per day), and for type of ACS. We excluded participants lost to follow-up from main analyses but performed sensitivity analysis including them as continuous smokers. Analyses were performed using STATA 17.0 (StataCorp, Texas, USA).

3. Results

Between August 2009 and February 2012, 616 participants admitted for ACS were included in the study; of these, 245 were smokers (Auer et al., 2016). We obtained motivation scores at baseline for 230 participants. At one year, 217/230 (94%) of these participants were available for follow-up; 8 (3.5%) had died, 5 (2%) were lost to follow-up. At 5 years, 156/230 (68%) were available for follow-up; 23 (10%) had died, 47 (20) were lost to follow-up (see flow diagram in online Appendix). Median age was 55 years; 22% were women. Sex, education, and cigarettes smoked per day were equally distributed across categories (Table 1). People were younger in the high motivation group than in the low motivation group ($p = 0.014$).

Among those with low motivation, 14% ($N = 4$) participants received a smoking cessation counseling intervention in the reactive phase and 78% ($N = 14$) in the proactive phase. NRT prescriptions increased more in those with low motivation than in those with high motivation to quit between reactive and proactive phases (Table 2). The median duration of counseling was 45 min in reactive phase and 50 in the proactive phase and did not differ by motivation-to-quit categories (Table 2). We found a significant interaction between motivation-to-quit score and study phases on smoking cessation at 1 year (p for interaction $= 0.10$). In stratified analyses by motivation to-quit-score, we found that 1-year smoking cessation rates were 19% in the reactive phase compared to 50% in the proactive phase among participants with low motivation-to-quit at baseline, multivariable adjusted RR $= 2.85$ (95%CI: 0.91–8.91). Among participants with high motivation-to-quit score, 48% of smokers included in the reactive phase were abstinent at 1-year follow-up compared to 49% of smokers included in the proactive phase (multivariable adjusted RR $= 1.02$, 95%CI: 0.75–1.39).

At 5-years follow-up, the point estimate was lower, but tended towards the same direction: Among participants with low motivation at baseline, 5-year smoking cessation rates were 28% in the reactive phase and 55% in the proactive phase (multivariable adjusted RR 2.98, 95%CI: 0.76–11.7). Smoking cessation rates of highly motivated patients were 51% in the reactive phase compared to 55% in the proactive phase (multivariable adjusted RR 1.07, 95%CI: 0.76–1.51). In sensitivity analyses including participants lost to follow-up as continuous smokers, results remained virtually unchanged at 1-year and at 5-years follow-up.

Table 1
Characteristics of participants with information on motivation to quit smoking at baseline.

Variable	All	Low motivation Reactive Phase (N)	Proactive phase (N)	High motivation Reactive Phase (N)	Proactive phase (N)	
Total	230	29	18	91	92	p-value
Age, median years (IQ-range)	55 (49;63)	61 (52; 72)	59 (54; 69)	55 (49; 62)	53 (48;61)	0.014
Sex, n (%)						0.9
Female	51 (22)	6 (21)	5 (28)	21 (23)	19 (21)	
Male	179 (78)	23 (79)	13 (72)	70 (77)	72 (79)	
Education*, n (%)						0.10
University or	65 (28)	7 (24)	5 (28)	22 (24)	31 (33)	
High school; Apprenticeship or lower	162 (71)	21 (72)	13 (72)	69 (76)	59 (64)	
ACS type, n (%)						0.055
NSTEMI	109 (47)	20 (69)	6 (33)	39 (43)	44 (48)	
STEMI	121 (53)	9 (31)	12 (67)	52 (57)	48 (52)	
Baseline number of cigarettes per day, n (IQ-Range)	20 (10; 24)	20 (6; 30)	20 (10; 24)	20 (10; 20)	20 (10; 24)	0.9

*3 missings in education.

Table 2
Process and clinical outcomes: comparing the effectiveness of proactively and reactively offering an intensive smoking cessation intervention to hospitalized smokers after ACS. Results stratified by baseline self-reported motivation to quit smoking before the intervention was offered. Data from one site of the SPUM-ACS study, Switzerland*.

Outcome	Low motivation				High motivation			
	Reactive phase (Group A)	Proactive phase (Group B)	Risk ratio (95% CI)	Multivariable adjusted** Risk ratio (95% CI)	Reactive phase (Group C)	Proactive phase (Group D)	Risk ratio (95% CI)	Multivariable adjusted** Risk ratio (95% CI)
Received counselling, % (n/N total)	14% (4/29)	78% (14/18)	5.64 (2.20–14.48)	–	35% (32/91)	95% (87/92)	2.69 (2.03–3.57)	–
Median Interview Duration, min., (IQR)	45 (45–45)	50 (38–60)	–	–	45 (40–50)	50 (35–60)	–	–
Discharge with NRT, n (%)	10% (3/29)	67% (12/18)	6.44 (2.10–19.75)	–	25% (23/91)	64% (59/92)	2.54 (1.73–3.73)	–
Stopped at year 1, n (%)***	19% (5/26)	50% (8/16)	2.60 (1.03–6.57)	2.85 (0.91–8.91)	48% (41/86)	49% (44/89)	1.04 (0.76–1.41)	1.02 (0.75–1.39)
Stopped at year 5, n (%)****	28% (5/18)	55% (6/11)	1.96 (0.78–4.93)	2.98 (0.76–11.7)	51% (33/65)	55% (34/62)	1.08 (0.78–1.50)	1.07 (0.76–1.51)

* Participants included in the reactive phase from 08/2009 to 10/2010 and the proactive phase from 11/2010 to 02/2012.
** Multivariable adjusted generalized linear models following a negative binomial distribution adjusted for sex, age, ACS type (STEMI/NSTEMI), education (University grade/High school grade/Apprenticeship or lower) and baseline cigarettes smoked per day. Three participants with missing data on education were excluded from multivariable analysis, but sensitivity analysis including them using multiple imputation showed similar results.
*** Follow-up outcome data for 94% (217/230) of included participants; 8 died within first year, and 5 were lost to follow-up. They were excluded from the analyses (see online supplement with flow-chart).
**** Follow-up outcome data for 68% (156/230) of included participants; 23 died within 5 years, 47 were lost to follow-up and 4 had a missing smoking status. They were excluded from analyses (see online supplement with flow-chart).

4. Discussion

In this secondary analysis of a before-after trial, we found that self-reported motivation-to-quit at baseline modified the effect of a proactive intensive MI-based smoking cessation intervention offered to all smokers hospitalized for ACS, regardless of self-reported motivation-to-quit. The proportion of smokers with low motivation-to-quit who received an intensive smoking cessation intervention increased substantially, from 14% to 78% between the reactive and proactive phase. When smokers received MI-based counseling, the duration of the intervention was similar across groups with different motivation to quit (45 min vs 50 min), suggesting smokers with low motivation to quit are still open to receiving intensive MI smoking cessation counseling. The proactive approach of offering MI-based intensive smoking cessation intervention was associated with increased smoking cessation at 1 year among the smokers with low motivation-to-quit (18% vs 50%), suggesting smokers with low motivation-to-quit appeared to benefit as much from the intervention as smokers with high motivation-to-quit. These findings challenge current recommendations to offer intensive smoking cessation counseling only to hospitalized smokers motivated-to-quit.

Our findings align with studies in the outpatient setting, where proactive approaches that delivered telephone-based smoking cessation counseling increased smoking cessation rates (Fu et al., 2016; Fu et al., 2014; Japuntich et al., 2020). Similarly, a RCT among smokers in the general population of Denmark showed that smokers at all motivational stages who said they had not planned to quit still accepted intensive smoking cessation counseling when systematically offered (Pisinger et al., 2005b), and this counseling raised smoking cessation rates (Pisinger et al., 2005a).

Our results suggest that proactive counseling benefits inpatient smokers after ACS who state they are not motivated to quit. We know of only one dedicated RCT that compares the effectiveness of a proactive vs reactive approach in the inpatient setting, which just finished recruitment (Faseru et al., 2017). Until then, we have to rely on indirect evidence from previous RCT based on the smokers these studies included. A rigorously performed RCT found significant differences in smoking cessation rates when testing the benefits of offering MI-based smoking cessation intervention to all smokers hospitalized for ACS whether or not they were ready to quit (Dornelas et al., 2000). Authors did not present stratified analyses based on readiness to quit smoking, so we do not know whether those who stated they were not ready to quit benefited as

much or more from the intervention than those who stated they were ready to quit. In contrast, a subsequent RCT only including smokers "willing to make a serious attempt to quit smoking" after ACS, thereby excluding smokers with low motivation-to-quit, showed no benefit of the smoking cessation intervention (Sivarajan Froelicher et al., 2004). These findings highlight the need to consider the motivation to quit of included participants in smoking cessation intervention in future research.

Our study has limitations. Since we did not pre-specify stratified analyses by motivation-to-quit when we set up our clinical trial, our results should be considered exploratory in nature. Our conclusions are also limited because we were underpowered to detect meaningful changes in these stratified analyses. The multivariable adjusted RR = 2.85 (95%CI: 0.91–8.91) is also consistent with no effect or a negative effect of proactive counselling. Also, the before-after design may have introduced selection bias over time even though patients hospitalized with ACS were consecutively recruited (Auer et al., 2016). Adequately powered RCTs needed to further test our hypothesis (Faseru et al., 2017). The follow-up rate was high at one year. The 5-year analyses should be interpreted carefully since we cannot exclude the possibility of informative censoring of participants. Furthermore, our data set was limited to patients hospitalized at a single site in Switzerland with ACS, whose smoking cessation rates are high compared to other health conditions. Future studies should test this hypothesis within a broader range of health conditions and settings.

Our exploratory findings challenge current recommendations to allocate high intensity smoking cessation counseling only to those who state they are motivated to quit (Fiore et al., 2012). We found that offering MI-based systematic smoking cessation counseling to all smokers more effectively reduced smoking rates among smokers hospitalized for an ACS overall than restricting delivery of smoking cessation intervention only to smokers motivated to quit. We suggest other researchers collect and use data on patients' motivation to quit smoking when testing the effectiveness of MI-based smoking cessation interventions on larger and more diverse patient populations.

5. Disclosures

T.F.L received research grants to the institution from Amgen, Abbott, AstraZeneca, Bayer Healthcare, Boehringer Ingelheim, Eli Lilly, Medtronic, Novartis, Roche Diagnostics, Servier and Vifor, including speaker fees by some of them. CMM received research grants to the institution from Eli Lilly, AstraZeneca, Roche, Amgen and MSD including speaker or consultant fees. DN received speaker and consulting fees from Novartis, Amgen, AstraZeneca, Abbot, Dr. Willmar Schwabe GmbH & Co. KG, Daiichi Sankyo and Pfizer.

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CRediT authorship contribution statement

Inge Worni-Schudel: Conceptualization, Formal analysis, Investigation, Writing – original draft, Visualization. **Vasilis Tzalis:** Investigation, Writing – review & editing. **Julian Jakob:** Formal analysis, Data curation, Writing – review & editing, Visualization. **Kali Tal:** Conceptualization, Investigation, Writing – review & editing. **Lauriane Gilgien-Dénéréaz:** Writing – review & editing, Formal analysis. **Baris Gencer:** Data curation, Writing – review & editing, Funding acquisition. **Christian M. Matter:** Writing – review & editing, Project administration, Funding acquisition. **Thomas Felix Lüscher:** Resources, Writing – review & editing, Project administration, Funding acquisition. **Stephan Windecker:** Writing – review & editing, Funding acquisition. **François Mach:** Writing – review & editing, Funding acquisition. **Jean-Paul Humair:** Conceptualization, Writing – review & editing. **Nicolas Rodondi:** Conceptualization, Resources, Writing – review & editing, Supervision, Project administration, Funding acquisition. **David Nanchen:** Resources, Writing – review & editing, Supervision, Project administration, Funding acquisition. **Reto Auer:** Conceptualization, Formal analysis, Investigation, Resources, Writing – original draft, Visualization, Supervision, Project administration, Funding acquisition.

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 data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2021.101583.

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